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K-12 online teacher beliefs: relationships among intelligence, confidence, teacher-student interactions, and student outcomes

Ploeg Guadalupe Vander

Pepperdine University

Graduate School of Education and Psychology

K-12 ONLINE TEACHER BELIEFS: RELATIONSHIPS AMONG INTELLIGENCE, CONFIDENCE, TEACHER-STUDENT INTERACTIONS, AND STUDENT OUTCOMES

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by

Guadalupe Vander Ploeg

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Paul Sparks, Ph.D. — Dissertation Chairperson

This dissertation, written by

Guadalupe Vander Ploeg

under the guidance of a Faculty Committee and approved by its members, has been submitted to and accepted by the Graduate Faculty in partial fulfillment of the requirements for the degree of

DOCTOR OF EDUCATION

Doctoral Committee:

Paul Sparks, Ph.D., Chairperson

John F. McManus, Ph.D.

Gary S. Smith, Ed.D.

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DEDICATION

I dedicate this dissertation to my family, who served to inspire, support, and fill me with love as I journeyed through the process, especially:

- To my husband, a patient listener who has encouragingly challenged ideas along the way;
- To my parents and grandparents who have been an inspiration through their example of hard work, perseverance, commitment, and familial support;
- To my sister who has danced with me through life's peaks and troughs; and
- To my nephews, may you also be motivated and encouraged to reach your dreams.

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VITA

Guadalupe Vander Ploeg

Current Position: Director of Academic Services for K12 Inc.

Education

Pepperdine University, Graduate School of Education & Psychology, Malibu, CA 2008–2012

Major: Learning Technology, Degree: Doctor of Education, Learning Technologies
Dissertation topic: K-12 Online Teacher Beliefs: Relationships Between Intelligence, Confidence, Teacher Student Interactions and Student Outcomes

University of California, San Diego 2002–2003
Professional Clear CA Credential

Purdue University, Hammond, IN 2001
Major: Educational Administration; Degree: Master of Science, Educational Administration
Credential Earned: IL Type 75 Administrative Certificate

Governors State University, University Park, IL 1997
Major: Elementary Education; Degree: Bachelor of Arts, Elementary Education
Minor in Mathematics and Computer Science
Credential: IL Type 03 Certificate

Professional Experience

- Director, Academic Services, K12 Inc., Herndon, VA 2005-present
- Master Teacher, Curriculum and Instruction, California Virtual Academies, Simi Valley, CA 2002–2005
- Middle School Math Teacher, San Diego City Schools, San Diego, CA 2001–2002
- Teacher (sixth grade), Wentworth Junior High, Calumet City, IL 1997–2001

Skills and Areas of Knowledge

- Energetic and creative professional with proven success in program development, leadership development, facilitation, and training
- Uniquely proficient in launching new initiatives in educational settings

- Experienced in instructional program development and implementation
- Demonstrated skills in developing and implementing training and recruiting programs
- In-depth experience providing educational and training consultation to variety of audiences
- Led design team through implementation of a math online synchronous instructional pilot to inform scalability of model.
- Launched first hybrid charter school in Chicago, as Interim Academic Administrator
- Assessed teaching culture utilizing survey based research methods and communicated results
- Designed and proposed synchronous instruction action plan to address areas of need and bolster effectiveness of real-time online instruction
- Facilitated the strategic planning sessions resulting in the regional WASC accreditation for all California Virtual Academies
- Mentored, coached, and modeled skills-techniques to teachers to improve classroom effectiveness
- Worked in a start-up environment to assist school administration in developing, implementing, and revising school policies and procedures for staff and students
- Designed and facilitated professional development program for teachers, resulting in increased academic achievement in literacy and mathematics.
- Coached new teachers to improve instructional practices and reach goals identified in students individual learning plans
- Created and maintained a demonstration classroom for use of integrated curriculum using cooperative learning and constructivist strategies to engage effectively students

Publications and Presentations

Tomorrow People—Education and Development Conference, Bangkok, Thailand, March 6, 2009

ABSTRACT

The vigorous expansion of online learning in K-12 education is a recent change to the conceptualization of schooling that has been occurring for more than 10 years. However, methods used for recruiting, hiring, and preparing online teachers have not been altered beyond the current federal standard defined by No Child Left Behind of Highly Qualified Teachers in order to provide students with teachers demonstrating an orientation toward learning. Historically, educational theory and research suggest that teachers who are learners make a difference for student learning. Recently, social cognitive psychology and neuroscience research has demonstrated a key finding that beliefs about intelligence influence learning success.

The purpose of this empirical inferential study was to examine teacher belief about intelligence, teacher confidence in one's intelligence, and the relationship with teacher-student interactions and student outcomes through the administration of a 9-item online questionnaire. The study used the Theory of Intelligence Scale and Confidence in One's Intelligence Scale created by Carol Dweck combined with student academic gains from the 2010–2011 Fall and Spring Scantron Performance Series assessments and archived documentation from the internal communication system. Data from 298 randomly selected K-12 online teachers serving as a primary teacher of record for 1 of 18 cyber charters, managed by the same education management organization, were used to address 6 null hypotheses and 4 research questions.

Findings suggest teacher belief in the malleability of intelligence positively affects student learning in literacy, which subsequently impacts math achievement. This affirming belief of intelligence shapes teacher behavior evidenced through greater

interaction with students in a virtual classroom using a diverse set of interaction strategies. Teachers' confidence in one's intelligence alone was not an effective predictor of class achievement gains. However, once teacher's confidence was combined with his or her framework for intelligence, it served to identify the population that resorted to using known strategies as the primary means for interacting with students and the population of online teachers that seemingly disengaged through their limited teacher-student interaction.

Chapter 1: The Problem

Online learning is a rapidly growing phenomenon in K-12 education. Picciano and Seaman (2009) estimated that 1.03 million K-12 students took online courses in school year 2007–2008. This figure represents a 47% increase in 2 years from the previous survey conducted during the 2005–2006 school year. Yet with the growing number of students moving to online learning there are problems that arise. Piccano and Seaman cited the four main concerns from school administrators as course quality, course development and/or purchasing costs, receiving funding based on student attendance for online and/or blended-hybrid education courses, and the need for teacher training.

The increase in online programs and school development has created a need to recruit, hire, develop, and retain high quality online teachers. Full-time online schools are similar to public and/or charter schools, as they share state and federal accountability requirements (Watson, Murin et al., 2010). These levels of accountability include employment of highly qualified teachers as defined by the No Child Left Behind and attainment of adequate yearly progress through student participation in state testing programs. For this reason, the professional development needs of K-12 online teachers have been the subject of recent studies (Dawley, Rice, & Hinks, 2010; Rice & Dawley, 2007; Rice, Dawley, Gasell, & Florez, 2008).

While the proliferation of online learning is new, the theory, which drives it, is not. Online learning is a form of distance education. Smith, Clark, and Blomeyer (2005) summarize distance-learning theories that date to 1967, and the introduction of the term distance education by Otto Peters describing an industrialized theory for distance-teaching organizations. However Watson (2008) adds nuance to the concept of online learning by noting that the use of the term has come to include both distance education and blended learning, a largely variable term that describes a combination of online curriculum and instruction delivered in a face-to-face setting. Dziuban, Hartman, and Moskal (2004) describe the blended strategy as one that shifts from lecture- to student-centered instruction in which students become active and interactive learners, noting that its benefits include increased interaction between student and instructor, student and student, student and content, and student and outside resources. Zucker and Kozma (2003) reinforced the social aspects of online learning, noting that students separated by distance throughout the United States can work together on group projects with shared resources. Through the incorporation of this strategy, learning can take place anytime, anywhere, and is not bound to a school building. Ultimately the precise definition of online learning may be less important than the worth. The value of the multidimensional, technology-enhanced form of instruction that engages students at a distance through synchronous and asynchronous interaction is readily recognized at earlier grade levels in education and throughout associated governing agencies. Recent findings substantiating the quality and related successful outcomes have resulted in an effort to expand this educational opportunity and choice to a greater number of K-12 students.

In April 2009, the U.S. Department of Education released a meta-analysis of more than 1,000 empirical studies comparing online and face-to-face instruction and selected what the authors considered to be the best 99 studies employing experimental or quasiexperimental methods (Means, Toyama, Murphy, Bakia, & Jones, 2009). These findings suggest that students who took all or part of their classes online perform significantly better on outcomes of learning measured than their purely face-to-face classroom counterparts. These findings have not been taken lightly, as the pace of distance education offerings continue to grow. According to Watson, Gemin, Ryan, and Wicks (2009) administrators in states with full-time online schools are rushing to develop courses in an effort to retain students in their districts. This effort, while seemingly innocuous, may not prove to be the path that creates equivalent success for districts, as more research is needed into the impact of the teacher's role in online learning. To do that requires both experimental and longitudinal studies in multiple settings and, in turn, is beyond the scope of this study. A starting point was to continue to build insight into developing effective online teachers by exploring the relationships among teacher knowledge, attitudes, dispositions, and student outcomes in order to inform the selection and professional development required for effective K-12 online teachers.

Teacher effectiveness and learning receives comparable attention as online learning. The value of high quality professional learning opportunities for teachers was reflected in the spending of federal Title II, Part A funds, providing grants to local and state educational agencies and targeted at improving teacher quality. Annually, the U.S. spends almost $3 billion on state grants to improve teacher quality. In 2009, a sample of 800 districts representative of the U.S. national population was drawn from the Common Core of Data for surveyed use of Title II, Part A funds. The results of that survey revealed that 39% of the annual $2.67 billion spent on teacher quality reforms were funds used for professional development activities for teachers and related personnel. This figure represents a 44% increase in spending on professional development activities from the previous survey in 2002–2003. Despite the increased spending on teacher professional development, student academic achievement levels have increased only incrementally. According to the National Assessment of Educational Progress, the average reading scale score of public school fourth graders increased 1.4%, eighth-grade scores increased 0.4%, and 12^{th}-grade scores increased 0.34% from 2003 to 2009 (National Center for Education Statistics, 2010). Similar patterns were found in mathematics during this time period. The National Assessment of Educational Progress average mathematics scale score of public school fourth graders had a marginal increase of 2.1%, eighth-grade scores increased 1.8%, and 12^{th}-grade scores increased 2% between 2005 to 2009. The 2003 scores for 12th graders are unavailable.

Background

Historically, educational theory and research suggest that teachers who are learners make a difference for student learning. This notion dates to early philosophy of education that describes the shared relationship with the construction of knowledge. In 1916, Dewey described the shared experience between a teacher and a student as the "teacher as the learner, and the learner without knowing it, a teacher" (p. 188). He advanced the theory of an active role for the teacher as learner, describing it as one that should not be viewed as a judge standing off to the side simply assessing the accuracy of reproduction of knowledge rather the role of the teacher as an active participant. The responsibility of the teacher then became to know both the subject matter and the characteristics of the learner in order to adjust continually and shape the knowledge creation experience for the learner.

This social constructivist view of learning and the teacher's role has not readily been the definitive meaning of effective teaching or the interpretation of teacher as learner. Recent federal state and local reform efforts to identify high quality teachers have led to the measurement of learning characteristics, including degrees, course work, test scores, and years of experience. Much research exists describing the relationships among university degrees (Galambos, 1985; Murnane; 1985, Rowan, Chiang, & Miller, 1997), content area course work (Evertson, Hawley, & Zlontik, 1985; Monk, 1994), professional exam scores (Rivkin, Hanushek, & Kain, 2005), years of experience (Murnane & Phillips, 1981; Summers & Wolfe, 1977), and their relationship to student achievement. While these studies are valuable in providing insight into personal teacher characteristics that have a moderate influence on student learning, they provide little in the way of informing areas for development of practice. Furthermore, according to Kennedy (2010), this view of teacher learning overestimates the influence of personal characteristics and does not account for continuously shifting demands and situational factors that require teachers to accommodate and account for incursions into the learning environment.

It is these incursions and continuous adaptations that require teacher learning to be viewed as an ongoing process that occurs within the context of various situations. Cochran-Smith and Lytle (1999) promote the notion of inquiry as a stance describing how teachers learn across their professional life span, connecting the activities within their classroom, school, and community to critical perspectives and research that inform judgments. Subsequently, these judgments inform the strategies teachers employ to engage students in learning. From this perspective, the knowledge, skills, and dispositions of teachers are not fixed, but rather they are continuously evolving in tandem with the changing environment and situational needs of students.

In support of this view, recently, cognitive scientists and teacher educators have advanced the notion of teachers as adaptive experts (Arends & Kilcher, 2009; Cochran-

Smith, Feiman-Nemser, McIntyre, & Association of Teacher Educators, 2008; Darling-Hammond, 2006; Darling-Hammond, Bransford, & National Academy of Education, 2005). The continual development of knowledge and practice conducted through disciplined experimentation and active reflection in order to meet new challenges is the defining characteristic of adaptive experts (Bransford, National Research Council, 2000; Hatano & Inagaki, 1992). Rather than employing a fixed set of technical and routine strategies, adaptive experts continually assess their own understanding and seek broader or deeper knowledge that allows them to innovate and put into place new mental models. The set of metacompetencies demonstrated by adaptive experts includes organizing and rearranging knowledge structures in flexible ways that lead to effectual problem solving. Included is an approach to problem solving requiring active monitoring of comprehension by the adaptive expert to determine when understanding is insufficient to solve any relevant issues. Educational researchers advocating teachers as adaptive experts recognize the needs of teachers to adapt continually materials, instructional strategies, and communication strategies, and incorporate new knowledge, technologies, and student supports to meet the needs of a diverse range of students in an ever-changing world. The high frequency of change requires a commitment of teachers to lifelong learning that leads to improvement in teacher knowledge or practice. Along a similar line, other fields of practice suggest a different set of metaskills recognized as adaptivity, flexibility, openness to feedback, and habits of mind as central to professional learning (Derry & Murphy, 1986; Silzer & Church, 2009). However powerful these notions of adaptivity and flexibility are, they merely allude to the internal mental processes and strategies required for professional learning without directly accounting for the underlying axioms bearing fruit for the willingness to learn.

Recent research in social cognitive psychology and neuroscience has demonstrated a key finding that beliefs about intelligence influence learning success (Dweck, 1999; Mangels, Butterfield, Lamb, Good, & Dweck, 2006). Through 15 years of studies with children and adults, Dweck repeatedly compared the responses to challenge and failure of entity theorists (fixed trait) and incremental theorists (malleable trait) as they relate to beliefs of intelligence. Entity theorists' belief of intelligence as a fixed trait commonly results in disengagement from challenge and learning opportunities stemming from an emphasis on performance goals and validation of existing intelligence. This set of responses is distinct from incremental theorists whose belief in malleable intelligence affords a superior rate of recovery from occasional failures, providing space for openness to feedback. Applying this notion to teachers as learners, an incremental theory of intelligence would position a teacher as both a performer and a learner continually adapting in tandem with feedback and according to the needs of students.

Yet how could a simple concept as a belief system have such purported implications for teacher learning and subsequently student learning? Through a review of educational research on teachers' beliefs, Pajares (1992) synthesized findings on beliefs and further advanced the notion substantiated by Abelson, Bandura, Nisbett, Ross, Posner, and Rokeach that beliefs play a critical role in defining behavior and organizing knowledge and information and, in effect, are instrumental in defining tasks and selecting the cognitive tools with which to interpret, plan, and make decisions regarding such tasks. More than 25 years of research into teacher education research has espoused the implications of the complex relationships between teacher beliefs and practices. Thus far, the research has taken place with teachers instructing in face-to-face classrooms and has not accounted for implications of the teacher beliefs of distance educators.

Problem

Studies of the impact of teacher professional learning on student achievement tend to approach teacher professional learning employing a fixed trait approach. The evidence is almost uniformly consistent in indicating that students with teachers committed to professional learning reap benefit in academic outcomes. However, these studies are limited in the measurement of commitment to continued professional learning, as studies in other practice fields have revealed additional essential variables in determining the learning orientation of a professional. Dweck's findings related to relationship of belief of intelligence to learning success seem to fit well within the scope of further research essential to understanding the complex relationship of teacher beliefs to their behaviors and, subsequently, student outcomes. This study provided research into the key construct of implicit theories of intelligence as they related to K-12 online teachers, as it was unlikely that additional funding to develop high quality teachers alone would result in increased student academic achievement.

Purpose

The purpose of this empirical inferential study was to examine the relationships among teacher-student interactions, student outcomes, and the implicit theories of intelligence and confidence of online teachers designated as students' primary teacher. Student outcomes were defined by the academic gains in the academic program. The examination of the background information was important, as it is hoped it identifies characteristics of teachers' contributing to significant differences in teacher behaviors and students' academic gains. Implicit theory of intelligence was defined by the way people prescribe meaning and understand intelligence. Through Dweck's (1999) Theories of Intelligence Scale, a measurement of two frameworks of intelligence, entity, or incremental theorists was provided. Similarly, confidence was a measurement described as either high or low confidence. Taken together, implicit theories of intelligence and confidence in one's intelligence were combined to create a dichotomous variable used to assess the judgments made and subsequent reactions online teachers had with students. The online teachers worked in functionally equivalent roles for one of 18 cyber charter schools managed by a recognized education management company in the United States.

Research Questions

The 4 research questions derived for this study were as follows:

1. What is the impact, if any, of teacher theory of Intelligence on student achievement gains scores?
2. What is the impact, if any, of teacher theory of Intelligence on amount of interaction with students in virtual classes?
3. What is the impact, if any, of confidence in one's intelligence on student achievement gains scores?
4. What is the impact, if any, of confidence in one's intelligence on amount of interactions with students in virtual classes?

Significance of the Study

With the rapid growth of K-12 online education has grown the interest and need for research. There exist a limited number of studies into K-12 online distance educator population. According to the *Going Virtual Study* series, examining the professional development needs of K-12 online teachers, more than half of the teachers teaching online hold a master's degree or higher (Dawley et al., 2010). They are generally certified and experienced teachers who have backgrounds consisting of 6 to 15 years in a brick and mortar class and have limited experience with technology and limited experience taking online courses. A closer look at the preparation to teach online reveals that 62% of teachers and 26% of administrators reported that teachers received no training prior to teaching online. However, continual learning and effective training is a crucial component to the success of teachers and students alike. In light of the evolving field that is creating new or additional teaching positions with limited preparation, it is essential to identify and develop effective teachers who possess a belief system that advances teacher and student learning. The intent of this study was to contribute to the body of knowledge in understanding how the implicit theories of online teachers related to their interactions with students and subsequently impact student outcomes. Four key findings presented are useful in the selection and development of K-12 online teachers: (a) teachers' belief in the malleability of intelligence positively affects student learning in literacy, which subsequently impacts math achievement; (b) teachers' belief in intelligence alone is not an effective predictor of teacher-student interaction frequency; (c) teachers' confidence in one's intelligence alone is not an effective predictor of class achievement gains; and (d) once teachers' confidence in intelligence is combined with online teacher framework for intelligence, it serves to predict the population that will attain significantly different literacy gains and resort to using increased frequency of known strategies as the primary means for interacting with students and the population that would seemingly disengage through limited teacher-student interaction.

Limitations

First, the constructs of theories of intelligence and confidence in one's intelligence have been used in previous research settings with children and college students. There exists a possibility that the constructs may be confounded with self-efficacy, a prevalent theory in teacher educator research related to confidence in one's ability to impact student performance.

Second, in circumstances of self-reports, participants may report answers according to known socially accepted answers. To account for respondents' choice of highly compelling incremental theory items, the original three entity theory items recommended by Dweck (1999) were used for this study.

Organization of the Remainder of the Study

Chapter 2 begins the literature review, exploring the concepts of varying models of K-12 online learning, online teacher selection, federal role in student achievement, teacher beliefs, theories of intelligence, confidence in one's intelligence, and teacher expectancy effects. Chapter 3 describes the research methodology selected, the survey instruments, data collection and analysis procedures, reporting details, and concerns regarding reliability and validity. Chapter 4 describes the data analysis procedures and key findings addressing each of the research questions. Chapter 5 concludes the study with a review of the problem and purpose of the study, adding conclusions, discussion, implications, and recommendations for future research.

Chapter 2: Literature Review

The importance of teacher as learner dates back to early foundations of educational theory, but the practices employed to select and develop effective teachers have not readily accounted for this principle. A preponderance of studies and methods has given credence to discrete teacher traits, characteristics, and personality with limited emphasis given to the personal theories that undergird the foundation from which recursive behaviors originate. More recently, with the evolution and rapid rate of expansion of online learning, school administrators and researchers have been concerned about online teacher professional learning and how to transfer knowledge acquired through traditional university preparation and classroom experience to facilitate adequately online instruction that meets the needs of diverse learners while adhering to federal accountability requirements (Dawley et al., 2010; Picciano & Seaman, 2009; Rice & Dawley, 2007; Rice et al., 2008). As a response to the confluence of factors, including the proliferation of K-12 online programs, expansion of federal accountability requirements, and an increase in student diversity within schools, universities have begun developing online teacher certification programs while, in tandem, state education agencies have created new online teacher certification requirements.

Theoretical Basis

Educational theorists, teacher educators, cognitive scientists, and researchers in other practice fields have upheld the importance of an orientation toward learning as a pillar of teacher quality. They have determined groupings of metacompetencies, metaskills, and cognitive structures as essential factors to possessing fruitful learning dispositions. Social cognitive theory has emphasized the central role a belief in incremental versus fixed intelligence plays in creating space for learning exemplified through remaining open to feedback, creating learning goals, and rebounding from failure (Dweck, 1999; Mangels, Butterfield, Lamb, Good, & Dweck, 2006).

Theorists of intelligence have not agreed upon a single construct for human intelligence; however, a presumption of fixed intelligence has early roots dating to the development of Intelligence Quotient (IQ) testing. The evolution of the federal government's role in education has contributed to the emphasized use of state standardized testing, and a readily used psychometric approach to evaluate student academic achievement. As a result, it is this explanation of intelligence that pervades education, creating a tension between teacher theory of intelligence and teacher-student interactions, which subsequently impact student outcomes. Several researchers recognize the value of addressing teacher beliefs as a promising medium for adjusting teacher decisions and behaviors, thereby stimulating effective teaching practices leading to increased student learning (Pajares, 1992 & Haberman, 2005).

In order to study the effect of online teacher beliefs on student outcomes, an examination of the historic influence of the U.S. federal role in education, the federal role's relationship to the interpretation of intelligence, and disconnect with methods used for teacher selection were necessary. Six frameworks contribute to researching the relationship of online teacher beliefs of intelligence, including confidence and teacher-student interactions leading to student achievement.

- The Rise of K-12 Online Learning in Public Education
- Evaluating Teacher Characteristics to Predict Effectiveness
- Teacher-Student Interaction Theory and Research

- Evolution of the Federal Role in Student Achievement
- The Influence of Beliefs and Expectations
- Constructs of Intelligence and Confidence

The Rise of K-12 Online Learning in Public Education

Early adopters of online learning recognized the value of the pedagogical strategy that moves the teacher from the sage on the stage to the guide on the side. In 1996, the Hudson Public Schools received a $7.4 million federal grant to build the Virtual High School, one of the first groups to design and operate a national online high school (Zucker & Kozma, 2003). In the fall of 1997, the Florida Online High School, known as the Florida Virtual School, began its own statewide virtual program along with more than a dozen other states, including Alabama, Kentucky, Michigan, and New Mexico. The early part of 2000 gave rise to education management organizations and curriculum providers such as Connections Academy, K12 Inc., and Kaplan Virtual Education dedicated to growing this new initiative (Watson et al., 2009).

Major educational organizations soon began to tout the need for this type of educational option. In 2001, the National Association of State Boards of Education Study Group on e-learning examined evidence, considerations, doubts, and cautions and concluded that e-learning would improve American education in valuable ways and recommended that it be universally implemented as soon as possible. It further added that technology is a key component to helping schools address core educational challenges. In 2002, the National Education Association adopted a comprehensive policy for online learning citing that "[National Education Association] enthusiastically supports the continued and expanded use of distance education because it believes that distance education has the potential to improve learning opportunities for students, the quality of instruction, and the effectiveness of education employees" (National Education Association, 2011, p. 405).

This shift in learning environments is not one without challenges. Its use requires that various issues related to student accessibility to hardware, software, and bandwidth be addressed (Watson et al., 2009). School, district, and state administrators must grapple with creative methods of funding and accounting for student attendance. Teachers must add to their content knowledge and instructional repertoire by learning about technology orientation, constructing instructional design for an online environment, creating quality online assessments, and designing online courses (National Education Association, 2006).

Despite these challenges, elementary and secondary public, private not-for-profit, and private institutions are combining online learning and face-to-face teaching in some way. They are developing programs and courses to meet the flexibility requirements of students and institutions of learning in addition to the parental, political, and social demands for increased educational options suitable for a diverse range of needs.

According to the International Association for K-12 Online Learning's (Watson et al., 2009) "Keeping Pace With K-12 Online Learning Annual Review," there exists a variety of programs, which are grouped into four types. As recently as 1996, the four types of programs have developed into state virtual schools, full-time multidistrict programs, single-district programs, and consortium and other programs.

The International Association for K-12 Online Learning (2010) defines state virtual schools as "state-led online initiative [that] are created by legislation or by a state level agency" (p. 5). They report that the grade levels are primarily high school with few elementary schools. Most of these programs are not diploma granting, but rather they are supplemental courses for students enrolled in full-time traditional school. State appropriation and federal grants are the primary source of funding but may sometimes include course fees and private foundation grants.

Full-time, multidistrict programs are programs in which students enroll full time in order to earn credit and diplomas granted by the online school; most have few or no part-time enrollments. This type of program, sometimes referred to as a cyber school, has two other characteristics in the form of organization and management. Those that are organized as charter schools, sponsored by a district or charter authorizer, are otherwise termed cyber charter schools. The other distinguishing characteristic is the affiliation and management by an education management organization, that is, an organization that works with school districts and charter schools to finance operations such as the provision of courses, software, teacher professional development, and logistical support through the use of public funds. Despite the type of organization and management structure, these full-time, multidistrict programs generally offer all grades K-12 and attract students from across the entire state. Funding is based on enrollment (Full Time Enrollment) and provided via state public education funds, or through appropriations, fees, and grants (Watson et al., 2009).

Single-district programs are mostly supplemental programs that are primarily funded by a district out of public Full Time Enrollment (FTE) funds to serve students who reside within the district. The grade levels are primarily high school and often include a focus on credit recovery or at-risk students, although some middle schools also offer these programs. Emerging from this model in a few states, with limits on enrollment across district lines, are online schools such as the Chicago Virtual Charter School that serve as a single-district full-time online school (Watson et al., 2009).

A consortium, the fourth type of program, cannot be neatly described. The use of a consortium program is employed in most cases to work collaboratively with school districts across one or more states. Member schools participating in the consortium may select faculty to teach a course. In exchange, the school is able to offer the full catalog to students based on the number of teachers contributing services as part of the consortium model. Within this type also exist programs organized and governed by postsecondary institutions for which enrollment is either full-time or part-time and is funded through course fees. This option is unique in that the geographic reach is national (Watson et al., 2009).

Defining the role of online distance educators needs to consider the distinction Lowes (2007) made between virtual courses and virtual classrooms. Virtual courses come in the form of either a self-paced, classic correspondence course that involves minimal teacher involvement or a self-paced course that includes ongoing, one-on-one teacher-student interaction though phone, e-mail, chat, or other e-synchronous means. Virtual classrooms may include small Web-based simulations, document archives, and virtual textbooks. These depend on not only teacher-student interaction and student-content interaction, but also the incorporation of student-student interaction through asynchronous threaded discussions that take place in the content management system or synchronous interactions that occur via video conference or webcasts in platforms such as Elluminate, Breeze, Wimba, or Picture Talk. It is the virtual classroom that most resembles the familiar instruction available to students in a traditional face-to-face context, as the role of the teacher includes not merely interactions, but employment of requisite instructional design, pedagogical, motivational, and assessment strategies to keep students successfully engaged while learning at a distance (Johnston, 2007; Zucker & Kozma, 2003).

Instruction in an online course, by its nature, is quite complex, as it involves selection and use of effective communication strategies. It is insufficient simply to consider two broad categories of communication as being asynchronous (e-mail, discussion boards, and wikis) and synchronous (chat, video, or web conference) instruction. Instead, it is of greater importance to understand the three types of communication and the psychological and cognitive supports provided within both mediums (Bender, 2003; Hrastinski, 2008; Zucker & Kozma, 2003). In a recent study of e-learning methods, Hrastinski (2008) established a framework for employing both methods, describing different purposes that contribute to distinctive dimensions of participation. The framework distinguished three types of communication, originally proposed by Haythornewaite, as essential for building and sustaining online learning communities. The communication types include content-related exchanges used to share ideas pertaining to course content, planning of tasks exchanges used to coordinate collaborative efforts and resolve conflicts, and social support exchanges used to express emotional, technical, and advice-giving support. The benefits of asynchronous communication, which afford opportunities for contribution, highlighted the readily cited benefit of participation in learning even when students cannot be online at the same time. The flexibility in asynchronous communication creates an environment of anywhere, anytime learning conducive to a wide variety of schedules. Moreover, it creates a dimension Hrastinski refers to as cognitive participation, providing learners more time to reflect, process information, and contribute quality responses to discussions. Synchronous communication, as Hrastinksi describes, affords personal learning dimensions that are considered more social, as in resembling natural conversations. Consequently, this leads to increasing psychological arousal and motivation for participation. Uses of synchronous communication also have the added benefit of decreased frustration as conversations occur in real time, as do responses to questions raised during discussion. Both asynchronous and synchronous communication strategies work in tandem to support the affective, cognitive, and behavioral outcomes evidenced in successful virtual classrooms.

Based on the distinctions between virtual courses and virtual classrooms, combined with the ends achieved by the two general communication categories and the variability in program models, it is challenging to provide a universal description for the role of online educators. Despite the inconsistency in program models and ambiguous role of the online teacher, influential organizations began the work of defining competencies and standards for quality online teaching in 2005, with publications from the Ohio Department of Education, Electronic Classroom of Tomorrow and the Institute of Higher Education Policy. The National Education Association (2006) outlined standards for hiring, preparing, supporting, evaluating, and assessing online teachers, including defining credentialing and skills. By 2007, North American Council for Online Learning conducted a review of these recommendations and endorsed those of the Southern Region Education Board and used by 16 Southern Region Education Board states, as a comprehensive set of criteria to publish the *Standards for Quality Online*

Teaching. The recommended guidelines were to be used at the district or organizational level but are not required (North American Council for Online Learning, 2007b). At the time of the study, there were only three states that required a specific endorsement for online teaching, but this too was changing, as university programs were developing certification programs to address the changing legislation.

The preponderance of studies related to K-12 online teacher learning needs and related preparation has been of a qualitative nature and consequently represents small samples. At the time of this study, a small number of dissertations had been published studying the characteristics, knowledge, and preparation of online distance educators, the experience of preservice teachers completing a virtual school internship, the motivation factors to teach online, and the necessary components of a staff development program to prepare teachers to teach secondary online classes. Postdoctoral research in this area has also been qualitative with a small sample size. DiPietro, Ferdig, Black, and Preston (2008) studied 16 online distance educators from Michigan Virtual School to report on the best practices of the teachers selected for the study in an effort to begin developing content-based best practices in K-12 online instruction.

At the time of the study, the most comprehensive research on K-12 online distance education had been the result of a 5-year evaluation carried out by Stanford Research Institute on the evolution of the Virtual High School. A follow-up to that study was conducted on teachers at the Virtual High School. Lowes (2005) employed a mixed-methods approach of interviews and surveys to study the full migration path of 215 Virtual High School teachers as they moved from teaching face-to-face to online classrooms and back to face-to-face classrooms. She reported on the transformation of teacher pedagogy and positive impact on school community as a whole reported by school administrators participating in the study.

Evaluating Teacher Characteristics to Predict Effectiveness

Earliest research on teacher quality dates to the early part of the 20th century and considered traits such as neatness and punctuality. During the ’30s and ’40s, Barr (1952), a professor at the University of Wisconsin, conducted studies in an effort to answer what characterizes a good teacher by focusing on five areas: teacher-pupil relations, teacher personality, qualities basic to teaching success, prediction of teaching success, and criteria for teacher effectiveness. This early work had considerable contributions to the interpretations of quality teachers we use today; however, it also held important limitations in that it did not account for variability in student demographics such as ethnicity, gender, and socioeconomic level. Furthermore, Barr recognized the possibility that there may not be a complete set of traits or personality characteristics. Instead, Barr concluded:

> Much of the research on teacher effectiveness seems to proceed as if the qualities in question resided entirely in the teacher. This may or may not be true. “Teacher effectiveness” may be essentially a *relationship* between teachers, pupils, and the other persons concerned with the educational undertaking, all affected by limiting and facilitating aspects of the immediate situation. (p. 174)

Becker, Kennedy, and Hundersmark (2003) located more than 600 studies from which they discerned three hypotheses that contribute to the constructs used by communities of scholars to define teacher quality. First was the bright, well-educated person hypothesis, which promotes the idea reflected in the name of the theory that bright well-educated people can be placed into a classroom and will naturally figure out what to do without requisite training and preparation. Second, the professional-knowledge hypothesis makes a case that quality teachers are developed though successful completion of course work in education and a common knowledge base. Third, the educational values hypothesis contends that effective teachers share a common set of values about education such as persistence, tolerance, patience, and commitment. While the first two hypotheses are more commonly cited in the literature, the most popular commercialized teacher selection instruments are based on the educational values hypothesis, specifically Gaullup's Teacher Perceiver Instrument and Haberman's Urban Teacher Selection (Star Teachers; Metzger & Wu, 2008).

Gallup's Teacher Perceiver system, developed in the early 1970s, is the most pervasive commercial teacher selection instrument in use by school districts (Metzger & Wu, 2008). The instrument is available online under the name TeacherInsight, and addresses 12 themes, including mission, empathy, rapport drive, individualized perception, listening, investment, input drive, activation, innovation, gestalt, objectivity, and focus. According to Gallup, the themes are drawn from research on characteristics of teachers most successful at working with students.

The Urban Teacher Selection Interview, commonly recognized as the Star Teacher Interview, is more readily marketed and used by high-volume, high-turnover urban districts. Similar to the Teacher Perceiver Instrument, this interview protocols seeks to understand the beliefs, attitudes, and values that drive teacher behavior and practices. However, Haberman (2005), a professor at the University of Wisconsin, employed the approach of Robert K. Merton in defining 14 midrange functions of effective urban teachers, on the basis that these predispositions would be powerful predictors of professional behavior. The midrange functions include protect children's learning, persistence, approach to at-risk students, theory into practice, professional-personal orientation to students, fallibility, emotional and physical stamina, organizational ability, explanation of teacher success, explanation of student success, real teaching, making students feel needed, the materials versus the student, and gentle teaching in a violent society.

In a meta-analysis of 24 studies investigating the predictive validity of commercial teacher selection instruments, Metzger and Wu (2008) concluded that the Teacher Perceiver Instrument best predicts which teachers will show up regularly and will be most liked by their administrators. Relationships between student academic gains and Teacher Perceiver Instrument scores were not as strong as attendance and observer ratings; however, the meta-analysis only included one study referencing student academic gains. The meta-analysis did not include the Urban Teacher Selection Interview, noting that it lacked empirical data for independent analysis. However, Haberman (2005) claims the instrument predicts the effectiveness of teachers in terms of their students' learning, teacher's ability to relate to diverse children in urban poverty schools, and teacher staying power.

Recently, the International Association for K-12 Online Learning (2010) explored the at-risk learning population in online education. A range of reasons were used to define at-risk, including students experiencing an academic risk, such as not meeting promotion requirements; students with language acquisition issues; teen pregnancy; high mobility; and absentee parents. The response from 22 different programs, including cyber charter schools, revealed the following:

- Twenty-five percent reported more than 75% of their student enrollments were at-risk
- Twenty-one percent indicated that 51%–75% of their student enrollments were at-risk
- Twenty-nine percent reported that 26%–50% of their student enrollments were at-risk
- Seventeen percent indicated that 11%–25% of their student enrollments were at-risk
- Eight percent reported that less than 10% of their student enrollments were at-risk

With 75% of programs classifying 25% or more of the student enrollment as at-risk students, it is clear that teacher selection and preparation to teach online is essential for serving the learning needs of these students. Professional development for K-12 online teachers in identification of at-risk students and differentiating instruction to meet the needs of diverse populations is not part of current professional development programs for the majority of K-12 online teachers (International Association for K-12 Online Learning, 2010; Rice & Dawley, 2007). The path to providing students with K-12 online teachers equipped to serve the needs of diverse learners may reside within Haberman's approach and the use of values and beliefs as essential indicators pointing to teacher effectiveness.

Teacher-Student Interaction Theory and Research

In consideration of the role of an online teacher in a virtual classroom, it can be discerned that the job inevitably involves cognitive, affective, and behavioral dimensions similar to those of traditional face-to-face classrooms, as it involves synchronous and asynchronous interactions between teachers and students. Interactions initiated by a teacher occur to address the delivery of academic content; it is these interactions, while at a distance, that also serve to develop the teacher-student relationship and establish students' sense of interpersonal connectedness to the class and school community (Palloff, Pratt & Palloff, 2007; Zucker & Kozma, 2003).

A significant body of research has produced findings about the importance of a positive learner-centered teacher-student relationship. Scholars have written about students' preference to have teachers who are warm, friendly, caring, and who encourage learning. In a recent meta-analysis, Cornelius-White (2007) synthesized 119 studies on the influence of the quality of teacher-student relationships conducted from 1948 to 2004, with 1,450 findings for 355,325 students. The methods employed for analysis compared various factors about the relationships (i.e., respect, higher order thinking, and adapting to difference) to student cognitive (grades, math, verbal, and reading achievement) and affective or behavioral (self-esteem, social skills, and motivation) outcomes. Overall, the findings reveal that when all the person-centered teacher variables were taken together, there was a statistically significant relationship to positive student outcomes (r = .31, SD = .29). Further decomposition of the analysis reveals the influence of the composite of all person-centered teacher variables result in a similar relationship with cognitive student outcomes (r = .31, SD = .25) and affective or behavioral student outcomes (r =.35, SD = .20). It is important to consider the wide variability from these findings, as they point to the varying impacts from each of the nine individual teacher variables. For example, there were moderate relationships (r =. 20 to r = .35) among the variables of adapting to differences, encouraging higher order thinking, warmth, empathy, and nondirectivity compared to other variables such as learner-centered beliefs and genuineness that reveal almost no direct relationship ($r \leq .14$) to positive student outcomes. Yet when the factors were taken as a whole, they contributed to a considerable impact on student outcomes.

While these findings were based on the instruction and teacher-student interactions that occur in a traditional face-to-face classroom, their value continue to ring true for the online teacher. The North American Council for Online Learning (2007a) *Standards for Quality Online Teaching* relay the importance of teacher-student, student-to-student, and student-content interactions facilitated by an effective online teacher. They are specifically addressed in Section C:

> The teacher plans, designs and incorporates strategies to encourage active learning, interaction, participation and collaboration in the online environment.
>
> - Encourages interaction and cooperation among students, encourages active learning, provides prompt feedback, communicates high expectations, and respects diverse talents and learning styles.
> - Establishes and maintains ongoing and frequent teacher-student interaction, student-student interaction and teacher-parent interaction.
> - Recognizes that student interaction with the lesson has instructional value and therefore encourages students to participate in leading the instruction and/or demonstrating mastery of the content in other appropriate ways.
> - Encourages collaboration and interaction among all students. (p. 4)

However, the theory of teacher-student relationships from a face-to-face classroom does not translate equally to an online classroom. Zucker and Kozma (2003) report on high satisfaction levels of teachers with teacher-student interactions, and yet Virtual High School teachers also described the challenges they felt with facilitating student-student interaction. Bender (2003) provides insight into the reason for the challenge by conveying findings related by Wegerif from the Open University. Based on interviews with 21 students enrolled in an interactive online course, Wegerif discovered that the student's degree of failure or success was closely related to whether the student felt like an insider or outsider of the community of practice. Insider students were also successful students who attributed a large majority of their learning gains to other students in the course, endorsing the great friendships they had formed. When interviewing a student who had dropped the course, it was revealed that the student felt a commitment to contribute to conversations on a daily basis thereby feeling overwhelmed by the pace of the course. It is the sentiment of the student who dropped the course that points to the importance of not simply the quality of interactions but rather the type and quantity of interactions that contribute to student outcomes. After all, there is no opportunity to increase student outcomes when students drop a course.

The degree to which interactions facilitated by an online instructor effects student achievement has been examined through the lens of the equivalency theorem by Bernard et al. (2009) who conducted a meta-analysis of 74 studies selected from 6,000 manuscripts ranging from 1985 to 2006. The theory suggests that varying combinations of interactions (student-student, student-teacher, student-content) can be provided in variable frequencies to diverse groupings of students in order to provide students with equivalent interaction opportunities and attain similar academic outcomes. Bernard's findings suggest six important concepts:

1. Student-to-student and student-to-content interactions both had significantly larger effects than those of student-to-teacher.
2. Increasing the strength (frequency) of interactions affects achievement.
3. Stronger student-content interactions provide achievement advantages over weaker (infrequent) student-content interactions.
4. The combinations of student-student and student-content, and student-teacher and student-content produced better achievement outcomes than student-student and student-teacher.
5. In terms of achievement, the types of education (synchronous, asynchronous, or mixed) did not produce statistically significant results.

6. The strength (frequency) of student-content affects outcomes in asynchronous settings more than in synchronous or mixed-course settings. (p. 1257)

When considering these findings, it is important to note that study results are based on findings gathered from undergraduate- and graduate-level students. This is of importance to note, as the results suggest a lower effect size between student-teacher than the other two forms of interaction. One explanation for this result provided by Bernard et al. (2009) is the difficulty with implementing student-teacher interactions consistently. For a K-12 online teacher, the results may bear out differently as a result of the age and maturity level of students, who may require explicit guidance, additional scaffolding, or feedback from a teacher. Bransford and the National Research Council U.S.; (2000) stated that as “expert teachers are sensitive to those aspects of the (knowledge) discipline that are especially hard or easy for the student to master” (p. 155) and subsequently facilitate the appropriate interaction based on the needs of the learner (Darling-Hammond et al., 2005).

It is the teacher who recognizes when a student may be struggling and adapts his or her approach in order to tap into the student’s existing knowledge who is deemed the adaptive expert teacher. Using the same arguement, it can be said that for a K-12 online teacher, it is necessary to adapt continually both instructional and communication strategies to meet the academic and social needs of the students. As evidenced by the story Bender related, a student may become disengaged with the course as a result of his or her perceptions. A K-12 online teacher needs to be attuned continually to the signals of potential student disengagement from the course and confusion with the knowledge (Bender, 2003; Zucker & Kozma, 2003). This requires a willingess to try new strategies, and a willingness to fail in order to identify the strategies that work with certain students while failing for others.

Evolution of the Federal Role in Student Achievement

According to Dede (2004), "A major challenge in professional development is helping teachers unlearn the beliefs, values, assumptions and cultural underlying of school's standard operating practice" (para. 6). The challenge Dede cited applies equally to K-12 online teachers, as they bring to the online classroom a rich history of teaching experience from traditional face-to-face classrooms (Dawley et al., 2010) and their own set of experiences as students. For any individual interacting in a school since the end of the 19th century, this means continuous exposure to the concept of intelligence measured through a classic psychometric approach. Through this view of statistically measured intelligence, teachers have formed a belief system focused on moving students toward attainment of performance goals, rather than a combination of learning and performance goals (Mangels et al, 2006; Rheinberg, 1983).

From the psychometric approach, intelligence is defined as a general factor of cognitive ability on which human beings differ (Herrnstein & Murray, 1994). This view of intelligence dates back to the early 20th century with Binet's (1908) development of the IQ test, which is recognized, and still in use today, as the Stanford-Binet. The original intended use of the IQ assessment results was to obtain information for the development of programs to support students with special needs failed by the Paris school system.

Following the development of IQ testing, during the 1930s, additional mental tests evolved, including the Wechsler Intelligence Scale for Children. However, similar to Binet's IQ test, these assessments were resource intensive, as they required trained personnel for administration. World War II provided a major opportunity for advancement in psychometrics, as the military sought to develop paper-and-pencil assessments to measure military aptitudes, resulting in a surge in psychological assessment and use evidenced to this day (Herrnstein, & Murray, 1994).

The psychometric approach to measuring intelligence pervades the educational system as assessments such as the Wechsler-Bellevue Intelligence Scale, and Wechsler Preschool and Primary Scale of Intelligence are used with children to assess clinically cognitive ability through verbal comprehension, perceptual reasoning, processing speed, and working memory in an effort to diagnose learning disabilities. With general education students, a psychometric approach is also instituted through the administration of the state standardized testing used in the United States, as all standardized tests measure intelligence to some degree (Herrnstein & Murray, 1994). Through the measurement of intelligence as cognitive factors, statistical tools such as factor analysis are used to identify common sources of variation among people and infer proficiencies and abilities of students in various content areas.

Historically, the U.S. Department of Education has gathered information and statistics from the nation's schools since it originated in 1867 under Andrew Johnson. However, it was not until the first Coleman Report, *Equality of Educational Opportunity*, commissioned by the U.S. Office of Education under the Civil Rights Act of 1964 that disparities in student academic achievement rates among various demographic groups would result in public discussion. Using data from more than 600,000 students across the country, Coleman produced a 737-page report that described school effects. These school effects suggested that a student's academic achievement was more closely related to the social composition of the school, the quality of the teacher (specifically verbal skills), and the student's family background (socioeconomic) than to the quality of the school (as measured by per pupil spending; Coleman et al. (1966). This study is considered one of the most important studies of the 20th century, as it was a call to action for parents, educators, community leaders, and politicians. Coleman et al. described the powerful impact of the tests administered in schools as predictors of future performance:

> The school bears many responsibilities. Among the most important is the teaching of certain intellectual skills such as reading, writing, calculating, and problem solving. One way of assessing the educational opportunity offered by the schools is to measure how well they perform this task. Standard achievement tests are available to measure these skills, as several such tests were administered to pupils at grades 1, 3, 6, 9 and 12.
>
> These tests do not measure intelligence, nor attitudes, nor qualities of character. Furthermore they are not, nor are they intended, to be 'culture free.' Quite the reverse: they are culture bound. What they measure are the skills, which are among the most important in our society for getting a good job and moving to a better one, and for full participation in an increasingly technical world. Consequently, a pupil's test results at the end of public school provide a good measure of the range of opportunities open to him as he finishes school—a wide range of choice of jobs or colleges if these skills are very high; a very narrow range that includes only the most menial jobs if these skills are very low. (p. 20)

An outgrowth of the *Equality of Educational Opportunity* was the Elementary and Secondary Education Act (1965; Pub. L. No. 89–10, §2, 79 Stat. 27), which was part of President Lyndon B. Johnson's War on Poverty. The act called for equal access to education, federal funding of primary and secondary educational programs intended to lead to improved achievement for the disadvantaged, and limited-English proficiency through the establishment of high standards and accountability. Since its enactment, Congress has reauthorized Elementary and Secondary Education Act repeatedly.

The No Child Left Behind Act (2001) is the most recent reauthorization of the Elementary and Secondary Education Act, promoting the notion of standards-based education reform. It is based on the belief that by setting high standards and establishing measurable goals, individual outcomes in education will improve. The act requires states to develop assessments that measure basic skills of all students in certain grades in order to receive federal funding for schools. The act does not assert a national achievement standard; standards are set by each state.

The act (107th Congress, 2001) requires that,

> …each state shall establish a timeline for adequate yearly progress. The timeline shall ensure that not later than 12 years after the end of the 2001-2002 school year, all students in each group described in subparagraph (C)(v) will meet or exceed the State's proficient level of academic achievement on the State assessments under paragraph (3). (p. 23)

These timelines are developed by state education agencies working under guidance from the federal government. According to the No Child Left Behind Act (2001), Adequate Yearly Progress scores are a diagnostic tool that determines how schools need to improve and where financial resources should be allocated. The act requires that 95% of students within a school must reach the same state standards in reading and mathematics by 2014. States must report the assessment scores of 95% of students when calculating adequate yearly progress scores. Students who have an individual education plan and who are assessed must receive the accommodations specified in the individual education plan during assessment; if these accommodations do not change the nature of the assessment, then these students' scores are counted the same as any other student's score.

The No Child Left Behind Act (2001) makes provisions for schools that do not demonstrate adequate yearly progress. Those that do not meet adequate yearly progress for 2 consecutive years are identified as schools in need of improvement and are subject to immediate intervention by the State Education Agency in their states. First steps include technical assistance and then, according to the 107th Congress (2001), "corrective actions" (p. 28) occur if the school fails to make adequate yearly progress.

Critics of the act have cited the effectiveness of educational reform, describing the accountability measures as harsh and unrealistically attainable. Scholars have also described the motivational consequences on students and teachers alike when focus is placed on achievement when compared to a social norm group, rather than individual student-centered learning goals (Dweck, 2006; Rheinberg, 1983). While motivational studies have not been empirical, the findings have tremendous implications for the practice of teaching subsequently impacting student learning and outcomes.

The earliest motivation research conducted by Rheinberg in the 1970s was based on two existing conceptualizations of reference norms: social and criterion reference norms along with an overlooked reference norm, specifically the individual reference norm. From his studies with eight teachers and 193 fifth graders, Rheinberg (1983) found that teachers who preferred to employ individual reference norms over social norms had a tendency to work flexibly and individualize their instruction, responding sensitively to diverse student learning needs. Students who received feedback based on individual reference norms, what Rheinberg termed intraindividual feedback, demonstrated effective learning strategies, including goal setting and attribution of success to effort.

An important note to consider from these findings related to standardized testing implemented as part of NCLB is that there are two test score interpretations used to calculate scores for standards-based assessments: a norm-referenced score and a criterion-referenced score. The norm-referenced score yields a socially referenced score that compares results across the tested population to provide an estimated position along a bell curve continuum. To balance this information, a criterion-referenced score is also provided, which yields a score reflecting the level of proficiency within a specified domain of subject matter. Both interpretations of scores yield an element of social comparison, as the criterion-referenced score merely considers the expected behavioral outcomes within a domain without consideration to the existing schema of the learner. Furthermore, without consideration of Rheinberg's proposed use of individual reference norms, there is much room for unintentionally creating or reinforcing a belief in fixed quantity of intelligence (Rheinberg, 1983).

The Influence of Beliefs and Expectations

The research addressing teacher beliefs is conclusive in several key aspects: beliefs are personally formulated, culturally shared (van den Berg, 2002), and they are relevant to behavior and affect motivation (Bandura, 2002). A prevailing description for the relationship of teacher beliefs to student outcomes is derived from Bandura's work, which created a construct describing the notion that beliefs relevant to specific teaching behaviors can produce particular results. Specifically, this set of teacher beliefs, emotions, and attitudes include perception of teachers' own influence on internal factors such as student learning, and on other external factors that influence results such as socioeconomic status, gender, class size, and previous achievement levels. By holding a set of empowering beliefs in these areas, defined as high efficacy, teachers can create an intrinsically motivating working environment that reflects adaptation to student needs and to new initiatives (van den Berg, 2002). Conversely, low teacher self-efficacy leads to resistance to new initiatives, which subsequently impacts student learning.

Dweck's (1999) research with children and adults has repeatedly demonstrated the impact of holding an inherent belief of intelligence as either fixed or malleable. Outgrowths from this line of research pursued studies related specifically to classroom teacher beliefs and expectancy effects. Researchers (Butler, 2000; Rheinberg, 1983) demonstrated that teachers endorsing a fixed (entity) belief system appeared to build future inferences of student performance on early scores with minimal emphasis on successive performance gains, implying that the constancy of teacher beliefs may be a significant determining factor of expectancy effects and a formulaic method of establishing student perceptions.

In separate studies, Rubie-Davies (2010) explored the moderating effect of teacher expectations at the individual student level and class level. Rubie-Davies, Hattie, and Hamilton (2006) explored the differences in reading performance for 540 students of 21 primary teachers and the relationship to teacher expectations. The results produced evidence that teachers had different, specifically lower, expectations for Maori students than students from New Zealand, Pacific Islands, and Asia. Subsequently, the lower teacher expectations may have been a contributing factor to the lower student reading achievement levels produced only by the Maori students.

More recently, Rubie-Davies (2010) examined class-level expectations by studying nine teachers, six recognized as high expectation (HighEx) and three recognized as low expectation (LowEx) teachers and their 220 students. Teachers were asked to rate students on their attitudes related to school and relationships to others at school and home. Correlations between expectations and student factors were significant and positive for teachers recognized as High Ex. Conversely, any significant correlations for teachers recognized as LowEx were negative. A different pattern emerged for correlations between student achievement and teacher expectations. Results for HighEx teachers demonstrated significant positive correlations with student achievement. For LowEx teachers, the results demonstrated only weak correlations. Exploring how teachers attribute ability is aided by a review of our understandings of intelligence.

Constructs of Intelligence and Confidence

Intelligence is a concept without a definitive meaning. It has roots in education, computer science, and biology. The biological view of intelligence is illustrated in both Jean Piaget's theory of cognitive development and Jeff Hawkin's memory prediction framework. The essential point for consideration from each of the three sources is the distinction of fixed or malleable intelligence (Dweck, 2006).

Earlier it was discussed that the psychometric perspective of intelligence predominates education's meaning ascribed to the construct. While statistics are used for measurement, it is essential to note that Binet's (1984) attempts to measure psychological attributes and factors should not be confounded with a belief in a fixed quantity of intelligence. Instead, Binet held firmly that intelligence was expandable within the framework of effort, practice, and perseverance throughout the school years. This is exemplified in the ramifications he believed a failed school program could have for children. "The child who, while in school, loses the taste for work runs the risk of not acquiring it again after he leaves school" (p. 105).

While working in Binet's research lab, Piaget began his research in the area of cognitive development by studying children's wrong answers to test items (as cited in Wagner & Sternberg, 1984). Originating from the psychometric approach to describing intelligence, Piaget sought to explain intelligence as a function of biological activity with his description of how cognitive structures might be different at different developmental states. More recently, and within the field of neurobiology, Hawkins' memory prediction framework argues that intelligence is a function of the neocortex's ability to recall memories used to make predictions and see relationships, sequences, and patterns (Hawkins & Blakeslee, 2004). This theory further describes the size of the cortical sheet of the brain as a contributing factor to intelligence and attributes the superiority of human intelligence above animal intelligence, in part, to the larger size of the cortical sheet. Neither Piaget nor Hawkins confirms a theory of fixed intelligence. Instead Piaget's model points to intelligence from an incremental view that occurs through maturation whereas Hawkins' model has a clearer dependency on the size of the cortical sheet, subsequently alluding to a fixed biological quantity of intelligence.

The information processing view of intelligence has roots in both computer science and psychometrics. In 1956, John McCarthy coined the term Artificial Intelligence within the field of computer science to frame intelligence as a process in which computers use algorithms to reason through problems with incomplete information and uncertain outcomes. The use of computers was to lead to superiority over human knowledge because of the superior power to process and calculate large sets of data. However, recently, the limitations of this view of intelligence have continued to be reverberated (Hawkins & Blakeslee, 2004; Lohman, 1989; Wagner & Sternberg, 1984). Critiques indicate that processing data is not the key to human intelligence, as early forms of Artificial Intelligence used algorithms to calculate every aspect of a problem before arriving at a decision. Unlike computers, human beings do not consider every aspect of a problem before arriving at a decision for action.

Sternberg's (1985) triarchic model of intelligence is born out of his work as a psychometrician and has three components: contextual, experiential, and componential. The contextual component endeavors to delineate behaviors considered intelligent within a specific culture, and thus highlighting the value of adaptation within a culture or environment. The experiential component emphasizes calls for intelligent behavior that is evidenced through responses to novel tasks employing automatic and effortless responses. Within the componential component exist metacomponents, performance components, and knowledge-acquisition components that make up the cognitive structures and processes motivating intelligent behavior. From this theory, Sternberg derived the notion of cognitive styles, not to be confused with cognitive ability. Rather, more precisely defined as the preferred method employed to organize and think through problems and situations (Sternberg, 1997). Neither perspective derived from the information processing conceptions holds a definition that brings credence to the notion of fixed intelligence.

Much as with intelligence, confidence has a variation of meanings. There is also a dichotomy of views between the correlation of confidence and achievement, as confidence is one of the most popular constructs for consideration in research. Early research pointed to an important distinction that while there may exist a correlation, it is only a low positive relationship (Hansford & Hattie, 1982). However, in a more recent meta-analysis of 324 studies with 305,859 people, Hattie (2009) clarified that an important consideration from previous studies is the confounding of self-concept of ability and self-estimates. From the findings, Hattie describes the value of confidence. While the correlation with achievement is low, the effect size is high (0.43). It is this effect size that points to the important role of confidence in getting through perceived obstacles or roadblocks.

In light of the role of confidence in achievement, Hattie (2009) emphasizes the reciprocal model Valentine, DuBois, and Cooper (2004) defined. This model suggests that rather than a simple explanation of high confidence leading to achievement, there is a reciprocal effect between both measures. This is to say that confidence causes achievement and achievement causes confidence. Rather than confidence as stable factor, it may serve as an index of recent performance and, subsequently, only be a mediating factor, as achievement levels vary (Dweck, Chiu, & Hong, 1995). Attempts to learn do not consistently lead to the desired attainment level, and thereby require a change in direction or strategies.

While the field of teacher learning, in general, is relatively young, there are powerful lessons available from 2 decades of research in related fields and in continued developments in learning theory (Borko, 2004; Bransford & National Research Council [U.S.], 2000; Darling-Hammond et al., 2005). Recent scholarly writings have depicted a situated approach to professional learning in which teacher learners engage in authentic problem-solving practices within the profession (Darling-Hammond, 2006; Lave & Wenger, 1991; Webster & Hackley, 1997). Descriptions of the situated approach are multifaceted and range from using classrooms to serve as the context for learning, where research is embedded into the practice of learning (Borko, 2004; Darling-Hammond, 2006), to developing strong professional communities of learners engaged in discourse, peer coaching, apprenticeship, and reciprocal knowledge sharing with colleagues related to changes in instructional practice (Darling-Hammond et al., 2005; Garet, Porter, & Desimone, 2001; Parise & Spillane, 2010). The strengths of this approach relate not only to the embedded nature of changing the practice, but also the extended period of time over which culture, language, and beliefs are transformed.

However, what is also known about teacher learning in a professional learning community is that the exercise of teachers talking to teachers is not powerful enough to change practices to impact student outcomes (Hattie, 2009). Teachers within a school may lack sufficient expertise with a reform initiative and might benefit from help outside of the school or learning community (Penuel & Reil, 2007). Teachers may also possess misconceptions about learning (Bransford & National Research Council [U.S.], 2000) and how to use effectively curricula requiring professional development from experts that address teachers' conceptions of learning and dialogue related to the notion (Hattie, 2009). However, it is insufficient to provide one-shot workshops fitting with outdated paradigms of professional development, as this method does not sufficiently engage teachers in an ongoing process nor allow opportunities to connect experiences within the context in which teachers work (Garet et al., 2001).

Overwhelmingly, it can be stated that a primary role for a teacher is to be a continual learner and a problem solver who accepts challenges, poses questions, and endeavors to find informed solutions while grappling with uncertainty. K-12 online teachers may be new to the role, but not new to the cultural underpinnings that have shaped the American education system. However, the major life transition that moves the teacher from the front of the classroom to guide behind the computer breaks with traditionally recognized models of teacher professional development. For the K-12 online teacher, this transition may be considered a disorienting dilemma sufficiently powerful to transform belief systems couched in outdated paradigms of intelligence and ability. The disorientation triggered by the magnitude of change experienced by a K-12 online educator, coupled with the online context, which provides time for greater reflection on practice and communication, is supported by a community of learners and professional development, and is steeped with teacher learner engagement in various domains, may be the key factors that are essential to transforming beliefs, values, and assumptions created by federally mandated definitions of achievement. These assumptions serve to create the underlying cultural of the publically funded education system, which subsequently influences the standard operating practices of K-12 online teachers.

Summary

Teacher professional learning needs have changed significantly as a result of a confluence of factors, including technological innovations, evolution of the federal government's role in education, and an increase in the demographic composition of today's classroom. Much is still unknown about the role of the online teacher and the instructional practices that can be used to serve the needs of students. To date, what researchers have established is the importance of a positive learner-centered teacher-student relationship as it relates to positive student outcomes. In the virtual classroom, the significance of this relationship continues to be emphasized, as standards call for online teachers to plan, design, and incorporate varying combinations of interactions in variable frequencies to diverse groupings of students to encourage active learning, interaction, and participation in the online environment. The intention of varied interactions is to provide students with equivalent interaction opportunities, affording opportunities for similar academic outcomes.

Historically, teacher selection has employed a range of approaches, including selection based upon personal traits and personality characteristics. However, these methods have neglected to inquire into the underlying axioms that form the foundation from which recursive behaviors occur. Social cognitive psychology and neuroscience suggest that beliefs about intelligence influence learning success. While the construct of intelligence has derivatives in education, biology, and computer science, there remains no agreed upon definitive meaning for human intelligence.

Early in the 1900s, Binet's research and subsequent development of the IQ test laid the foundation for scholastic aptitude tests still in use in schools. In education, this psychometric interpretation of intelligence is readily used in classrooms throughout the country as part of the standardized testing protocol required by the No Child Left Behind Act. However, Binet's development of the IQ construct had unintended consequences, as it inadvertently created the space for a belief system in fixed versus malleable intelligence. The simple implicit theory of intelligence has implications for teacher learning, as research has repeatedly demonstrated successful learning practices associated with children and adults holding an incremental view of intelligence, regardless of confidence in one's own intelligence versus the helpless and occasionally defensive behaviors demonstrated by those holding a fixed theory of intelligence. To date, there exists limited research on the effects of teacher expectations and beliefs related to traditional classroom instruction. Similarly, the academic research for K-12 online teacher learning is limited; furthermore, the landscape into the relationship of online teacher beliefs to student achievement and teacher-student interactions is void.

Chapter 3: Methodology and Procedures

Overview of Purpose

The purpose of this empirical inferential study was to examine the relationships among, teacher-student interactions, student outcomes, and the implicit theories of intelligence of online teachers designated as students' primary teacher. Student outcomes were defined by the academic gains in the academic program. The examination of the background information was important, as it is hoped to identify characteristics of teachers contributing to significant differences in teacher behaviors and students' academic gains. Implicit theory of intelligence is defined by the way people prescribe meaning and understand intelligence. Through Dweck's (1999) Theories of Intelligence Scale, a measurement of two frameworks of intelligence, entity or incremental theories were provided. The measurement was used to assess the judgments online teachers made of students and the teachers' subsequent reactions. The online teachers worked in functionally equivalent roles for one of 18 cyber charter schools managed by a recognized education management company in the United States.

Research Questions

The 4 research questions derived for this study were as follows:

1. What is the impact, if any, of teacher theory of Intelligence on student achievement gains scores?
2. What is the impact, if any, of teacher theory of Intelligence on amount of interaction with students in virtual classes?
3. What is the impact, if any, of confidence in one's intelligence on student achievement gains scores?

4. What is the impact, if any, of confidence in one's intelligence on amount of interactions with students in virtual classes?

In an attempt to answer these 4 research questions, 6 null hypotheses were established. They were as follows:

Ho 1: There is no difference between Malleable and Fixed teacher theory of Intelligence and student gains scores as measured by Scantron Performance Series Median Class Gain Scores at $p < .05$.

Ho 2: There is no difference between Malleable and Fixed teacher theory of Intelligence and the amount of teacher interaction with students in a virtual classroom, as measured by Frequency of Interactions at $p < .05$.

Ho 3: There is no significance between High and Low Confidence in Intelligence of teachers and student gains scores as measured by Scantron Performance Series Median Class Gain Scores at $p < .05$.

Ho 4: There is no significance between High and Low Confidence in Intelligence of teachers and the amount of teacher interaction with students in a virtual classroom, as measured by Frequency of Interactions at $p < .05$.

Ho 5: There is no interactive effect of Malleable and Fixed theory of Intelligence High and Low Confidence in Intelligence of teachers on student gains scores as measured by Scantron Performance Series Median Class Gain Scores and Frequency of Interactions at $p < .05$.

Ho 6: There is no interactive effect of Malleable and Fixed theory of Intelligence High and Low Confidence in Intelligence of teachers on the amount of teacher interaction with students in a virtual classroom, as measured by Scantron

Performance Series Median Class Gain Scores and Frequency of Interactions at $p < .05$.

Research Design

The design of the study was an empirical inferential design that quantitatively measured the relationships between the theory of intelligence and confidence in one's intelligence of K-12 online teachers, teacher-student interactions, and student academic gains. Inferential studies seek to draw inferences about a population based on observations and statistics computed on the respondents from a representative sample (McMillan & Schumacher, 2010). Through a coordinated set of steps, including obtaining answers to questions that mirror a construct, the inferential survey in this study used information obtained imperfectly to describe a more abstract, larger entity.

K-12 online teachers, serving in functionally equivalent roles and working for one of 18 cyber charter schools managed by the same educational management organization, were randomly selected to participate in the completion of an assessment measuring implicit theories of intelligence and confidence in one's intelligence. Eligible candidates were sent e-mail to request participation in the study and that provided an explanation of the study's purpose and the qualifications used to select them for participation. Further, the e-mail included a consent form describing the voluntary nature of the study, their right of refusal to participate, the associated risks, and benefits of their participation.

Eligible candidates consenting to participation were asked to complete the nine-item online questionnaire within a 2-week study window. After the completion of the study window, scores from the assessment were downloaded into NCSS statistical software and used for relationship analysis with three other variables.

Archival data from the internal communication system for each of the online schools were accessed to obtain metrics for teacher-student interaction. Archival data for student academic gains were acquired through provision from the director of Assessment and Evaluation for the educational management organization. At the beginning of the school year, in fall of 2010 and end of school year in Spring of 2011, students completed a standards-based criterion-referenced and norm-referenced assessment. A gain score measuring the difference between the spring score and fall score was provided. During the school year, each teacher recorded interactions with students in the internal communication system. Interactions include online synchronous instruction, and phone and face-to-face interactions. Both sets of archival data were downloaded, numerically coded, and entered into NCSS statistical software program.

Sample

The theoretical population for this study consisted of K-12 online teachers at cyber charter schools managed by the education management organization, including homeroom, Title 1, content area, and special education teachers. In addition, it included instructional coordinators and school counselors. The teaching population at the cyber charter schools ranged in size from four teachers at the smallest school to 352 teachers at the largest school. The sample was drawn from this population and included the following qualifications for inclusion in the sampling frame:

- Serving in functionally equivalent roles as the primary teacher of record who was responsible for academic outcomes, specifically deemed either a homeroom teacher (K-8) or instructional coordinator (High School).

- Hire date prior to the start of first day of school signifying a minimum of one complete year of online teaching.
- Teacher at one of the 18 cyber charters selected for the study.
- 95% or more of third through 10th grade students in class completed the Fall and Spring Performance Series assessments in the 2010–2011 school year in reading and math.

For this study, 250 teachers were sought to meet a quantifiable sample size. In order to achieve this sample size, 525 online teachers, deemed primary teacher of record, were invited to participate out of 697 teachers who met the inclusion criteria. The 18-cyber charter schools for which the teachers work were also selected based on qualification, including established experience as a full-time, online cyber charter school that included 2 or more complete years in operation and fidelity in use of the provided internal communication system.

In order to locate subjects, the researcher obtained permission to solicit school staff to participate in the study from the senior vice president of School Management for the education management company (see Appendix A). Each of the 18 full-time, online cyber charter schools selected for the study employed management personnel reporting to the School Management division for the education management organization; however, the online teachers were employees of the local charter authorized organization or school district. The approval from the senior vice president of School Management reflected the executive permission necessary to engage online teachers as part of the research study. Once all necessary approvals were provided, teachers at the 18 cyber charter schools were entered into a database used for a multistage stratified sample selection.

The compiled population database was analyzed to create stratum for eligible teachers based on observed school size characteristics. According to Groves, Fowler, Couper, Lepkowski, & Singer (2009), stratification can improve the sample design by assuring representation of population subgroups in the sample. Each member of the database was assigned a grouping variable reflective of the school size characteristic. Active data for Excel was used to draw the stratified random sample using six strata, a 5% tolerable error rate, and a 95% confidence level.

Instrumentation and Data Collection

Theory of intelligence and confidence in one's intelligence. Theory of Intelligence was measured through the administration of the Theories of Intelligence Scale and Confidence in One's Intelligence scale, both of which combine to equal six items designed by Dweck et al. (1995) and three questions related to participant demographics. The researcher obtained permission for use of the instrument through communication with Carol Dweck Ph.D. and subsequent formal submission of a letter seeking permission for instrument use (see Appendix B). The six items Dweck developed were readily available to researchers for use in future studies, as documented in scholarly publications related to the construct and instrument validity (Dweck, 1999; Dweck et al, 1995; Mangels et al., 2006). After Institutional Review Board approval and permission for instrument use was granted, an online survey engine was used to gather consent and deliver the questionnaire.

The researcher sent an e-mail invitation (see Appendix C) requesting participation to the eligible study candidates chosen from the stratified random sample. The e-mail invitation explained the purpose of the study, the qualifications for participation, and the

2-week timeline for participation in the study. The e-mail included a link to the online questionnaire and a digital copy of informed consent (see Appendix D) as an attachment for the candidate's complete review prior to accepting terms for participation.

The questionnaire was accessed via Survey Gizmo and used branching logic to fulfill three purposes: (a) acknowledge participant consent for participation, (b) gather an alternate work e-mail address, and (c) gather responses to online questionnaire, including implicit theories of intelligence and confidence in one's intelligence scale. The informed consent was required for participation in the study (see Appendix D). The alternate nonwork related e-mail address was used to communicate with study participants for purposes of this study.

Once the participant acknowledged consent to participate in the study the participant was presented with two scales: Theories of Intelligence (Others) and Confidence in One's Intelligence. The participant was delivered both scales intact; this is to say that the researcher did not modify the original instrument. Upon completion of the questionnaire, the participant was provided a copy of the digitally signed informed consent and a report detailing answer selection, which was e-mailed to the alternate nonwork related e-mail address and made available only to the study participant.

The researcher employed multiple strategies to maximize participation rates. After the initial e-mail invitation had been sent to eligible candidates, the researcher monitored response rates on a daily basis during the 2-week window. A reminder e-mail message was sent on the 3rd and 6th day of the study to any eligible candidates who had not responded to online questionnaire.

Teacher-student interaction. Teacher-student interaction was captured as an artifact obtained through a combination of indicators used to measure teacher performance of instructional interactions with students. Each of the online schools in the population employed the use of a common procedure to document interactions with students. A qualifier for school selection in the study was demonstrated effective use of the documentation procedure quantified through 2 previous years of use of said process and system. The procedure required teachers to use discrete templates to log notes for interactions that occur via phone, web-based conference, or face-to-face communication, through the school's internal communication system. Notes were entered following an interaction and were visible to teachers and administration employed at the local online charter school. Each note was subsequently reported as a metric used to gauge the level of teacher-student interaction and depicted a facet of teacher performance. Throughout the academic year, a teacher entered seven interaction note types. The seven note types include the following:

1. Web-based conference—described one-on-one targeted instruction that took place via web-based conference. The interaction may have been impromptu or scheduled and involve only the teacher and student.
2. Small group face-to-face—described an interaction in which a teacher met face-to-face for targeted instruction with a small group of students.
3. Small group web-based conference—described an interaction that occurs via web-based conference with a clear state standards-based objective and with the objective of increasing proficiency on state tests. The format required essential components for lesson presentation, including instruction on a

lesson, modeling examples, checking for understanding, questioning of students, and using guided practice.

4. Power conference: Phone—described an interaction that takes place via phone with a student, utilizing state-specific frameworks to provide one-on-one instruction for the student, followed with a closing conversation with the student's learning coach to provide additional strategies and follow-up activities.
5. Power conference: Web-based conference—described an interaction that took place via web conference with a student, utilizing state-specific frameworks to provide one-on-one instruction for the student, followed with a closing conversation with the student's learning coach to provide additional strategies and follow-up activities.
6. Standards based: Test preparation—described an interaction with a student with a purpose of working directly on a standards-based test preparation curriculum. The interaction was intended to encourage consistent use of the test preparation curriculum, focusing on specific skills.
7. Missed interaction—describes the documentation of communication related to a missed scheduled interaction. The student was invited and required to attend an interaction and did not show for the instruction.

Throughout the school year, the interactions were aggregated and quantitatively reported for each student.

Academic gains. Academic gains were captured as an artifact obtained through implementation of the Scantron Performance Series, an online standards-based adaptive measurement. Each of the online schools in the population ensured the administration of the Performance Series to measure academic growth. All third- through 10^{th}-grade students complete math and reading Scantron Performance Series assessments during the 1st week of enrollment in the Fall and again in late Spring. Testing session scores from the Gain reports were used to determine if academic gains for an individual student were appropriate to the grade level. The student gain score is the difference between the Fall testing session and the Spring testing session. For classes or groups, this is an average, or mean, of all the students in that category. This can display as a positive or a negative number. If a student scores 1,750 in the Fall and 1,905 in the Spring, his or her gain is 155.

Data Analysis

After the 2-week window for participation in the online questionnaire had closed, responses were downloaded from Survey Gizmo. The data set was imported into NCSS where scoring of both Theories of Intelligence and Confidence in One's Intelligence took place. The Theories of Intelligence Scale assessed administration of three items that measured an overall implicit theory of intelligence as either entity or incremental theory of intelligence. The score on the scale was obtained by averaging responses from 1 to 6, ranging from strongly agree to strongly disagree with a statement. Dweck et al. (1995) recommend establishing a clear criterion by using scores of 3.0 or lower as entity theorists and 4.0 or higher as incremental theorists. From their validation studies, this criterion excludes the range of scores between 3.0 and 4.0, which is about 15% of the participants, leaving the remaining 85% of the participants evenly distributed between the two groups.

Confidence in one's intelligence was a three-item questionnaire developed by Henderson, Dweck, and Chiu in 1992 (Hong, Chiu, & Dweck, 1995). Responses to this measure were recorded into a 6-point scale, ranging from low to high confidence. To calculate respondents' scores for this measure, first the mean sample confidence score was identified. Respondents with scores below the mean were rated as low confidence, scores above the mean were considered of high confidence, and scores at the mean were eliminated from the sample.

Dweck et al. (1995) acknowledge and address the issue related to the limited number of items used to assess both constructs of implicit theory of intelligence and confidence in one's own intelligence. As a result of a simple unitary theme, the researchers explain that a limited number is appropriate. They note that repetition and rephrasing of assessment items may lead to confusion or boredom from the respondents.

The researcher used NCSS to import Excel output files for theories of intelligence and confidence in one's intelligence. The first analysis completed used a table to report participation rates, including sample number eligible and solicited for participation compared to actual number and percentage participated. A second table and analysis reports the number and percentage of theories of intelligence and confidence in one's intelligence according to entity theorists or incremental theorists. A third table reports the demographics of the teaching population gathered in the final three questions according to the number and percentage for each response.

To check for response bias, the researcher conducted a wave analysis. According to Creswell (2009), wave analysis is one method of checking for bias introduced into the results as a result of nonrespondent effect. To account for this effect, the researcher used an Analysis of Variance (ANOVA) to compare the differences in responses submitted in week 1 and week 2 for theories of intelligence and confidence in one's intelligence. Results were reported in a table and a subsequent written interpretation of the figures follow.

Two additional databases were added to NCSS reporting: teacher-student interaction and student academic gains. A descriptive analysis of the two variables, independent and dependent, was conducted. Descriptive statistics for teacher theory of intelligence, confidence in one's intelligence, teacher-student interaction, and student academic gains were reported according to school size characteristics and teacher demographics. The report details sample size, mean score, standard deviation, and range of scores for each of the variables.

To answer the four research questions, the researcher addressed the six null hypotheses. Inferential statistics were used to analyze each of the hypotheses outlined in the research questions. According to Creswell (2009), inferential questions or hypothesis relate variables so that inferences can be drawn from the sample to a population.

For Null Hypothesis 1, an ANOVA was conducted. In this null hypothesis, the X-variable (or factor) was a nominal variable, called teacher Theory of Intelligence. There were two levels within this factor: malleable and fixed. The categorization of teacher theory was determined by Theories of Intelligence Scale, which categorized each teacher's perception of intelligence as either malleable or fixed. The Y-variable was a continuous variable: student gains scores as measured by the difference between pre- and post assessments on defined achievement tests taken in the Fall and Spring of the 2010–2011 school year.

For Null Hypothesis 2, an ANOVA was conducted. In this null hypothesis, the X-variable (or factor) was a nominal variable, called teacher Theory of Intelligence. There were two levels within this factor: malleable and fixed. The categorization of teacher theory was determined by Theories of Intelligence Scale, which categorized each teacher's perception of intelligence as either malleable or fixed. The Y-variable was a continuous variable: number of interactions between teacher and students in a virtual classroom. These interactions were measured by documentation of interactions entered into the school's internal communication system.

For Null Hypothesis 3, an ANOVA was conducted. In this null hypothesis, the X-variable (or factor) was a nominal variable, called Teacher Confidence in Self-Intelligence. There were two levels within this factor: high and low. The categorization of teacher perception was determined by Confidence in One's Own Intelligence Scale, which categorized each teacher's perception of self-confidence as either high or low. The Y-variable was a continuous variable: number of interactions between teacher and students in a virtual classroom. These interactions were measured by documentation of interactions entered into the school's internal communication system.

For Null Hypothesis 4, an ANOVA was conducted. In this null hypothesis, the X-variable (or factor) was a nominal variable, called Teacher Confidence in Self-Intelligence. There were two levels within this factor: high and low. The categorization of teacher perception was determined by Confidence in One's Own Intelligence Scale, which categorized each teacher's perception of self-confidence as either high or low. The Y-variable was a continuous variable: number of interactions between teacher and students in a virtual classroom. These interactions were measured by documentation of interactions entered into the school's internal communication system.

For Null Hypothesis 5, a two-way ANOVA was run to assess any interaction between teacher Theory of Intelligence and Teacher Confidence in Self-Intelligence on student gains scores, as measured by the difference between pre- and postassessments on defined achievement tests taken in the Fall and Spring of the 2010–2011 school year.

For Null Hypothesis 6, a two-way ANOVA was run to assess any interaction between Teacher Perception of Intelligence and Teacher Confidence in Self-Intelligence and number of interactions between teacher and students in a virtual classroom. These interactions were measured by documentation of interactions entered into the school's internal communication system.

The cumulative results of all analyses were used to deliver an interpretation of results addressing each of the research questions. The interpretation describes support or refusal of the hypothesis. Explanation of results describes and accounts for any inadequate procedures that may have introduced a threat to validity. Finally, the interpretation reports how the results can be generalized to a larger population and suggestions for future research.

Validity and Reliability

Theories of intelligence and confidence in one's intelligence. Dweck originally developed the Theories of Intelligence scale in 1992. Dweck (1999) reports using a Theories of Intelligence scale that included only entity theory items. Over time, the scales have evolved to measure implicit self-theories and theories of others for both children (ages 10 and older) and adults. Further, the scales have developed to include incremental theory items that produce a very high negative correlation with the entity theory items. For this study, the three recommended entity-only scale was used, as Dweck reports the use of this scale is preferable in certain circumstances in which participants may drift toward the incremental items.

Along the same line of research, Henderson, Dweck, and Chiu created a three-item assessment, in 1992, to measure confidence in one's intelligence (Hong et al., 1995). Each assessment item was structured first as a question that asks a respondent to select a response reflective of his or her own intelligence from two opposing confidence descriptions. Next respondents were asked to use a 6-point scale to rate their confidence in the supplied description using a scale of 1 to 5.

Reliability. Chronbach alpha scores are one of four general reliability estimates used to measure internal consistency of results across items within the test (Trochim, 2006). The results for testing internal consistency produced by Dweck et al. (1995), through a series of five studies, reflect a high reliability within the unitary theme of implicit theory of intelligence, ranging between an alpha of 0.94 to 0.98. The test-retest reliability for implicit theory of intelligence was 0.80 during a 2-week interval. Similar high reliability is evidenced for confidence in one's own intelligence. Dweck et al. (1995) report high internal reliability (a = 0.81) with a high test-retest reliability ($r = 0.83$, $N = 50$) for confidence in one's own intelligence.

Construct validity. Construct validity for the Implicit Theories of Intelligence Scale was demonstrated through factor analysis, establishment of convergent and discriminate validity, and subgroup analysis. Dweck et al. (1995) reported on five validation studies measuring implicit theories about different human attributes. Factor analyses were conducted and resulted in the conclusion that implicit theories about intelligence, morality, and the world are statistically independent. This is to say that endorsement of an implicit theory about one human attribute, such as intelligence, does not represent assent in a separate attribute such as morality. Within the factor-loading analysis, convergent validity for the implicit theory of intelligence was established. The correlations provide evidence for convergence on the same construct of implicit theory of intelligence.

Convergent validity for the Confidence in One's Own Intelligence scale was established through comparison of two related scales. Through comparison studies of self-confidence and self-esteem, Hong et al. (1995) found high correlation ($r = 0.77$, $N = 33$) with the perceived intellectual competence subscale of Self-Perception Profile for College Students and a moderate correlation ($r = 0.43$, $N = 55$) with the Rosenberg Self-Esteem Scale. This is to say that while related to both self-confidence and self-esteem, confidence in one's intelligence is more closely related to self-confidence.

Taken together, convergent or correspondence with similar constructs, and divergent or dissimilar constructs work together to establish construct validity (Trochim, 2006). Discriminate validity for implicit theory of intelligence and confidence in one's own intelligence were examined through comparison of the theory measures to other recognized scales, resulting in insignificant correlations for self-monitoring (0.040), social desirability (0.024), cognitive ability (-11.03), confidence in the self (-0.001), self-esteem (0.391), control by internal factors (.150), control by powerful others (0.059), confidence in other people's morality (.110), and confidence in the world (-1.71).

Using six separate studies to examine gender, age, political affiliation, and religion, Dweck et al. (1995) demonstrate that implicit theory measures are independent of the demographic characteristic of the respondent. The regression model reflects insignificant relations ranging from -0.240 for political affiliation to -0.041 for gender. The results of these studies demonstrate the validity of the construct as items measuring implicit theories of intelligence converge and, at the same time, are unrelated and, thus, not confounded with other measures.

Academic gains. The Scantron Performance Series is both a criterion referenced and norm-referenced assessment system that works with state standards (Scantron Corporation, 2010). The computer adaptive engine relies upon Item Response Theory calibration to ensure that all content units are covered, and uses the Item Response Theory-based item bank of questions and difficulty indices to provide reliability and accuracy. In an attempt to illustrate the content validity of Performance Series with regard to content areas, Scantron examined the concepts of item validity and sampling validity, both of which are necessary components of content validity. Item validity focuses on the degree to which test items are relevant in measuring the desired content area. Sampling validity focuses on how well items selected for the test sample or span the content area.

According to Scantron Corporation (2010), it began the item development process by creating a list of skills through research of individual state standards, state assessment programs, and the National Assessment of Educational Progress. In addition, those standards proposed by national organizations such as the National Council of Teachers of Mathematics and the National Council of Teachers of English were also reviewed. It created a database of skills and objectives aligned to standards and assessment documents from around the country that have been created within the last 15 years. A review of the content in the database reveals a core of these most common elements, taken within and across grade levels. The performance series skill list represents this core group of skill lists.

Ethical Considerations

Survey methodology is both a field of scientific inquiry and part of a larger profession of survey research (Groves, Fowler, Couper, Lepkowski, & Singer, 2009). The use of survey instruments and use of archival data provide an opportunity for sensitive information to be revealed. In order to protect participants' privacy and respect their rights, needs, and values, this study employed several safeguards in accordance with federal and professional standards to protect human subjects.

In addition to the aforementioned use of best practices of survey research, including scientific methods of sampling, use of statistically valid and reliable instruments and following-up to achieve an adequate response rate, additional measures were taken to maximize ethical practices (Groves et al., 2009). Privacy and empowerment of participants was demonstrated throughout the study and beyond the research activities. Participants invited to be part of the study were sent e-mail describing the researcher's role, purpose, and selection criteria used to select the sample (see Appendix C). The e-mail contained the Informed Consent that served as a dialogue to articulate in writing the research objectives, data collection devices, activities, and confidentiality strategies (see Appendix D). This approach empowered participants with an understanding of the voluntary nature of the study and their right to withdraw from the study at any time. The researcher was responsible for assuring this understanding through the acquisition of submitted online informed consent survey from participants prior to participation in the study. A copy of the completed informed consent and responses submitted to the online questionnaire was e-mailed to participants to their nonwork-related e-mail address.

Recognizably, there were minimal risk to participants of the study, as association of individual identity to an overall theory of intelligence and confidence in one's intelligence may lead to a false interpretation of employability. In order to protect research subjects from association with individually identifiable information, the researcher used advanced programming of the survey engine, Survey Gizmo, to employ strategies for performing ethical and scientifically sound research. The first strategy was to use a randomly generated unique identifier known only to the researcher in lieu of using a staff identification number. The researcher created a key code with staff identification numbers and unique identifiers. The unique identifiers were used for programming the online questionnaire and incorporating data from other databases. Immediately following the closing of the survey window, the researcher downloaded data into Excel format and maintained records of responses, specifically participant names and responses to the questionnaire, in an encrypted folder on a single USB drive stored in a locked filing cabinet in the researcher's home. The researcher also downloaded records from Scantron Performance Series and the internal communication system and replaced names with the unique randomly generated identifier known only to the researcher in an effort to restrict names or other directly identifying information from the respondent data

(Groves et al., 2009). The use of the code adds a layer of confidentiality by removing individual identities during the data analysis.

The list of names, codes, and databases will be maintained on the aforementioned USB drive. After 5 years, the data stored on USB drive will be destroyed through the use of Darik's Boot and Nuke. This program will wipe the contents of the drive with the Deparment of Defense Short Pass Method. Once the drive has been completely erased, the USB drive will be physically destroyed and eliminated. The collective use of these strategies ensured confidentiality through coding of participant names and protecting other persons in the setting and the participants from the general public.

In accordance with Pepperdine's (Pepperdine University, 2009) Institutional Review Board's applicability process, the researcher pursued exempt status as defined by the Office of Human Research Protections in 45 CFR 46.101(b). The study fell into two of six activities exempted from federal regulations:

> Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior. (p. 32)
>
> Research, involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects. (p. 32)

Taken together, these safeguards served to protect participants against the minimal risk of this study, as defined (Pepperdine University, 2009) by the "harm or discomfort ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests" (p. 7).

Limitations

First, the constructs of Theories of Intelligence and Confidence in One's Intelligence have been used in previous research settings with children and college students. There exists a possibility that the constructs may be confounded with self-efficacy, a prevalent theory in teacher educator research related to confidence in one's ability to impact student performance.

Second, in circumstances of self-reports, participants may report answers according to known socially accepted answers. To account for respondents' choice of highly compelling incremental theory items, the original three entity theory items recommended by Dweck (1999) were used for this study.

Chapter 4: Results

This section presents the data collected and associated analysis for the study. The chapter is divided into 10 parts, not including the introduction: reiteration of purpose statement and research questions, description and characteristics of the sample, test hypothesis 1, test hypothesis 2, test hypothesis 3, test hypothesis 4, test hypothesis 5, test hypothesis 6, other findings, and summary of findings.

Reiteration of Purpose Statement and Research Questions

The purpose of this empirical inferential study was to examine the relationships among, teacher-student interactions, student outcomes, the implicit theories of intelligence, and confidence of online teachers designated as students' primary teacher. Student outcomes were defined by the academic gains in the academic program. The examination of the background information was important, as it was hoped to identify characteristics of teachers' contributing to significant differences in teacher behaviors and students' academic gains. Implicit theory of intelligence was defined by the way people prescribe meaning and understand intelligence. Through Dweck's (1999) Theories of Intelligence Scale, a measurement of two frameworks of intelligence, entity or incremental theories were provided. Similarly confidence was a measurement described as either high or low confidence. Taken together, implicit theories of intelligence and confidence in one's intelligence were combined to create a dichotomous variable used to assess the judgments online teachers made of students and the teachers' subsequent reactions. The online teachers worked in functionally equivalent roles for one of 18 cyber charter schools managed by a recognized education management company in the United States.

Research Questions

The 4 research questions derived for this study were as follows:

1. What is the impact, if any, of teacher theory of Intelligence on student achievement gains scores?
2. What is the impact, if any, of teacher theory of Intelligence on amount of interaction with students in virtual classes?
3. What is the impact, if any, of confidence in one's intelligence on student achievement gains scores?
4. What is the impact, if any, of confidence in one's intelligence on amount of interactions with students in virtual classes?

Description and Characteristics of the Sample

The sample for this study consisted of functionally equivalent online teachers, teaching at one of 18 cyber charters selected for the study, with a qualifier of 95% or more of third through 10th grade students who completed the Fall and Spring Performance Series assessments in the 2010–2011 school year in reading and math. Eligible study candidates meeting the study criteria were chosen from a stratified random sample of 697 primary teachers and instructional coordinators. The compiled population database was analyzed to create stratum for eligible teachers based on observed school size characteristics, subsequently employing six strata. Table 1 provides a detailed overview of the proportional stratified sample according to school size characteristics.

Table 1

Stratified Random Sample Selection

Strata	Student Enrollment	Number of Eligible Teachers in Population	Number of Teachers in Sample	% Teachers in Sample
1	0–499	10	8	2
2	500–999	19	14	3
3	1,000–1,999	116	87	17
4	2,000–2,999	66	50	10
5	3,000–5,499	97	73	14
6	5,500–11,000	389	293	56
Total		697	525	100

To test the six hypotheses, a nine-item online questionnaire was electronically sent to 525 eligible teachers. After a 2-week window, the survey response rate was 54% with a 62% contact rate, which is a measure of the proportion of all cases in which a candidate was reached by the survey. This resulted in an 89% cooperation rate. Those unable to complete the questionnaire were considered as also incapable of cooperating. Table 2 provides detailed overview of the calculation of response rate and cooperation rate.

Table 2

Response and Cooperation Rates

Response Type	Participants	% of Participants
Returned questionnaire		
Complete	288	55
Partial or break-off with sufficient information	1	0
Eligible, Noninterview		
Invitation Returned Undeliverable	17	3
Explicit Refusal	11	2
Implicit Refusal	7	1
Logged on, Did Not Complete Any Items	3	1
Break-Off or Partial With Insufficient Information	13	2
Non-Contact	183	35
Respondent Was Unavailable During Field Period	2	0

(*continued*)

Response Type	Participants	% of Participants
Not Eligible		
Selected Respondent Screened Out of Sample	1	0
Total	525	100

Upon completion of the 2-week window for survey completion, answers were downloaded, coded, and analyzed. To score the Implicit Theory of Intelligence questionnaire, scores on the three items, questions 1 through 3, were averaged to form an overall implicit theory score ranging from 1 to 6, where the higher score implies a stronger malleable (incremental) theory. To ensure that only participants with clear theories were included, participants were classified as fixed (entity) theorists if their overall implicit theory was 3.0 or lower. Participants were scored as malleable (incremental) theorists if their scores were 4.0 or higher. To score the confidence in one's intelligence, a statement depicting high confidence was pitted against a statement depicting low confidence, questions 4 through 6. Respondents were asked to choose the one statement that was truer for them and then to indicate how true it is for them on a scale of 1 (Very true) to 3 (sort of true). Responses were recorded onto a 6-point scale ranging from low to high confidence. Respondents with scores lower than the mean for the sample were classified as having low confidence. Those at the mean were eliminated from the sample. Participants were then categorized into three categories: malleable, fixed, and disqualified theory of intelligence. Table 3 shows that the preponderance of the sample, 72% (*N* = 208), reported holding a malleable theory of intelligence. Furthermore, the sample disqualified only 8% (*N* = 23) of scores in the area of theory of intelligence. This was less than the 15% disqualification threshold Dweck suggested.

Table 3

Characteristics of Sample

Characteristic	No. participants	% of participants
Theory of Intelligence		
Fixed (Entity)	58	20
Malleable (Incremental)	208	72
Disqualified	23	8
Confidence in One's Intelligence		
High	143	49
Low	145	50
Disqualified	1	1
Dichotomous Variable		
Fixed High Confidence	26	9
Fixed Low Confidence	32	11
Malleable High Confidence	106	37
Malleable Low Confidence	101	35
Malleable Disqualified Confidence	1	0
Disqualified High Confidence	10	3
Disqualified Low Confidence	13	4
Years of Total Teaching Experience		
1 to 5	49	17
6 to 10	111	38
11 to 15	69	24
15 to 20	42	15
21 or more years	18	6
Years of Online Teaching Experience		
1 Year	51	18
2 to 3	98	34
4 to 5	81	28
6 to 7	36	12
8 to 9	15	5
10 or More	8	3
Level of Education		
12^{th} Grade or Less	1	0.3
Graduated High School or Equivalent	1	0.3
Associate Degree	1	0.3
Bachelor's Degree	147	50.9
Master's Degree	135	46.7
Doctoral Degree	4	1.4
Total	289	100

The scoring of confidence in one's intelligence naturally produced an even split between high and low confidence in one's intelligence among the sample resulting in 49% (*N* = 143) High confidence, 50% (*N* = 145) Low confidence, and 1% (*N* = 1) disqualified confidence. When this variable was taken to create a dichotomous variable together with theory of intelligence, it produced sufficiently sized samples in the proposed categories of fixed high confidence 9% (*N* = 26), fixed low confidence 11% (*N* = 32), malleable high confidence 37% (*N* = 106), and malleable low confidence 35% (*N* = 101). The remaining categories with a disqualified variable were not used for analysis for the respective characteristic.

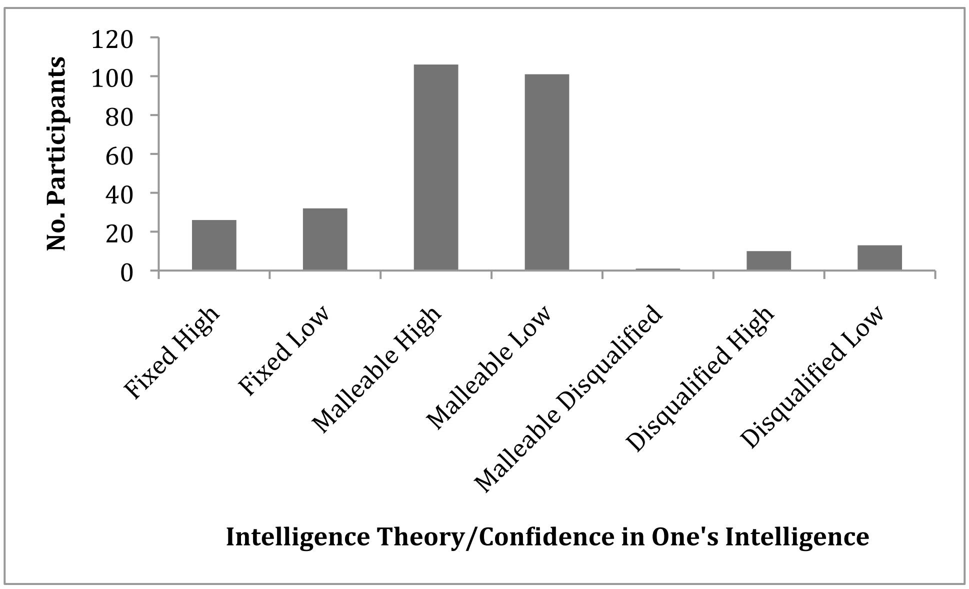

Figure 1. Sample distribution of intelligence theory and confidence in one's intelligence (#).

The representation of total years teaching was normally distributed given that the qualification to have completed a minimum of 1 full year of teaching; there were no participants who could have had less than 1 year of teaching experience. The highest proportion of participants, 38%, reported 6 to 10 years total years' teaching experience.

At the other end of the spectrum, 6% of the sample reported 21 or more total years of teaching experience. In light of the normal distribution coupled with the secondary analysis discussed later, total years of teaching experience may have been an important consideration in the present study. Figure 2 below depicts the aforementioned distribution of years actively teaching.

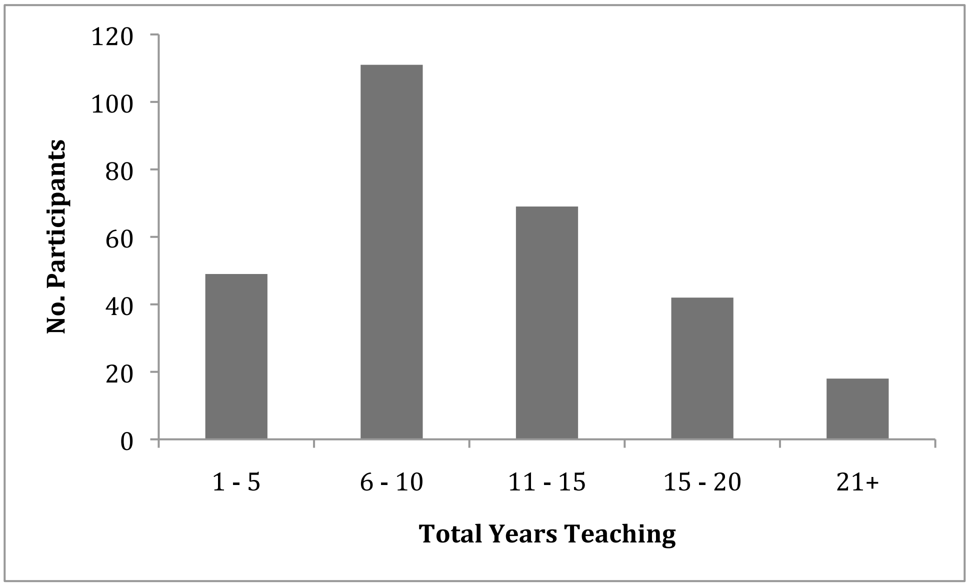

Figure 2. Sample distribution of years actively teaching (#).

Similar to total years teaching, the representation of years teaching online was normally distributed given that the qualification to have completed a minimum of 1 full year of teaching with the cyber charter school; there were no participants who could have had less than 1 year of teaching experience. The highest proportion of participants, 34%, reported 2 to 3 years' experience teaching online. At the other end of the spectrum, 3% of the sample reported 10 or more total years of experience teaching online. In light of the normal distribution coupled with the secondary analysis discussed later, years of online teaching experience did not appear to be an important consideration in the present study.

Figure 3 below depicts the aforementioned distribution of years teaching online for the sample.

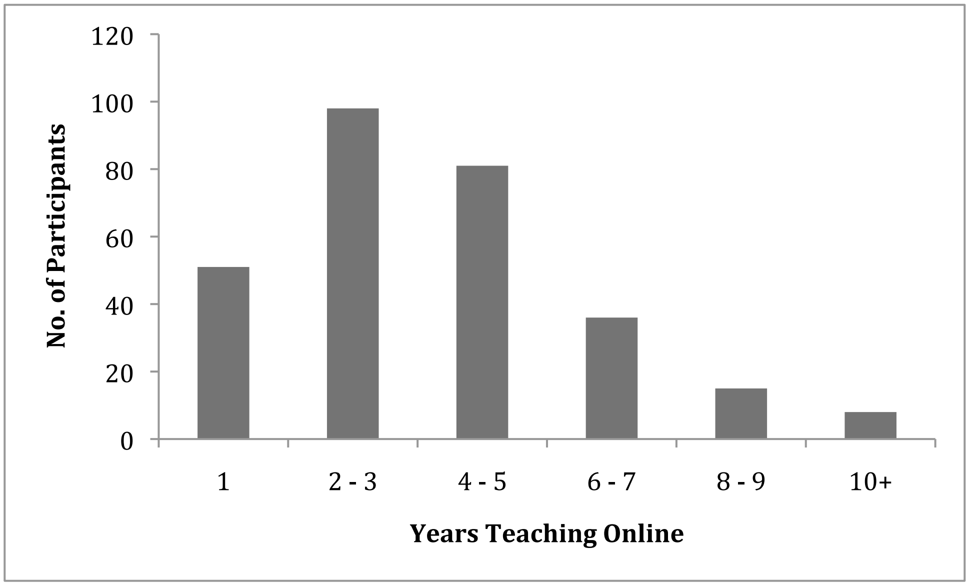

Figure 3. Sample distribution of years teaching online (#).

The representation of level of education revealed that the preponderance of participants reported holding either a Bachelor's degree 51% (*N* = 147) or a Master's degree 47% (*N* = 135). In light of teacher certification and credential renewal requirements, results were also normally distributed. However, there were three outliers who reported holding an Associate's degree or less, which constituted 1% of the sample. At the opposing end of the educational spectrum 1% of the sample reported holding doctoral degrees. Figure 4 below depicts the aforementioned distribution of level of education for the sample.

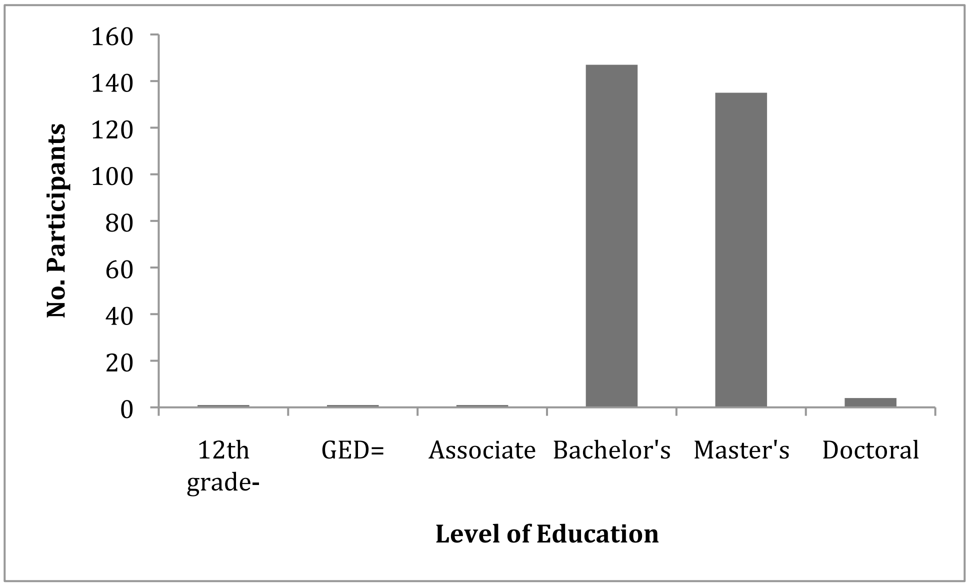

Figure 4. Sample distribution of level of education (#).

To check for response bias, an ANOVA was used to compare the differences in responses submitted week 1 and week 2 for theories of intelligence and confidence in one's intelligence. The results displayed in Table 4 revealed that there was a significant difference between the responses received in week 1 and week 2, only as it related to theory of intelligence (F [1, 287] = 5.83, p = .01). Participants submitting a response in week 2 (M = 4.5) had a greater mean score for theory of intelligence than week-2 participants (M = 4.1) signifying a stronger malleable theory of intelligence.

Table 4

Wave Analysis for Responses Submitted Weeks 1 and 2

	df_1	df_2	F	η^2	p	β
Theory of Intelligence	1	287	5.83*	0.0199231	0.01	0.67294
Confidence	1	287	1.47	0.005101526	0.22	0.054583

Note. * $p < .05$, Alpha = 0.05

In addition to gathering the responses to the questionnaire, two additional databases for the sample were analyzed reporting teacher-student interaction and student academic gains in the domains of reading and math. Missing data for frequencies of interactions reduced the sample size available for investigation of research questions 2 and 4. In this study, on average 36% (N = 105) of the data was missing for analysis of interactions across academic domains. Upon closer scrutiny of the remaining sample sizes, the missing data for interactions did not pose a threat to the validity of hypothesis 6.

For participants with available data, interaction types within a domain were taken together to create a sum of interactions within the domain. This revealed that 59% of total interactions were reported for math (N = 52,673) whereas reading reflected only 41% of the total interactions (N = 38,763). Across each of the interaction types, the pattern of higher proportion of interactions held true for each of the seven interactions, with the exception of Power Conference: Phone in the reading domain, 1.4% (N = 1,317) as opposed to 0.4% (N = 406) in the math domain. Figure 5 below depicts the distribution of interaction by type according to domain.

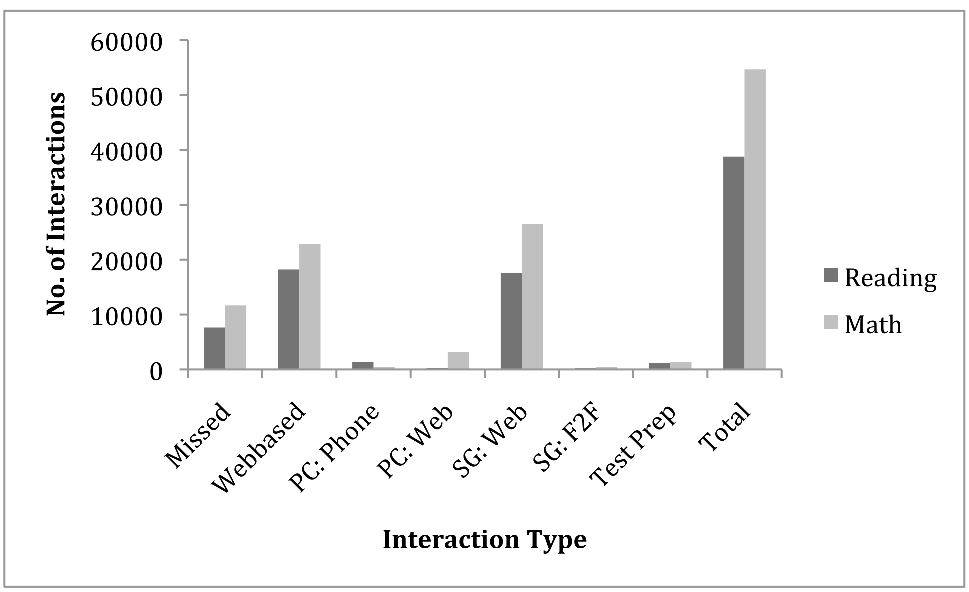

Figure 5. Sample distribution of number of interactions by type according to domain.

The higher proportion of math interactions may be an important consideration in the present study. This is particularly true if there is a relation between the frequencies of interactions and median academic gains. Justification for the need of the preliminary analysis was further evidenced by the significant difference between median reading gains (89) and median math gains (108). In an effort to understand the impact of interactions on academic gains, a multiple regression analysis of total interactions within a domain and the associated academic median gains was conducted. A positive relationship ($r^2 = 0.00076$) between total reading interactions and reading class gains was identified. Of the variation, 2% in median reading gain scores can be accounted for by differences in total reading interactions. The same did not hold true for math. There was not a direct relationship between the two variables of total math interactions and math gain scores.

Table 5

Sample Academic Gains

	Reading	Math
Mean	90.69	109.62
Median	89.00	108.00
Mode	96.00	82.00
N	289	289
SD	54.72	54.43
Minimum	-81.50	-31.00
Maximum	278.00	271.00

Test of Hypothesis 1

Important background information on the overall sample and the characteristics that could potentially impact the independent variables (intelligence theory and confidence in one's intelligence) were previously described. In this section and the next five that follow, the focus is further refined to the purpose of this study by testing each of the six predetermined hypothesis in order to answer the four associated research questions. The first hypothesis follows.

Ho 1: There is no difference between malleable and fixed teacher theory of intelligence and student gains scores as measured by Scantron Performance Series Median Class Gain Scores at $p < .05$.

The outcome for this hypothesis was garnered through an ANOVA of the nominal variable, called Theory of Intelligence, with two levels within this factor: malleable and fixed. The Y-variable was a continuous variable—student gains scores as measured by the difference between pre- and post assessments on defined achievement tests taken in the Fall and Spring of the 2010–2011 school year. Sample participants with a disqualified theory of intelligence ($N = 23$) were removed from the sample for this analysis. The results constituted the Malleable ($N = 208$) and Fixed ($N = 58$) theories of intelligence scores of teachers and the associated academic gains of students.

A one-way ANOVA was used to test for reading academic gain differences between two theories of intelligence (fixed and malleable). Reading academic gains approached significant differences across the two theories ($F[1, 263] = 2.64$, $p = .10$). While the relationship was not significant using the standard alpha level of .05, the *p*-value was less than .10 and the difference between class reading gain scores—Malleable theory ($M = 92.7$) and Fixed theory ($M = 79.2$)—for teachers was 13.5, which poses an important effect when considering the translation of academic gains. On average, a 10-point gain is considered 1 month of academic learning.

Similar to reading, a one-way ANOVA was used to test for math academic gain differences between two theories of intelligence. Math gains did not differ significantly across the two theories ($F[1, 263] = 0.07$, $p = 0.786318$). Those with a Malleable theory of intelligence had only a marginally higher mean gain score ($M = 108.3$) in math than those with a Fixed theory of intelligence ($M = 106.1$).

Table 6

Relationship of Theory of Intelligence to Academic Gains

Domain	df_1	df_2	F	η^2	p	β
Reading	1	263	2.64	0.00993	0.10	0.366449
Math	1	263	0.07	0.0002799	0.79	0.0584416

Note. * $p < .05$ Alpha =0.05

However, to understand fully the relationship of Teacher Theory of Intelligence across domains, it was essential to conduct a secondary analysis in the form of a multiple regression analysis to determine if a teacher's math gain score was directly associated to the reading gain score. A direct positive relationship (r^2=0.11117) relationship signified that a teacher's math gain score could be predicted by reading gain score. Of the variation, 33% in math gain scores could be accounted for by variation in reading gain scores. Figure 6 below depicts the direct and positive correlation of math achievement gains to reading achievement gains.

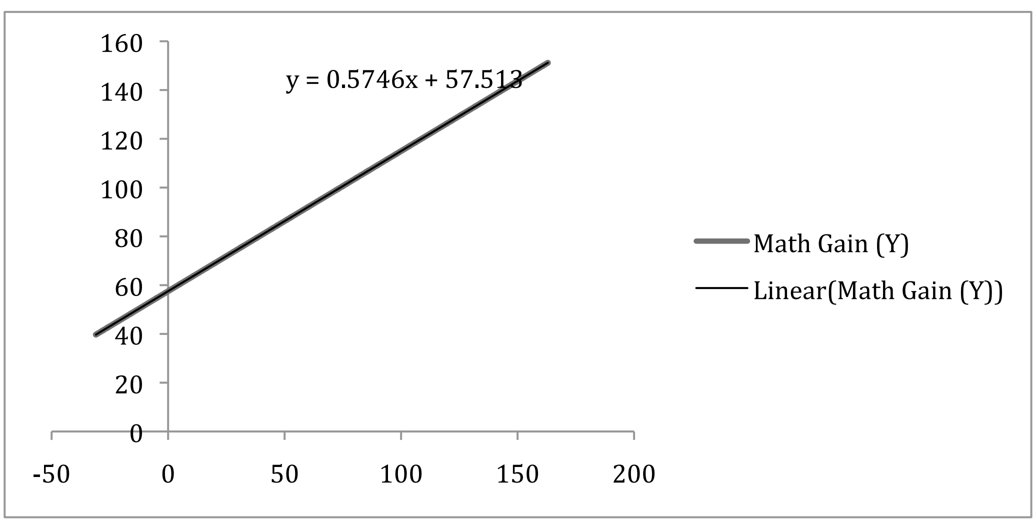

Figure 6. Math gain relationship to reading gain, including line of regression.

Given these findings, the null hypothesis (Ho1) failed to be rejected for both domains. This is to say that there is no significant difference between malleable and fixed teacher theory of intelligence and student gains scores as measured by Scantron Performance Series Median Class Gain Scores, as measured by Scantron Performance Series Median Class Gain Scores.

Test of Hypothesis 2

Ho 2: There is no difference between malleable and fixed teacher theory of intelligence and the amount of teacher interaction with students in a virtual classroom, as measured by Frequency of Interactions at $p < .05$.

The outcome for this hypothesis was garnered through an ANOVA of the nominal variable, called Theory of Intelligence, with two levels within this factor: malleable and fixed. The Y-variable was a continuous variable—number of interactions between teacher and students in a virtual classroom. These interactions were measured by documentation of interactions entered into the school's internal communication system. Sample participants with a disqualified theory of intelligence ($N = 23$) were removed from the sample for this analysis, as were those with missing student interaction data ($N = 105$). The results constituted the Malleable ($N = 132$) and Fixed ($N = 34$) theories of intelligence scores of teachers and the associated academic interactions with students in the virtual classroom.

For each domain, the sum of the six positive interactions types was combined to produce a total for interactions within the domain. While there were seven distinct interactions types, the missed interaction was a reflection of a scheduled interaction that was missed by the student, consequently resulting in no interaction. When the six remaining interaction types were taken as a whole, within the reading domain, the total number of interactions (F[1, 263] = 2.10, p = .15) were the closest to approaching significance; however, it did not attain statistical significance at $p < 0.05$. Those with a Malleable theory (M = 233) of intelligence had 97 more total reading interactions than those with a Fixed theory of intelligence (M = 136). Within the math domain, total interactions did not differ significantly or approach significance between the two theories of intelligence (F[1, 164] = 1.43, p = .23). Those with a Malleable theory of intelligence had only a marginally higher total mean interaction frequency (M = 325) in math than those with a Fixed theory of intelligence (M = 226).

Table 7

Relationship of Theory of Intelligence to Teacher-Student Interaction Type

Domain	df_1	df_2	F	η^2	p	β
Reading	1	164	2.10	0.013	0.15	0.301608
Math	1	164	1.43	0.009	0.23	0.221037

Note. * $p < .05$ Alpha =0.05

During a secondary analysis, an ANOVA was used to assess each interaction type within the respective domain. Detailed results of each analysis are listed in Table 8. Within the reading domain, there were not any interaction types that attained a statistical significance at p< .05. However there were two interactions that were notable. Malleable theory (M= 109) teachers employed a Web based Reading interaction (F[1, 162] = 1.63, p = .20) with greater frequency than those with a Fixed theory of intelligence (M = 59). By way of review, a Web-based conference describes one-on-one targeted instruction that took place via the Internet. The interaction may have been impromptu or scheduled and involved only the teacher and student. Conversely, those with a Fixed theory of intelligence (M = 2.7) had a greater frequency of small group face-to-face interactions for reading than Malleable theory teachers (*M* = 0.9; *F*[1, 155] = 1.67, *p*= 0.2). The label of this interaction is reflective of the meaning, as it describes an interaction where a teacher met face-to-face for targeted instruction with a small group of students. Given these findings, the null hypothesis (Ho2) failed to be rejected for both domains. This is to say that there is no difference between malleable and fixed teacher theory of intelligence and teacher interaction with students in a virtual classroom as measured by frequency of interactions.

Table 8

Secondary Analysis: Relationship of Teacher Theory of Intelligence to Interaction Type

Domain	Interaction Type	df_1	df_2	F	η^2	p	β
Reading	Total	1	164	2.10	0.013	0.15	0.301608
	Web based	1	162	1.63	0.010	0.20	0.244884
	PC: Phone	1	160	0.20	0.001	0.66	0.072842
	PC: Web	1	157	0.80	0.005	0.37	0.143757
	SG: Web-Based	1	162	1.29	0.008	0.26	0.203772
	SG: Face-to-Face	1	155	1.67	0.017	0.20	0.221037
	Test Preparation	1	157	0.12	0.001	0.73	0.06691
	Missed	1	159	0.28	0.002	0.59	0.082736
Math	Total	1	164	1.43	0.009	0.23	0.221037
	Web-Based	1	164	0.56	0.003	0.45	0.115804
	PC: Phone	1	158	0.05	0.000	0.82	0.055909
	PC: Web	1	161	0.20	0.001	0.65	0.072630
	SG: Web-Based	1	163	1.16	0.007	0.28	0.188465
	SG: Face-to-Face	1	156	0.36	0.002	0.55	0.091524
	Test Preparation	1	157	0.00	0.000	0.95	0.050475
	Missed	1	161	0.04	0.000	0.84	0.054793

Note. * $p < .05$, Alpha = 0.05

Test of Hypothesis 3

Ho 3: There is no significance between high and low confidence in intelligence of teachers and student gains scores as measured by Scantron Performance Series Median Class Gain Scores at $p < .05$.

The outcome for this hypothesis was garnered through an ANOVA of the nominal variable, called Teacher Confidence in Self-Intelligence, with two levels within this factor: high and low. The Y-variable was a continuous variable—number of interactions between teacher and students in a virtual classroom. Sample participants with a disqualified score of Confidence in Self Intelligence ($N = 1$) were removed from the sample for this analysis. The results constituted the High ($N = 142$) and Low ($N = 145$) confidence scores of teachers and the associated academic gains. For both reading $F(1, 264) = 0.55$, $p = .0.458266$ and math ($F[1, 264] = 0.98$, $p = .0.322280$), the hypothesis is not supported. The academic gains of high and low confidence teachers in both domains did not differ significantly.

Table 9

Relationship of Confidence in One's Intelligence to Academic Gains

Domain	df_1	df_2	F	η^2	p	β
Reading	1	264	0.55	0.002	0.46	0.114723
Math	1	264	0.98	0.004	0.32	0.167141

Note. * $p < .05$, Alpha = 0.05

Those with Low Confidence had only a marginally higher mean gain score ($M = 92$) in reading than those with High Confidence in Self-Intelligence ($M = 87$). This relationship held true in math as well. Those with Low Confidence had only a marginally higher gain score ($M = 111$) in math than those with High Confidence in Self-Intelligence ($M = 104$). Given these findings, the null hypothesis (Ho 3) failed to be rejected. There is no significance between high and low confidence in intelligence of teachers and student gains scores as measured by Scantron Performance Series Median Class Gain Scores.

Test of Hypothesis 4

Ho 4: There is no significance between high and low confidence in intelligence of teachers and the amount of teacher interaction with students in a virtual classroom, as measured by Frequency of Interactions at $p < .05$.

The outcome for this hypothesis was garnered through an ANOVA of the nominal variable, called Teacher Confidence in Self-Intelligence, with two levels within this factor: high and low. The Y-variable was a continuous variable—student gains scores as measured by the difference between pre- and postassessments on defined achievement tests taken in the Fall and Spring of the 2010–2011 school year. Sample participants with a disqualified score of Confidence in Self-Intelligence ($N = 1$) were removed from the sample for this analysis as were those with missing student interaction data ($N = 105$). The results constituted the High ($N = 84$) and Low ($N = 99$) Confidence in Self-Intelligence scores of teachers and the associated academic interactions with students in the virtual classroom.

For each domain, the sum of the six positive interactions types was combined to produce a total for interactions within the domain. When the interaction types were taken as a whole, within both reading ($F[1, 181] = 0.01$, $p = .94$) and math ($F[1,182] = .76$, $p = .38$) there was no statistically significant difference at $p < .5$. Those with Low Confidence in Self-Intelligence had only a marginally higher total mean interaction frequency in reading ($M = 208$) than those with a High Confidence ($M = 204$). Similarly, in math, those with Low Confidence had an insignificant higher total mean interaction frequency ($M = 318$) than those with High Confidence in Self-Intelligence ($M = 264$).

Table 10

Relationship of Confidence in One's Intelligence to Teacher-Student Interaction

Domain	df_1	df_2	F	η^2	p	β
Reading	1	181	0.01	2.82837E-05	0.94	0.050580
Math	1	182	0.76	0.004177236	0.38	0.139498

Note. * $p < .05$ Alpha =0.05

During a secondary analysis, an ANOVA was used to assess each interaction type within the respective domain. Detailed results of each analysis are listed in Table 11. Within the reading domain, those with High Confidence in Self-Intelligence had a notably higher mean interaction frequency employing a Small Group Face-to-Face Reading Interaction (M = 1.98) than those with Low Confidence (M = 0.47; F[1, 172] = 2.30, p = 13); however, this did not reach statistical significance of $p < .05$. Following the same pattern, those with High Confidence in Self-Intelligence had a notably higher mean Missed Interaction Frequency (M = 48.51) for reading than those with Low Confidence (M = 32.3; F[1, 176] = 1.60, p = 0.21). However, again, the interactions did not reach statistical significance of $p < .05$. Within the math domain, a related notable pattern held true for three different interaction types: Web conference (F[1, 164]= 1.84, p = .18); Power Conference: Phone interaction; (F[1, 158] = 1.79, p = 18) and Small Group: Face-to-Face Interaction; (F[1, 156] = 2.22, p = .14). Those with High Confidence in Self-Intelligence had a noteworthy higher interaction frequency employing a Power Conference: Phone interaction (M = 3.23) and a Small Group: Face-to-Face Interaction (M = 4.2) than those with Low Confidence (M = 1.48 and 1.2, respectively). Those with Low Confidence in Self-Intelligence (M = 159) also had a notably higher interaction frequency employing a Web-based conference than those with High Confidence (M = 93). By way of review, Power Conference: Phone describes an interaction that takes place via phone with a student utilizing state specific frameworks to provide one-on-one instruction for the student, followed with a closing conversation with the student's learning coach to provide additional strategies and follow-up activities. Web-based conference describes one-on-one targeted instruction that took place via the Internet.

Table 11

Secondary Analysis: Relationship Confidence in Self-Intelligence to Teacher-Student Interaction Type

Domain	Interaction Type	df_1	df_2	F	η^2	p	β
Reading	Total	1	181	0.01	2.82837E-05	0.94	0.050580
	Web-Based	1	180	0.01	8.0149E-05	0.90	0.051628
	PC: Phone	1	177	0.20	0.001154957	0.65	0.073498
	PC: Web	1	174	1.16	0.006626684	0.28	0.188345
	SG: Web-Based	1	179	0.12	0.000655674	0.73	0.063414
	SG: Face-to-Face	1	172	2.30	0.013188212	0.13	0.325795
	Test Preparation	1	174	0.19	0.001064144	0.67	0.071230
	Missed	1	176	1.60	0.009004228	0.21	0.241896
Math	Total	1	182	0.76	0.004177236	0.38	0.139498
	Web-Based	1	164	1.84	0.011071253	0.18	0.270443
	PC: Phone	1	158	1.79	0.011337321	0.18	0.264946
	PC: Web	1	161	0.64	0.003957168	0.43	0.124954
	SG: Web-Based	1	163	0.06	0.000366475	0.81	0.056792
	SG: Face-to-Face	1	156	2.22	0.014060815	0.14	0.316764
	Test Preparation	1	157	0.00	4.21437E-06	0.98	0.050075
	Missed	1	161	0.08	0.000520031	0.78	0.059530

Note. * $p < .05$, Alpha = 0.05

Given these findings, the null hypothesis (Ho 4) failed to be rejected for both domains. This is to say that there is no significant difference between high and low confidence in intelligence of teachers and the amount of teacher interaction with students in a virtual classroom, as measured by frequency of interactions.

Test of Hypothesis 5

Ho 5: There is no interactive effect of malleable and fixed theory of intelligence high and low confidence in intelligence of teachers on student gains scores as measured by Scantron Performance Series Median Class Gain Scores and Frequency of Interactions at $p < .05$.

The outcome for this analysis was obtained through a two-way ANOVA to assess any interaction between teacher Theory of Intelligence and Teacher Confidence in Self-Intelligence on student gains scores as measured by the difference between pre- and post assessments on defined achievement tests taken in the Fall and Spring of the 2010–2011 school year. Sample participants with a disqualified theory of intelligence ($N = 23$) were removed from the sample for this analysis, as were those with a disqualified score for confidence in self-intelligence ($N = 1$). The results constituted the Malleable High ($N = 016$), Malleable Low ($N = 101$), Fixed High ($N = 26$), and Fixed Low ($N = 32$) dichotomous attributes of teachers and the associated academic gains of students.

Within the domain of reading, theory of intelligence approached statistical significance ($F[1, 261] = 2.31$, $p = .12$). Confidence in one's intelligence independently was not statistically significant ($F[1,261] = 0.18$, $p = 0.67$). However, when taken together to create a dichotomous variable, there was a notable significant interactive effect ($F[1, 261] = 3.84$, $p = 0.05$). According to posthoc tests, the Fisher's Least Significant Difference multiple comparisons report Malleable Low teachers had a noteworthy different mean gain score ($M = 99.2$) in reading than Fix Low theorists ($M = 70.4$). Table 12 details the aforementioned mean gain scores for each of the four groups created by the dichotomous variable of belief of intelligence and confidence in self intelligence.

Table 12

Mean Gain Scores of Fixed-Malleable and High-Low Dichotomous Variable in Reading

Confidence	Malleable Belief	Fixed Belief
High	86.49	90.13
Low	99.25*	70.42*

Note. * $p < .05$, Alpha = 0.05

This relationship did not hold true for math, as seen in previous hypothesis. Within the domain of math, Theory of Intelligence ($F[1, 261] = 0.09$, $p = 0.76$), Confidence in Self-Intelligence ($F[1, 261] = 0.47$), $p = 0.49$), and Interaction ($F[1,261] = 0.06$, $p = 0.8$) between both variables each resulted is no statistical significance at $p < 0.5$.

Table 13

Interaction of Dichotomous Variable: Theory-Confidence to Academic Gains

Domain	df_1	df_2	F	η^2	p	β
Reading	1	261	3.84*	0.014330244	0.05	0.497371
Math	1	261	0.06	0.00023779	0.80	0.057118

Note. * $p < .05$, Alpha = 0.05

Given these findings, the null hypothesis (Ho 5) failed to be rejected for both domains. This is to say that there is no interactive effect of malleable and fixed theory of intelligence high and low confidence in intelligence of teachers on student gains scores as measured by Scantron Performance Series Median Class Gain Scores and frequency of interaction.

Test of Hypothesis 6

Ho 6: There is no interactive effect of malleable and fixed theory of intelligence high and low confidence in intelligence of teachers on the amount of teacher interaction with students in a virtual classroom, as measured by Scantron Performance Series Median Class Gain Scores and Frequency of Interactions at $p < .05$.

The outcome for this analysis was obtained through a two-way ANOVA to assess any interaction between teacher Theory of Intelligence and Teacher Confidence in Self-Intelligence and number of interactions between teacher and students in a virtual classroom. Sample participants with a disqualified theory of intelligence ($N = 23$), disqualified score for confidence in self-intelligence ($N = 1$), and missing interaction data were removed from the sample for this analysis. The results constituted the Malleable High ($N = 64$), Malleable Low ($N = 67$), Fixed High ($N = 13$), and Fixed Low ($N = 21$) dichotomous attributes of teachers and the associated academic gains of students.

For each domain, the sum of the six positive interactions types was combined to produce a total for interactions within the domain. When the interaction types were taken as a whole, similar to hypotheses 2 and 4, within both reading ($F[1,161] = 0.15$, $p = 0.69$) and math ($F[1,161] = 0.14$, $p = 0.70$), the probability level for theories of intelligence, confidence in self-intelligence, and interaction did not reach statistical significance at $p <$ 0.5, resulting in no interactive effect of malleable and fixed theory of intelligence high and low confidence in intelligence of teachers on the amount of teacher interaction with students in a virtual classroom.

Table 14

Interaction of Dichotomous Variable: Theory-Confidence to Interaction

Domain	df_1	df_2	F	η^2	p	β
Reading	1	161	0.15	0.001	0.70	0.067567
Math	1	161	0.14	0.001	0.70	0.066124

Note. * $p < .05$, Alpha = 0.05

A secondary analysis was conducted. Detailed results of each are listed in Table 14. Significant interactive effects were revealed only within the reading domain for three interactions with $p <$. 05; Power Conference Phone ($F[1,157] = 4.81$, $p = 0.03$), Small

Group: Face-to-Face (F[1,152] = 4.76, p = 0.03), and Missed Interactions (F[1,156] = 4.77, p = 0.03). According to posthoc tests, Fisher's Least Significant Difference multiple comparisons, the Fixed High group had the greatest amount of teacher interaction employing a Power conference: Phone interaction (M = 4.15) as opposed to Fixed Low (M = 0.65), Malleable High (M = 2.09), and Malleable Low (M = 1.04).

Table 15

Secondary Analysis: Interaction of Dichotomous Variable: Theory-Confidence to Interaction

Domain	Interaction Type	df_1	df_2	F	η^2	p	β
Reading	Total	1	161	0.15	0.001	0.70	0.067567
	Web-Based	1	159	0.20	0.001	0.66	0.072352
	PC: Phone	1	157	4.81*	0.030	0.03	0.586791
	PC: Web	1	154	0.32	0.002	0.57	0.087293
	SG: Web-Based	1	159	0.65	0.004	0.42	0.126008
	SG: Face-to-Face	1	152	4.76*	0.030	0.03	0.582350
	Test Preparation	1	154	0.16	0.001	0.69	0.068028
	Missed	1	156	4.77*	0.030	0.03	0.583857
Math	Total	1	161	0.14	0.001	0.70	0.066124
	Web-Based	1	164	0.06	0.000	0.80	0.056850
	PC: Phone	1	155	0.08	0.000	0.78	0.058827
	PC: Web	1	158	0.35	0.002	0.55	0.090896
	SG: Web-Based	1	160	0.39	0.002	0.53	0.095601
	SG: Face-to-Face	1	156	0.93	0.006	0.33	0.160048
	Test Preparation	1	154	0.02	0.000	0.88	0.052275
	Missed	1	158	0.33	0.002	0.57	0.087827

Note. * $p < .05$, Alpha = 0.05

Table 16

Interaction Frequency of Fixed-Malleable and High-Low Dichotomous Variable in Reading

	Phone		Face-to-Face		Missed	
Confidence	Malleable	Fixed	Malleable	Fixed	Malleable	Fixed
High	2.09	4.15*	1.2	6.53*	39.04	99.38*
Low	1.04	0.65	0.672	0.0526	37.41	21.85

Note. * $p < .05$, Alpha = 0.05

Similarly, the Fixed High group had the greatest amount of teacher interaction employing a Small Group Face-to-Face interaction (*M* = 6.53) as opposed to Fixed Low (*M* = 5.263158E-02), Malleable High (*M* = 1.2), and Malleable Low (*M* = 0.671875). The Fixed High group also reported the greatest amount of Missed Interactions (*M* = 99.38) as opposed to Fixed Low (*M* = 21.85), Malleable High (*M* = 39.04), and Malleable Low (*M* = 37.41). Given these findings, the null hypothesis (Ho 6) was rejected for the reading domain and failed to be rejected for the mathematics domain. This is to say that there an interactive effect of malleable and fixed theory of intelligence and high and low confidence in intelligence on the amount of teacher interaction with students in a virtual classroom in reading.

Other Findings

Several other aspects of teacher characteristics, interactions, and academic gains were assessed. Although these items were not directly associated to the hypotheses, they were important to the contextual understanding of the differences in results across domains.

First, a cross tabulation of the Theory of Intelligence according to school size characteristics, total years teaching, years teaching online, and level of education was conducted in order to understand the distribution of the theory according to these characteristics. The findings from each of these analyses are depicted in Figure 7 and reveal that for each characteristic (school size, total years teaching, years teaching online, and level of education), the representation of fixed and malleable theories was proportional across characteristics.

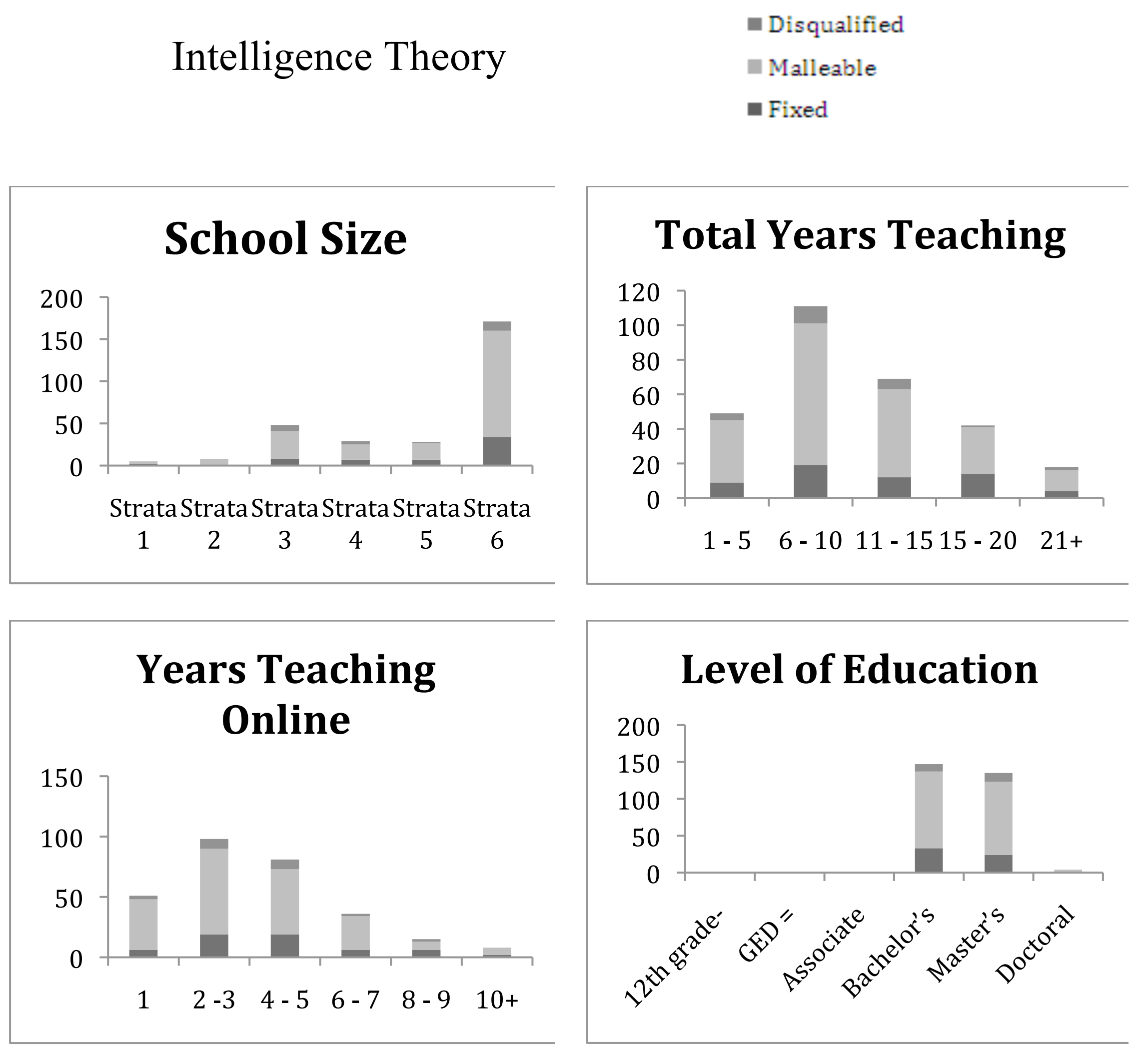

Figure 7. Distribution of intelligence theory according to school size and teacher characteristics.

Second, a cross tabulation of the Confidence in Self-Intelligence according to school size characteristics, total years teaching, years teaching online, and level of education was conducted in order to understand the distribution of the theory according to these characteristics. The findings from each of these analyses are depicted in Figure 8 and reveal that for each characteristic (school size, total years teaching, years teaching online, and level of education), the representation of high and low confidence in self-intelligence was proportional across characteristic.

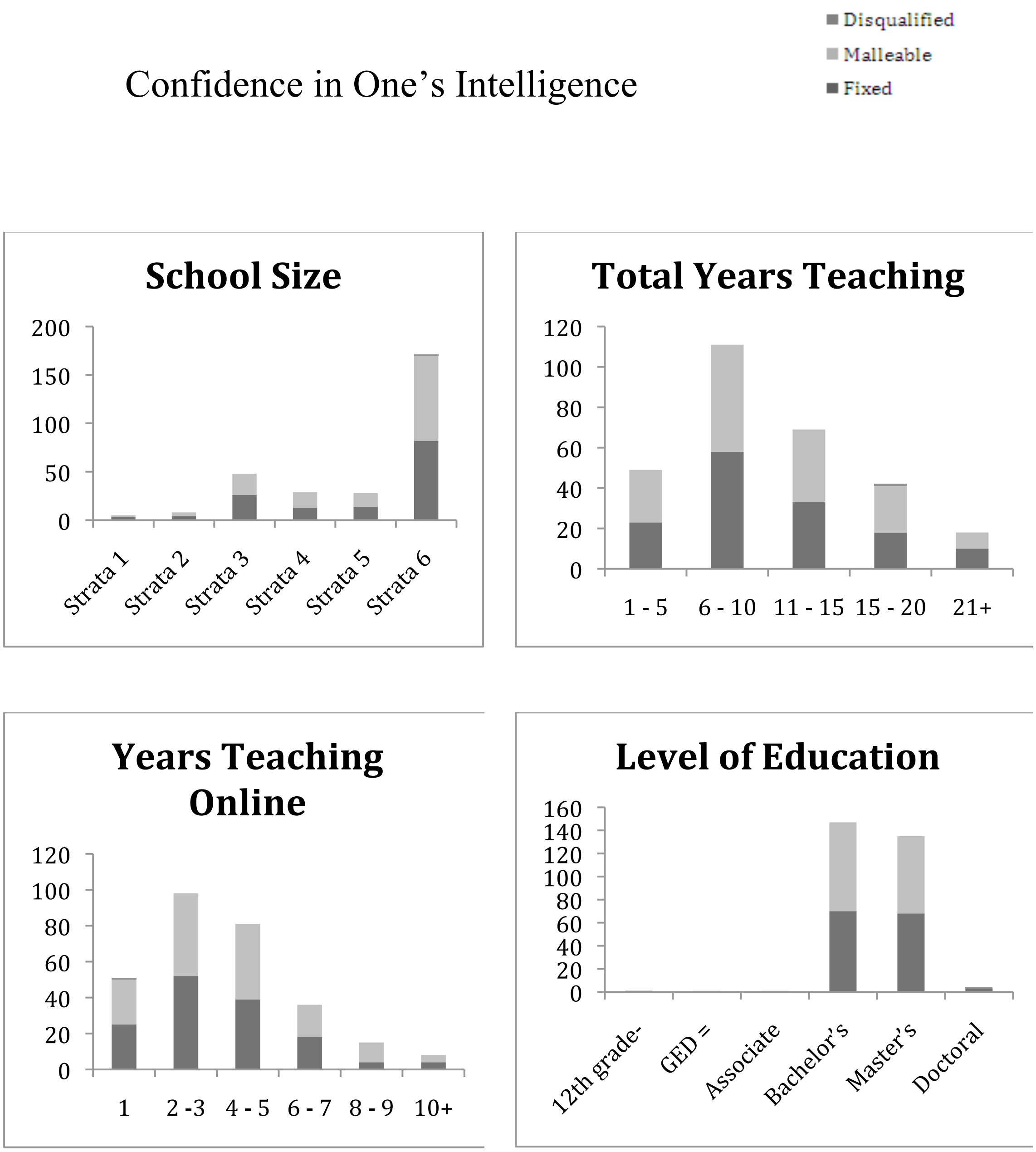

Figure 8. Distribution of confidence in self-intelligence according to school size and teacher characteristics.

Third, a cross tabulation of the Reading Interactions according to school size characteristics, total years teaching, years teaching online, and level of education was conducted in order to understand the distribution of the reading interactions according to these characteristics. The findings from each of these analyses are depicted in Figure 9. Naturally, one may assume that an increase in school size would result in a greater number of interactions resulting from the increased number of students for whom an interaction is documented. However, this did not bear out in the results, as the cumulative number of reading interactions for teachers in strata 5 schools (enrollment 3,000–5,499 students) had less than 5% of total reading interactions. Teachers in strata 3 schools (enrollment 1,000–1,999 students) reported 20% of total reading interactions, which was the second highest proportion of reading interactions when compared to teachers in strata 6 (61%). Similarly, the distribution of reading interactions across total years teaching was not normally distributed as the greatest amount (41%) of reading interactions were reported by teachers with 6 to 10 years of total teaching experience, as would be expected given that they constitute the largest proportion of the sample (38%). However, those with 15 to 20 years of total teaching experience constituted only 15% of the sample and reported 28% of the total reading interactions. When the focus of analysis was further refined to years teaching online, the distribution of reading interactions resulted in a normal distribution proportional to the sample. The same principle applied to level of education, which did not reveal any abnormalities in distribution.

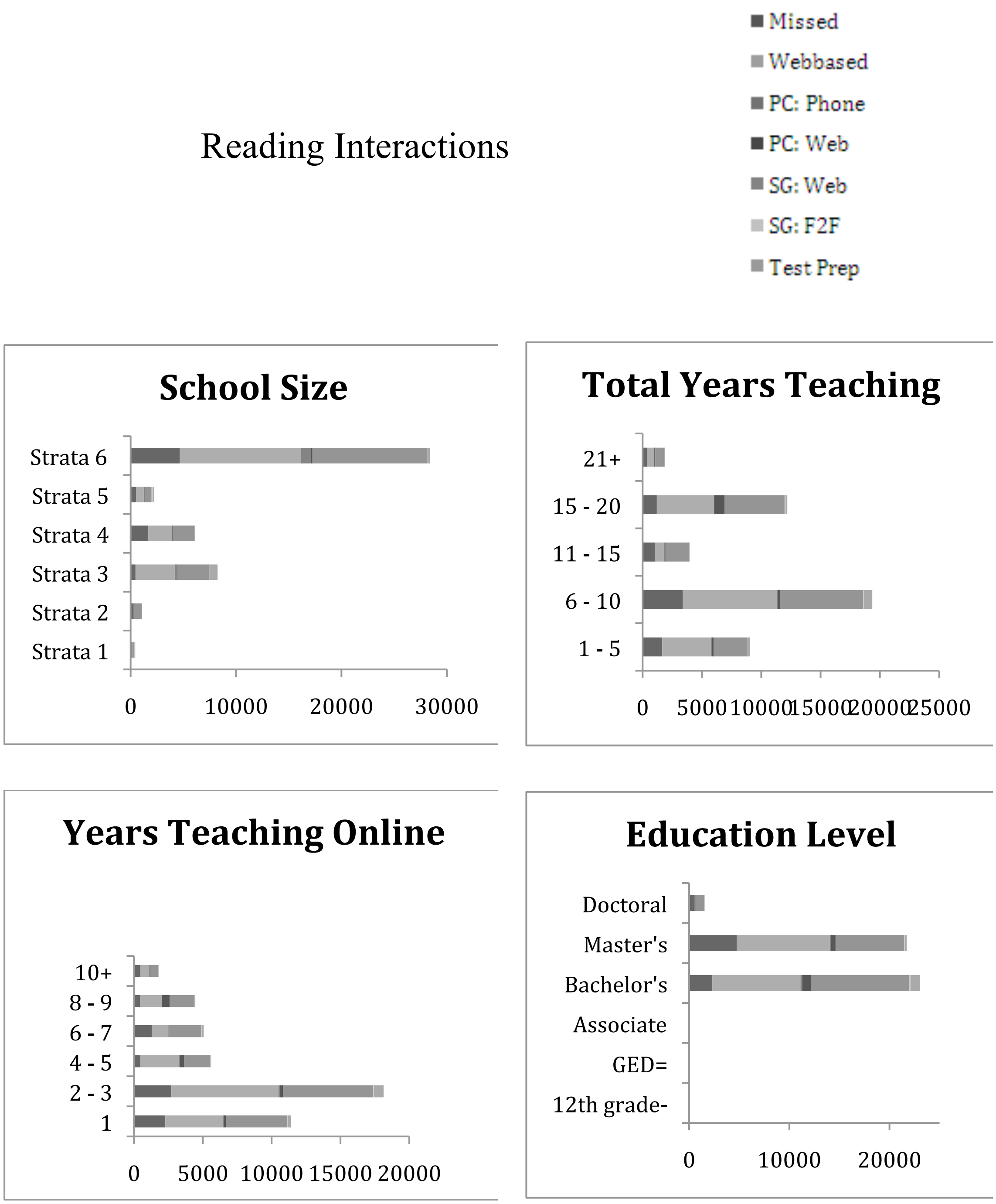

Figure 9. Distribution of reading interactions according to school size and teacher characteristics.

Fourth, a cross tabulation of the Math Interactions according to school size characteristics, total years teaching, years teaching online, and level of education was conducted in order to understand the distribution of the math interactions according to these characteristics. The findings from each of these analyses are depicted in Figure 10. Similar to reading interactions, the distribution of math interactions was not normally distributed across school size characteristics and total years of teaching experience. Once again, strata 6 schools reported the greatest amount of math interactions (69%) with strata 3 schools (14%) next. Similar to reading, teachers with 6 to 10 years of total teaching experience reported the greatest amount of total math interactions (40%). Teachers with 15 to 20 years of experience reported the second highest amount of total math interactions (24%). When the focus of analysis was further refined to years teaching online, the distribution of reading interactions resulted in a normal distribution proportional to the sample. The same principle applied to level of education, which did not reveal any abnormalities in distribution.

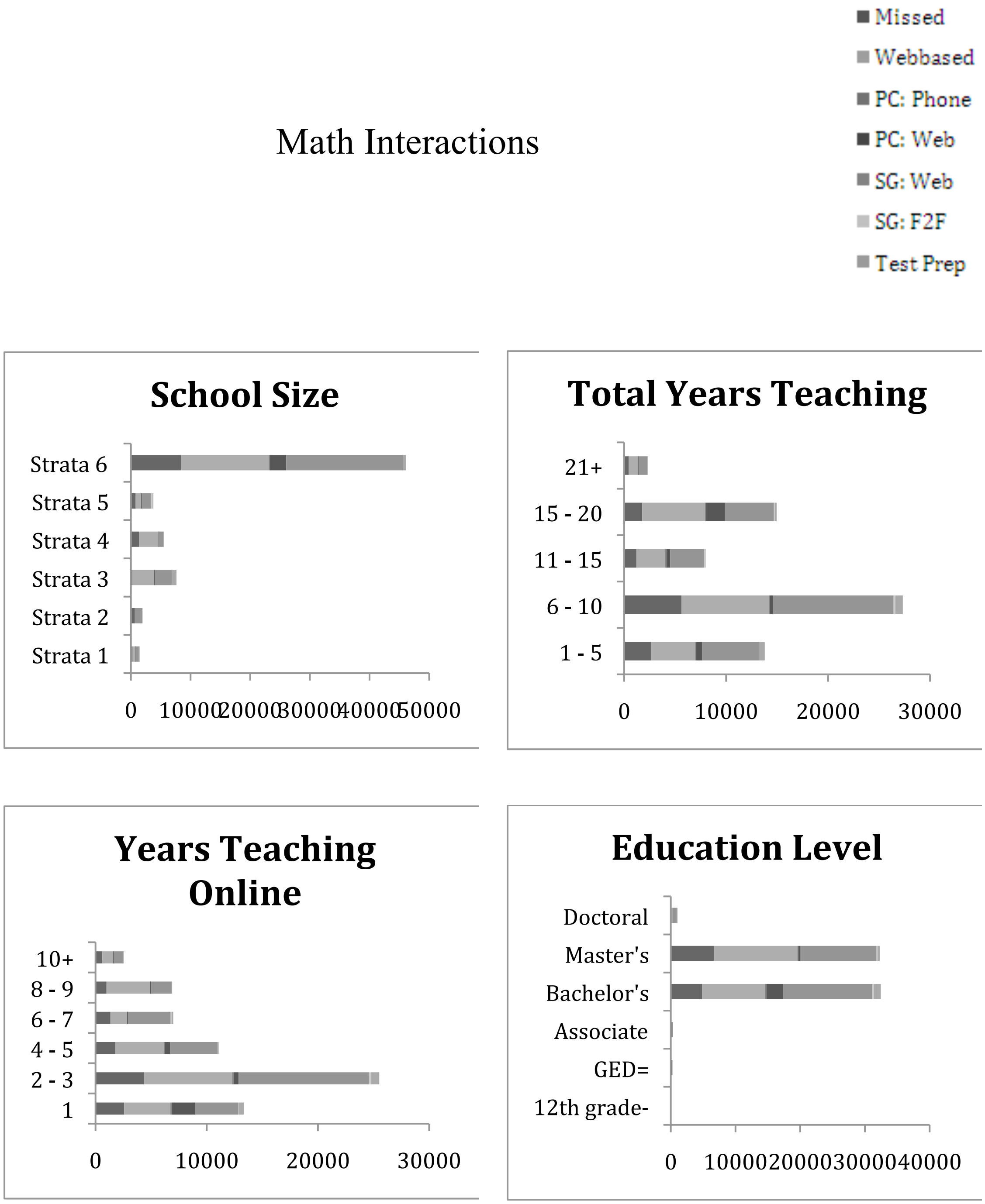

Figure 10. Distribution of math interactions according to school size and teacher characteristics.

Finally, a cross tabulation of the Academic Gains according to school size characteristics, total years teaching, years teaching online, and level of education was conducted in order to understand the distribution of the academic gains according to these characteristics. The findings from each of these analyses are depicted in Figure 11. With few exceptions, academic gains in the math domain were consistently higher across each cross-tabulation. According to school size characteristics, teachers in strata 2 (enrollment 500–999) were the only group with a notably lower math gains score (88) than reading gain score (94.5). The significant difference in this strata deviated from the parallel declining gains in both academic domains as school size increased. That aside, the pattern of consistently higher math gain scores was again evidenced in total years teaching and years teaching online; however, level of education posed mixed results. Teachers possessing a General Equivalency Diploma or equivalent appeared to have higher reading gain (94) than math gains (85), which is greater than the mean reading gains scores of teachers with Bachelor's degrees (84); however, it is essential to note the sample size of one within the demographic of General Equivalency Diploma or equivalent. Along similar lines, another abnormality was evidenced in the reading gains scores (100.5) of those holding a Doctorate as opposed to math gain scores (93.5), as this demographic did not follow the trend of greater math gain scores. However, it is essential also to make note of the small sample size ($N = 4$) for this subgroup.

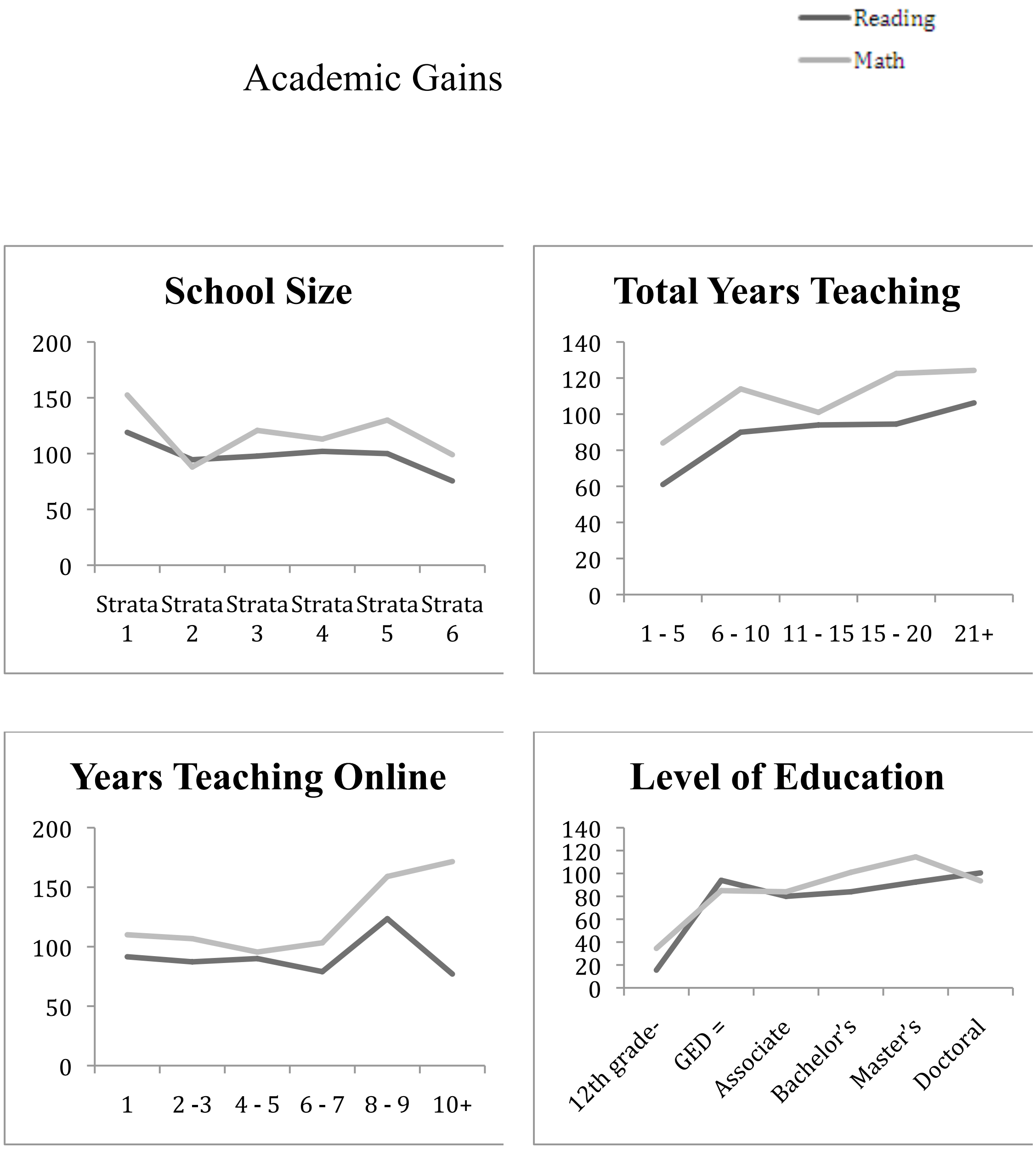

Figure 11. Distribution of academic gains according to school size and teacher characteristics.

Overall it was evidenced that school size and a teacher's total years of teaching experience had an effect on teacher-student interactions. Teachers in midsize online schools (strata 3) demonstrated the proportionally greatest number of teacher-student interactions across both domains. Teachers with 15 to 20 years total years of teaching experience as well displayed the maximum proportion of teacher-student interactions across both domains.

Analysis

The present sample consisted of functionally equivalent online teachers, teaching at one of 18 cyber charters selected for the study, with a preponderance of the sample holding a belief in malleable intelligence. The scoring of confidence in one's intelligence naturally produced an even split between high and low confidence in self-intelligence among the sample. Analysis of the sample's characteristics revealed a normal distribution of participation according to school size, total years teaching experience, years teaching online, and level of education. However, there was a sharp difference in the overall academic gains and teacher-student interactions across domains. Within the math domain, there was a markedly higher amount of teacher-student interactions and an overall greater math gain score when compared to reading. The contrast in greater frequency of interaction and higher academic gains did not translate to a direct correlation. On the contrary, results indicated that only within the reading domain there existed a positive direct relationship between total number of interactions and increased academic gains.

The importance of role of teacher beliefs about intelligence emerged in this study. Teachers reporting a belief in malleable intelligence had notably higher class achievement rates in reading, as revealed in the testing of hypothesis 1 ($F[1, 263] = 2.64$, $p = .10$). While the same cannot be said of math class achievement gains, there was a direct positive relationship ($r^2 = 0.1113$) between math and reading achievement gains, leading to the conclusion that any relationship that does exist between math and teacher belief of intelligence is indirect.

Moreover, teachers reporting a belief in malleable intelligence also had a notably higher level of teacher-student interaction frequency in reading. They initially appeared to differ in the approach to students, as this group reported the highest level of web-based reading interactions, as opposed to teachers holding a fixed view of intelligence who reported small group face-to-face interactions with the greatest frequency. However, the differences in approaches did not attain statistical significance as seen in Hypothesis 2.

Initially, teacher's confidence in self-intelligence did not manifest a significant relationship with achievement gain scores, as evidenced through testing of Hypothesis 3. However, when combined with teachers' beliefs about intelligence, an interactive effect was clearly identified. The results pointed to the sharp and notably greater class reading achievement gains of teachers holding a malleable belief in intelligence with low confidence in self-intelligence over teachers with a fixed belief and low confidence (F[1, 261] = 3.84, $p = 0.05$).

Moreover, is the marked difference of the impact of confidence in self-intelligence to teacher-student interaction in the reading domain. In testing of hypothesis 4, teachers reporting high confidence in their own intelligence interacted with students at a greater frequency in reading through small group face-to-face meetings and in math through phone and face-to-face meetings. However, the high confidence group also reported missed scheduled teacher-student interactions at a greater rate in reading. Teachers reporting low confidence in their own intelligence, had interactions with students at a greater frequency in math through web-based conferences. While notable, the probability strength did not reach statistical significance at $p < .05$. When confidence in self-intelligence was combined with teachers belief's about intelligence, a clear interactive effect was noted. Teachers holding a belief system in fixed intelligence coupled with high confidence in their own intelligence had a significantly different and greater amount of small group face-to-face and phone interactions only in the reading domain through tests of hypothesis 6. This group also had a significantly greater amount of missed scheduled teacher-student interactions than other groups.

Other findings important to the contextual understanding of the differences revealed the importance school size and teachers' overall teaching experience. Overall, it was evident that school size and a teacher's total years of teaching experience had an effect on teacher-student interactions. Teachers at midsized schools or with 15 to 20 years of overall teaching experience had the greatest frequency of teacher-student interaction across both domains.

Summary

This chapter described the response rate, demographics, and characteristics of the 298 online teachers from 18 cyber charters who were sampled for this study. The statistical procedures and considerations for participant exclusion from analysis and need for secondary analysis were explained in detail for each of the six research hypotheses. The findings were explained through acceptance or refusal of each null hypothesis, with further justification displayed in both graphic and tabular form. Further, an analysis was provided to associate the conclusions provided for each null hypothesis back to the original research questions. Chapter 5 relates the findings of this study to the literature review and presents some conclusions on the relationship of beliefs of intelligence and confidence in self-intelligence to teacher-student interaction and student outcomes. Implications of the findings and suggestions for future research also are provided.

Chapter 5: Discussion, Implications, and Recommendations

Overview and Discussion of Framework

The landscape of K-12 teaching has dramatically changed as a result of the increase in online education. Much is still unknown about the impact of the online teacher's role let alone the teacher knowledge, attitudes, and dispositions required by effective K-12 online teachers. A review of the literature raises concerns about the recruiting, hiring, and development of high-quality online teachers. The concern is raised in light of the selection criteria, which is typically based on the federal standard of Highly Qualified Teachers as defined by the No Child Left Behind Act, and the limited preparation online teachers receive through traditional education programs, leaving local online programs with the overwhelming responsibility of online teacher preparation (Dawley et al., 2010; Picciano & Seaman, 2009; Rice & Dawley, 2007; Rice et al., 2008).

The current federal reform effort to identify high-quality teachers is limited in its conceptualization of teacher learning, as researchers have demonstrated the inadequacy of measuring learning characteristics through the measurement of degrees, course work, test scores, and years of experience. This approach overestimates the influence of personal characteristics or discrete fixed traits. Furthermore, it does not account for the continuously shifting demands and situational factors requiring teachers to accommodate and account for incursions into the learning environment.

Historically, educational theory and research suggest that teachers who are learners make a difference for student learning. Recently, social cognitive psychology and neuroscience research has demonstrated a key finding that beliefs about intelligence influence learning success. During more than 15 years of research with students, children, and adults, Dweck has repeatedly compared the responses to challenge and failure of entity theorists (fixed trait) and incremental theorists (malleable trait) as they relate to beliefs of intelligence. Entity theorists' belief of intelligence as a fixed trait commonly results in disengagement from challenge and learning opportunities stemming from an emphasis on performance goals and validation of existing intelligence. This set of responses is distinct from incremental theorists whose belief in malleable intelligence affords a superior rate of recovery from occasional failures and provides space for openness to feedback. Applying this notion to teachers as learners, an incremental theory of intelligence would position a teacher as both a performer and a learner, continually adapting in tandem with feedback and according to the needs of students. Unlike personal characteristics or fixed traits, the association of influence of beliefs of intelligence to rebounding from failure and seeking challenges describe the essential underlying axioms bearing fruit for the willingness to learn.

The purpose of this empirical inferential study was to examine teacher belief about intelligence and the relationship with teacher-student interactions and student outcomes. In addition, the study attempted to gain insight into the role of teacher confidence in one's intelligence and the relationship with teacher-student interactions and student outcomes.

Restatement of Research Questions

The following research questions were used to guide this study. According to Theory of Intelligence Scale and Confidence in One's Intelligence Scale:

1. What is the impact, if any, of teacher theory of Intelligence on student achievement gains scores?

2. What is the impact, if any, of teacher theory of Intelligence on amount of interaction with students in virtual classes?
3. What is the impact, if any, of confidence in one's intelligence on student achievement gains scores?
4. What is the impact, if any, of confidence in one's intelligence on amount of interactions with students in virtual classes?

Review of Findings

The importance of the role of teacher beliefs about intelligence emerged through the administration of an online questionnaire to 298 online teachers from 18 cyber charter schools sampled for this study. Findings were explained through acceptance or refusal of each null hypothesis associated to the four research questions. After each hypothesis was addressed, the researcher identified four key findings:

Teacher theory of intelligence has a direct impact on the student achievement gains. Teachers reporting a belief in malleable intelligence had notably greater class achievement rates. Moreover, this group approached a significantly different interaction style, reporting the highest level of web-based one-on-one reading interactions, as opposed to teachers holding a fixed view of intelligence who reported small group face-to-face interactions with the greatest frequency.

Confidence in one's intelligence manifested a key impact on student literacy gains only when combined with teacher's belief about intelligence. Teachers reporting a belief in malleable intelligence with low confidence attained the greatest level of achievement gains. Fixed theorists with low confidence resulted in devastating lower literacy gains and limited teacher-student interaction. Fixed theorists with high confidence had a significantly greater amount of small group face-to-face and phone interactions while also reporting missed scheduled teacher-student interactions at the highest frequency.

Other important findings revealed that school size and a teacher's total years of teaching experience had effects on teacher-student interactions. Teachers at midsized schools or with 15 to 20 years of overall teaching experience had the greatest frequency of teacher-student interaction across both domains.

Conclusions

Based on the responses from the 298 online teachers combined with archival data from documented teacher-student interactions and student achievement gains, the following four conclusions can be drawn about the impact of teachers belief of intelligence and confidence in their own intelligence: (a) teacher belief in the malleability of intelligence positively affects student learning in literacy, which subsequently impacts math achievement; (b) teachers' belief in intelligence alone is not an effective predictor of teacher-student interaction frequency; (c) teachers' confidence in one's intelligence alone is not an effective predictor of class achievement gains; and (d) once teachers' confidence in intelligence is combined with online teacher framework for intelligence, it serves to predict the population that will attain significantly different literacy gains and resort to using increased frequency of known strategies as the primary means for interacting with students, and the population that will seemingly disengage through limited teacher-student interaction.

Each of the study participants demonstrated his or her interest in continuing to pursue the field of online teaching through completion of 2 or more years of service and return to the virtual classroom. Overwhelmingly, the preponderance of respondents expressed their beliefs in the malleability of intelligence, which subsequently resulted in greater reading gains for students. Math achievement gains were indirectly related to teacher belief of intelligence, as they were dependent upon literacy gains.

The online structure of the virtual classroom affords teachers a variety of options for interacting with students through various grouping and communication strategies, which can vary from one-on-one to small group instruction that takes place face-to-face, via phone, or through web-based conferencing. Teachers reporting malleable and fixed theories of intelligence appeared to use a diverse set of communication tools to interact with students across domains at varying frequencies. However, despite the interaction types, it was the teachers who held a malleable theory of intelligence who attained higher literacy achievement gains.

Confidence in one's intelligence had impacts on student achievement gains scores; however, not as plainly as one may presume. Confidence alone did not impact teachers' class achievement gains; however, when combined with teachers' framework of intelligence, the influence of confidence was illuminated. High confidence was not a prominent factor in the achievement gains of teachers holding a fixed or malleable belief in intelligence. However, the difference between the greater achievement gains attained by malleable low confidence teachers and the despairingly poorer gains attained by fixed low-confidence teachers was significant.

Similar to the influence on student achievement, the role of teacher confidence had a greater impact on the amount of interactions with students in a virtual class once combined with teachers' framework of intelligence. Low-confidence teachers with a fixed framework seemingly had the lowest levels of all seven documented forms of interaction whereas high-confidence teachers within the same framework demonstrated a preference for small group face-to-face and phone interactions while also reporting missed scheduled interactions with the greatest frequency. The interaction patterns of high-confidence teachers holding a malleable belief of intelligence was similar to that of low-confidence teachers within the same framework of intelligence, which serves to reinforce the notion that belief of intelligence is central to understanding teacher behavior.

The intention of this study was not to define intelligence, but rather a simple approach of demonstrating the powerful advantages of increased learning gains that are afforded to students through the provision of a teacher holding a belief that intelligence is expandable. Evidently, teachers' confidence in their own intellectual ability is secondary to the fundamental belief of expandable intelligence from which recursive behaviors originate. The confidence teachers need is not that they have a certain level of intelligence or ability to learn. Instead, teachers benefit from the confidence that anyone can learn through the use of different strategies and continued attempts applied toward the learning goal.

Integration With Literature

Educational theorists and researchers, dating back to Dewey, have historically emphasized the importance of an orientation toward learning as a pillar of teacher quality. They have determined groupings of metacompetencies, metaskills, and cognitive structures as essential factors to possessing fruitful learning dispositions. Social cognitive theory has emphasized the central role a belief in incremental versus fixed intelligence plays in creating space for learning, exemplified through remaining open to feedback, creating learning goals, and rebounding from failure.

A review of the literature in Chapter 2 showed that theorists of intelligence have not agreed upon a single construct for human intelligence; however, a presumption of fixed intelligence has early roots dating back to the development of IQ testing. The evolution of the federal government's role in education has contributed to the emphasized use of a state standardized testing and a readily used psychometric approach to evaluate student academic achievement. As a result, it is this explanation of intelligence that pervades education, creating a tension between teacher theory of intelligence and teacher-student interactions and subsequently impacting student outcomes. Several researchers, including Haberman, recognize the value of addressing teacher beliefs as a promising medium for adjusting teacher decisions and behaviors, thereby stimulating effective teaching practices leading to increased student learning. With 75% of programs classifying 25% or more of the student enrollment as at-risk students, it is clear that teacher selection and preparation to teach online is essential for serving the learning needs of these students. Identification of at-risk students and differentiating instruction to meet the needs of diverse populations is not part of current professional development programs for the majority of K-12 online teachers (International Association for K-12 Online Learning, 2010; Rice & Dawley, 2007).

Influence of beliefs and expectations. This study supports literature on teacher beliefs and student achievement and can be directly compared to previous studies conducted by Butler (2000), Rheinberg (1983), and Rubie-Davies et al. (2006), which demonstrate the relationship of reading performance to teacher expectations. Butler

(2000) and Rheinberg (1983) demonstrated that teachers endorsing a fixed (entity) belief system build future inferences of student performance on early scores, which implies the constancy of teacher beliefs and establishes student perceptions. Furthermore, according to Rheinberg, teachers endorsing an incremental (malleable) belief system preferred to employ individual reference norms over social norms, tend to work flexibly, individualize their instruction, and respond sensitively to diverse student learning needs.

The primary finding in the present study was that teachers holding a Malleable (Incremental) theory of intelligence produced notably higher reading gains than those holding a Fixed (entity) theory. The theory of intelligence alone was an essential contribution to the production of sizeable differences in literacy gains despite consideration of other factors, including total years or teaching experience, school size, and level of education. In light of the positive and direct relationship between reading and math achievement gains, it was determined that the impact of belief in intelligence with math gain is indirect and dependent upon reading. This study, along with others, compared the expectations and beliefs of teachers to subsequent student gains. These gains demonstrate the direct and positive impact of holding a positive belief system as opposed to the negative and debilitating effects for teachers demonstrating low confidence and fixed-ability beliefs. The important distinction that is essential to note is the difference in population, as previous studies were conducted with traditional face-to-face classroom teachers. Clearly, the belief system of the virtual classroom teacher continues to be an essential variable in providing students with optimal learning opportunities and environments.

Confidence. This study separated beliefs and confidence and supports what was previously demonstrated. Although previous research has identified a correlation between confidence and achievement, it has met with mixed results and demonstrated only a low positive relationship (Hansford & Hattie, 1982). Furthermore, rather than serving as a stable factor, confidence may simply serve as a mediating factor reflective of recent performance (Dweck et al., 1995). Attempts to learn do not consistently lead to the desired attainment level and thereby require a change in direction or strategies.

As evidenced in this study, teachers' confidence in their own intelligence did make a difference in student literacy achievement gains; however, only when it is combined within the context of how teachers consider intelligence. Teacher's conceptualization of intelligence played a more fundamental role than confidence in predicting achievement gains. Within the fixed (entity) theory, no matter what one's confidence is, failure and difficulty still imply low intelligence (Dweck, 1999). It is the framework, or belief, that gives meaning to outcomes, both positive and negative, and, to an extent, creates an attribution of confidence to a source of ability or intelligence. Similar to the findings of Dweck et al. (1995), the literacy achievement gains for fixed high-confidence teachers were as high as those of the malleable theorists, while their approach to student interaction, discussed later, more closely resembled interaction styles of fixed low-confidence teachers, only with greater frequency. Low confidence within the fixed mind-set seemingly strengthened the negative ability attribution, resulting in significantly lower class literacy achievement gains. Confidence within the malleable (incremental) framework did not make a difference, but rather it was malleable low-confidence teachers who demonstrated the greatest and most positive impact upon student learning.

Teacher-student interaction theory. This study supports the literature on teacher belief, concluding that the theoretical orientations possessed by teachers are used to organize and activate instructional behavior. In an online virtual classroom, instructional behavior may include incorporation of asynchronous and synchronous interactions between teacher-student, student-student, and student-content. Interactions initiated by a teacher occur to address the delivery of academic content; it is these interactions that also serve to develop the teacher-student relationship and establish students' sense of interpersonal connectedness to the class and school community (Palloff et al., 2007; Zucker & Kozma, 2003). The online instructor effects were examined through one strand of interaction described by Bernard's et al. (2009) equivalency theorem, which suggests that varying combinations of interactions (student-student, student-teacher, student-content) can be provided in variable frequencies to diverse groupings of students in order to provide students with equivalent interaction opportunities to attain similar academic outcomes.

Within the present study, teacher belief and confidence independently were insufficient to inform teacher behavior. Yet when both variables were considered together, an interesting story emerged. Teachers holding a malleable theory of intelligence appeared to have greater overall interaction frequency in reading than those with a fixed theory, demonstrating their motivation to interact with students. The difference became more nuanced as those with a belief in malleable intelligence provided the greatest amount of one-on-one targeted instruction that took place via web-based conference involving only the teacher and student. Rather than using a readily used method of communication taught in traditional education programs, malleable theorists expanded their repertoire to venture into new instructional approaches. Those with a fixed framework of intelligence demonstrated their preference for interaction by employing a significantly higher rate of small group face-to-face sessions with groups of students for reading. That is, this group demonstrated through their actions a reliance on known strategies and solutions by using a medium of communication that was not foreign to them rather than employing a new and different medium of instruction.

Confidence did not produce a different result in cumulative interaction frequency; however, there were notable differences between high- and low-confidence teachers and the amount of discrete teacher-student interaction across both domains. The instructional preference of high-confidence teachers was similar to the fixed theorists to the extent that the high-confidence teachers had a greater frequency of small group face-to-face interaction in both reading and math. In math, high-confidence teachers also demonstrated a greater frequency of phone interactions while low-confidence teachers demonstrated a greater frequency of Web-based conferences. Yet it was the high-confidence group that also reported missed scheduled and required reading interactions with students at a greater frequency. However, it was insufficient to consider confidence alone as the instructional behavior if more fully informed when confidence was considered within the framework of intelligence.

The effect of combining intelligence beliefs and confidence revealed a marked difference in instructional behavior, specifically in reading but not in math. When compared to other groups, fixed high-confidence teachers had a greater rate of small group face-to-face and phone interactions for reading while also reporting missed scheduled interaction at a significantly higher rate for reading. It is true that fixed low-confidence teachers reported the fewest number of missed interactions; however, this report was not isolated to missed interaction alone, as fixed low-confidence teachers reported the fewest number of interactions across all seven categories of interactions. Perhaps the instructional behavior of fixed low-confidence teachers most strongly reflects the combined effect of attribution to a fixed ability (or intelligence) for students and for their own intelligence. Within the malleable framework, confidence did not play a significant role, as it did not serve to intensify the tendency toward employing one interaction type over another.

In short, synchronous communication affords personal learning dimensions that are considered more social, as in resembling natural conversations. Consequently, this leads to increasing psychological arousal and motivation for participation. Alternatively, asynchronous communication offers time to reflect, process information, and contribute quality responses to discussions. However, it is insufficient to categorize simply the types of communication into two media regardless of their quality. What is of essential importance is the type and quantity of interactions that contribute to student outcomes (Bender, 2003). Teachers holding a malleable theory of intelligence seemingly demonstrated their belief in expandable intelligence by making the most of a variety of communication strategies to engage with students on an individual basis. The variation in the communication strategy may ostensibly be what led to greater literacy achievement gains by students. Confidence in one's intelligence when considered independently distinguished different utilization of communication tools. High confidence led to the use of known methods of instruction in the form of face-to-face or phone conversations whereas low confidence was more closely associated to web-based interaction, which may be considered innovative in the realm of instructional strategies. However, confidence did not appear to have as strong of an impact when considered independently. It is only when combined with the fundamental belief in intelligence that interaction preferences and frequencies became significant. Within the Fixed theory, high confidence significantly improved the frequency of teacher-student interaction. Conversely, low confidence did not bear out the same between both theories, as it did not result in limited or reduced interactions within the malleable mind-set. However, within the fixed mind-set, low confidence may have led teachers to fault their own intelligence, subsequently resulting in a helpless reaction demonstrated through limited teacher-student interaction.

Implications

Using Theory of Intelligence as criteria for selection of new online teachers is an essential practice for schools seeking to establish online learning programs or hiring online teachers for existing programs. Specifically, the six combined questions from the Theories of Intelligence Scale and Confidence in One's Intelligence scale can be added to routinely used teacher selection instruments or processes used as a basis to inform hiring decisions. Selecting malleable framework of intelligence is significant because online teacher quality and learning orientation matter. While online teachers may not provide daily instruction in the direct presence of students, their belief system has a direct impact on teacher-student interactions and, subsequently, academic gains of students. Consequently, teachers who do not hold a belief or expectation that intelligence is malleable may create an incomplete or negative learning environment. Conceivably, providing professional development and guiding existing teachers holding a fixed theory of intelligence through a change to a malleable one may help teachers to cope with challenges, obstacles, and difficulties, resulting in positive outcomes for students.

Confidence in One's Intelligence is an important factor once the core belief of intelligence has been established; however, it cannot serve to reconcile for the effects of the foundational belief of intelligence, as low confidence within the fixed mind-set has debilitating effects on reading academic gains. Moreover, for a teacher new to online teaching encountering a new learning environment of his or her own, one riddled with continuous change and challenge, using confidence as a measurement may serve to provide a reflection of past achievements rather than a predictor of success in the new environment.

For schools seeking to provide guiding policy or expectations related to student interaction, it is essential to note the sizable literacy gains achieved in part through one-on-one student-teacher interaction. The increased one-on-one interactions facilitated by malleable theory teachers may apparently be a demonstration of the sensitivity of expert teachers to the knowledge within the discipline that is especially hard for the student to master, subsequently facilitating the appropriate interaction according to the needs of the student. However, the path to increased learning gains is not as simple as added student-teacher interaction, as evidenced in math. Students may experience greater learning gains across this domain for other reasons not fully explored within the scope of this study, including, but not limited to, greater student-content or student-student interaction.

Recommendations for Future Research

This study examined the relationships of K-12 online teacher beliefs of intelligence to student academic gains and interactions with students in a virtual classroom. The results can be used to help inform the hiring and development of full-time online teachers. Policy makers searching to redefine the measure of online teacher quality may also find the data from this study useful.

While this study explored the relationship of online teacher beliefs of intelligence to student achievement gains, a limitation in the sample size may have prevented attainment of statistical significance at predefined thresholds. Future research with a larger sample allowing for disaggregation of effects across K-12 grade levels could further inform the impact of teacher beliefs on academic gains according to grade level. Along this line of research, the larger sample could provide opportunity for further investigation into frequency of interactions in light of the three interactions that did attain statistical significance (small group face-to-face, phone, and missed interactions).

The use of a hierarchical regression model considering student-student and student-content as additional variables will address limitations presented in this study. Evidently, within the present study, all students in a virtual classroom did not have the same level of student-teacher interaction. Despite the differentiated approach to teacher-student interaction, there was a direct correlation only in reading between student-teacher interaction frequency and increased academic gains. This is important to note, as it makes visible the need to consider additional strands of interaction in order to determine the effects of the online instructor to student achievement. Bernard et al. (2009) found the combinations of student-student and student-content, and student-teacher and student-content produced better achievement outcomes than student-student and student-teacher. Based on Bernard et al.'s findings, this is important, as rather than simply counting student-teacher interactions, it is also important to understand additional strands of interaction in order to put in context the impact of online teacher behavior.

Future research could be conducted in various blended formats and in other cultures to gain a better understanding of the cultural differences in attribution. While there is no agreed upon meaning of intelligence, Binet's development of IQ tests and the U.S. Federal approach to the measurement of intelligence through a psychometric approach may have reified the notion of fixed ability; however, future studies in other cultures will elucidate differences among various cultures.

Another study might be conducted to extend research to discover how the beliefs are manifested in virtual classroom through a qualitative or mixed-methods study. A limitation of this study was the broad range of the scope used to define teacher-student interaction, despite the categorization into seven interaction types. A web-based or phone conference could have varied from a routine, mechanized script, which was not individualized to the student. Consequently, it had no impact on the student beyond the realization that he or she was accountable to another. It was an interaction that targeted a specific objective and emphasized that the student had the power to change, subsequently guiding the student and strengthening the teacher-student relationship. Similarly, the small group face-to-face interactions could have ranged from a mere gathering of students intended to facilitate a programmed lecture to one that removes the sage from the stage and creates opportunities for student-student and student-content interaction, leading to student engagement and community building.

Summary

The vigorous expansion of online learning in K-12 education is a recent change to the conceptualization of schooling that has been occurring for more than 10 years. However, methods used for recruiting, hiring, and preparing online teachers have not been altered beyond the current federal standard defined by No Child Left Behind of Highly Qualified Teachers in order to provide students with teachers demonstrating an orientation toward learning. Historically, educational theory and research suggest that teachers who are learners make a difference for student learning. Recently, social cognitive psychology and neuroscience research has demonstrated a key finding that beliefs about intelligence influence learning success.

The purpose of this empirical inferential study was to examine teacher belief about intelligence, teacher confidence in one's intelligence, and the relationship with teacher-student interactions and student outcomes through the administration of a nine-item online questionnaire. Using the Theory of Intelligence Scale and Confidence in One's Intelligence Scale, created by Dweck, combined with student academic gains from the 2010–2011 Fall and Spring Scantron Performance Series assessments, and archived documentation from the internal communication system, data for 298 randomly selected K-12 online teachers serving as a primary teacher of record for one of 18 cyber charter schools, managed by the same education management organization, were used to address six null hypotheses and four research questions.

Findings suggest teacher belief in the malleability of intelligence positively affects student learning in literacy, which subsequently impacts math achievement. This affirming belief of intelligence shapes teacher behavior evidenced through greater interaction with students in a virtual classroom using a diverse set of interaction strategies. Teachers' confidence in one's intelligence alone was not an effective predictor of class achievement gains. However, once teachers' confidence was combined with their framework for intelligence, it served to identify the population that resorted to using known strategies as the primary means for interacting with students and the population of online teachers that seemingly disengaged through their limited teacher-student interaction.

For schools seeking to hire online teachers, using theory of intelligence as a criterion for selection provides instrumentation measuring the learning orientation of teachers. Using the criterion to hire teachers reporting a malleable framework of intelligence holds powerful advantages, resulting in increased student learning gains. Evidently, using teachers' confidence in their own intellectual ability is secondary to fundamental belief of expandable intelligence from which recursive behaviors originate. The confidence teachers need is not that they have a certain level of intelligence or ability to learn. Instead teachers benefit from the confidence that anyone can learn through the use of different strategies and continued attempts applied toward the learning goal.

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APPENDIX A

Institutional Consent

Dear Senior Vice President, School Management

This letter is to confirm your review and approval of my doctoral research project. Please accept this letter as my formal request to solicit 1200 homeroom teachers and instructional coordinators at 18 virtual academies meeting the qualifying criteria, as part of the empirical research for my doctoral dissertation.

My study seeks to examine the relationship between student academic gains, teacher-student interactions and the implicit theories of online teachers designated as students' primary teacher. The study focuses on Homeroom teachers (K-8) or Instructional coordinators (HS) whose students completed the Fall and Spring Performance Series assessments in the 2010-2011 school year in reading and math. I will utilize a 12-item questionnaire, based on constructs created by Carol Dweck related to Implicit Theories of Intelligence and Confidence in One's Own Intelligence. The questionnaire will be delivered via Survey Gizmo and should take approximately 10 minutes to complete. In order to answer the research questions, I will need access to archival data available on the internal Report Server and to the Scantron Performance Series results for school year 2010-2011. The survey and follow up communication will be conducted outside of normal school operations and business hours.

Each teacher in the study will receive an email thoroughly explaining the study and an informed consent form. The email invitation will emphasize the voluntary nature of the study and their right to withdraw from the study at any point within the study. In an effort to ensure confidentiality for the teacher and each of the schools, each teacher involved in the study will be provided a randomly generated code for purposes of data analysis and interpretation. The data gathered will be stored on a USB drive in a locked cabinet to which only I will have access. The list of participant names, codes and research databases will be destroyed five years following the completion of the study.

At the conclusion of the study, I will share my findings with you and the study participants. Subsequently I will use the findings as part of my dissertation and may also use the findings to publish or present to a professional audience through scholarly journals. Please do not hesitate to contact me should you have further questions.

______________________________________ __________________

Signature of Researcher Date

______________________________________ __________________

Signature of Senior Vice President, School Management Date

APPENDIX B

Request Use of Questionnaire Items

Dear Dr. Dweck,

I am a doctoral student at Pepperdine University conducting research in partial fulfillment of a doctorate in Learning Technologies through the Graduate School of Education and Psychology. As part of my doctoral research I am seeking your approval for use of the original three (3) entity theory items measuring implicit theory of intelligence of others and (3) items measuring confidence in one's intelligence. After IRB approval and permission for instrument use has been granted an online survey engine will be used to gather consent and deliver the questionnaire.

My study seeks to examine the relationship between student academic gains, teacher-student interactions and the implicit theories of full time online teachers designated as students' primary teacher. I will utilize a 9-item questionnaire to address four research questions:

1. What is the impact, if any, of teacher theory of Intelligence on student achievement gains scores?

2. What is the impact, if any, of teacher theory of Intelligence on amount of interaction with students in virtual classes?

3. What is the impact, if any, of confidence in one's intelligence on student achievement gains scores?

4. What is the impact, if any, of confidence in one's intelligence on amount of interactions with students in virtual classes?

To address these questions I am seeking your consent to use the following questions as part of the research study.

1. Everyone has a certain amount of intelligence, and they can't really do much to change it.
( ) Strongly agree
( ) Agree
( ) Mostly agree
( ) Mostly disagree
( ) Disagree
( ) Strongly disagree

2. Someone's intelligence is something about them that they can't change very much.
( ) Strongly agree
( ) Agree
( ) Mostly agree
( ) Mostly disagree

( ) Disagree
( ) Strongly disagree

3. People can learn new things, but they can't really change their basic intelligence.
( ) Strongly agree
( ) Agree
( ) Mostly agree
( ) Mostly disagree
( ) Disagree
( ) Strongly disagree

4. Check the sentence that is most true for you.
( ) I usually think I'm intelligent
( ) I wonder if I'm intelligent

4. A- Now select how true the statement you chose above is for you.
( ) Very true for me
( ) True for me
( ) Sort of true for me

5. Check the sentence that is most true for you.
( ) When I get new work in school, I'm sure I will be able to learn it.
( ) When I get new work in school, I often think if I'll be able to learn it.

5. A- Now select how true the statement you chose above is for you.
( ) Very true for me
( ) True for me
( ) Sort of true for me

6. Check the sentence that is most true for you.
( ) I'm not very confident about my intellectual ability
( ) I feel pretty confident about my intellectual ability

6. A- Now select how true the statement you chose above is for you.
( ) Very true for me
( ) True for me
( ) Sort of true for me

Recognizably, you have openly published the questionnaire items in your scholarly work, *Self-theories: their role in motivation, personality, and development.* However your review and signature on this letter serves to document your permission to use the questionnaire items. At the conclusion of the study, I will share my findings with you and the study participants. Subsequently I will use the findings as part of my dissertation and may also use the findings to publish or present to a professional audience through scholarly journals. Thank you in advance for your consideration of this request.

Signature of Researcher	Date
Carol Dweck Ph.D.	Date

APPENDIX C

Request to Participate in Study

INITIAL EMAIL TO TEACHERS

To: K-12 Online Teachers selected through stratified random sampling
From: Guadalupe Vander Ploeg, Researcher
Re: Participation in Study

Date:

Dear X,
I am a doctoral student at Pepperdine University studying the relationship of teacher implicit theories, teacher-student interactions and student academic gains. You have been randomly selected to participate in this study from a database of K-12 online teachers at 18 virtual academies with a primary role of homeroom teacher or instructional coordinator. It is my hope that you will be interested in participating in a study I am conducting for my dissertation in partial fulfillment of my doctorate under the guidance of my dissertation chair, Dr. Paul Sparks.

The purpose of this study is to examine the relationship between student academic gains, teacher-student interactions and the implicit theories of online teachers designated as students' primary teacher. You are one of select few teachers who have been randomly selected and meet the criteria I have defined for teachers in my study.

Inclusionary criteria includes multiple qualifiers:

- Teacher of record, specifically Homeroom teachers (K-8) or Instructional coordinators (HS).
- 95% or more of third through 10th grade students in class completed the Fall and Spring Performance Series assessments in the 2010-2011 school year in reading and math.
- Hire date prior to the start of first day of school signifying a minimum of one complete year of online teaching.
- Teacher at one of the 18 cyber charters selected for the study.

It is important that each homeroom teacher or instructional coordinator selected for this study, with students in the 3rd through 10th grade, complete one online questionnaire. The questionnaire has 9 questions and should take approximately 10 minutes to complete. You will receive a copy of your submitted answers.

By completing the first three questions of the questionnaire you acknowledge your consent to be part of the study. The individual results of the questionnaire are confidential and will not be shared directly with the <school name> administration. The information obtained will be reported to the school, in aggregate form. This means that no individual assessment results will be shared which also ensures the confidentiality of your responses.

Click here to access the online questionnaire:

[URL for Survey Gizmo]

This questionnaire will be available until XXX.

Should you have any questions please feel free to contact me via email at [redacted] and you should also feel free to contact me by telephone at [redacted]. I encourage your participation and thank you in advance for consideration of this request.

Respectfully,
Guadalupe Vander Ploeg
Doctoral Student
Pepperdine University, Graduate School of Educational Psychology
[redacted]

APPENDIX D

Data Collection Instrument, Informed Consent

Please review the informed consent and acknowledge your participation in the study.

Question 1:
I __________________, agree to participate in the research study being conducted by Guadalupe Vander Ploeg, a doctoral student under the direction of Dr. Paul Sparks, in the Graduate School of Educational Psychology at Pepperdine University.

Purpose: I have been asked to participate in a research project, which is designated to examine the relationship between student academic gains, teacher-student interactions and the implicit theories of online teachers designated as students' primary teacher. The study will require completion of one electronically delivered questionnaire with a total estimated completion time of 10 minutes.

Participant Selection: I have been asked to participate in this study because I was randomly selected from a database of K-12 online teachers who meet the following criteria:

- Teacher of record, specifically Homeroom teachers (K-8) or Instructional coordinators (HS).
- 95% or more of third through 10^{th} grade students in class completed the Fall and Spring Performance Series assessments in the 2010-2011 school year in reading and math.
- Hire date prior to the start of first day of school signifying a minimum of one complete year of online teaching.
- Teacher at one of the 18 cyber charters selected for the study.

Procedures:
I will be asked to complete one online questionnaire. The questionnaire will fulfill three purposes a) acknowledge my consent for participation, b) gather an alternate non-work related email address and c) gather responses related to implicit theories. The informed consent is required for participation in the study. The alternate non-work related email address would be used to communicate with me for purposes of this study.

Once I affirmatively respond to the first three questions of the questionnaire I acknowledge my consent to participate in the study. I will then be asked to submit an alternate non-work related email address. Upon completion of the questionnaire I will be emailed a copy of my informed consent and a report of my responses to my non-work related email address made available only to me. My direct supervisor will not receive a copy of the individual responses.

Confidentiality: I understand the researcher will immediately separate my first and last name, entered on the informed consent from the responses I submitted. I understand the researcher will use a randomly generated code, known only to the researcher in lieu of my staff identification. This measure is used to ensure confidentiality of my identity. Once the data collection window closes on XXX, the data will be downloaded in Excel format and will be stored on a USB drive stored in a locked cabinet in the researcher's home to which only the researcher has access. I understand the researcher will use NCSS statistical software to analyze in aggregate the results from the questionnaire.

I understand that no information gathered from my study participation will be released to others without my permission, unless law requires such a disclosure. I understand that under California law, the privileges of confidentiality do not extend to information about the abuse of a child. If the researcher has or is given such information, she is to report it to the authorities. The obligation to report includes alleged or probable abuse as well as known abuse.

I understand that the findings of the study will be published in a dissertation and may be published or presented to a professional audience through scholarly journals. At all times no personally identifying information will be released. The information gathered will be made available to other researchers with whom the researcher collaborates, and any data that is shared will be released without any personally identifying information so that I cannot be identified. The primary researcher Guadalupe Vander Ploeg will supervise the use of the data. I understand the list participant names, codes and research databases will be destroyed five years following the completion of the study.

Potential Risks: There are minimal risks to participants. These risks include the association of individually identifiable information to associated answers on the questionnaire. To safeguard participants I understand the researcher will a) immediately separate my first and last name, entered on the informed consent form from the responses I submitted to the questionnaire and b) use a randomly generated code known only to the researcher to separate my identity from the answers I submitted.

Potential Benefits: I understand that as a result of completing the online questionnaire I will receive a report detailing my responses. Outside of receipt of that report I understand there is no direct benefit from participation in this study, however the benefit(s) to the profession may be development of a deeper understanding of the relationship of teacher implicit theories, teacher-student interactions and student outcomes subsequently informing teacher learning.

Participation: I understand that participation is voluntary. I have the right to refuse to participate in, or to withdrawn from, the study at any time without prejudice to my current or future employment. My refusal to participate will involve no penalty or loss of benefits to which I am otherwise entitled. I also have the right to refuse to answer any questions I choose not to answer. I also understand that there might be times that the researcher may find it necessary to end my study participation.

Compensation: I understand I will receive no compensation, financial or otherwise, for participating in the study.

Contacts: I understand that if I have any questions regarding the study procedures, I can contact Guadalupe Vander Ploeg at [redacted] and [redacted] to get any answers to my questions. If I have further questions, I may contact Dr. Paul Sparks, Dissertation Chairperson at [redacted] and [redacted]. If I have further questions about my rights as a research participant, I may contact Pepperdine University Graduate and Professional School Institutional Review Board (GPS IRB) at [redacted] or at [redacted]

Principle Investigator Statement:
This statement serves to confirm the principle investigator's confirmation of detailed research procedures. I, Guadalupe Vander Ploeg have explained and defined in detail the research procedure in which the subject has consented to participate.

Check Box: Acknowledgement of Informed Consent

- I understand to my satisfaction the information in the consent form regarding my participation in the research project. All of my questions have been answered to my satisfaction. I have received a copy of this informed consent form, which I have read and understand. I hereby consent to participate in the research described above.
  <Move to Question #2>

- I do not consent to participate in the study
  <End Survey>

Question 2:
Provide your first and last name
<text field first name> <text field last name>

Question 3:
Provide an alternate email address that may be used to communicate with you regarding the study.

<text field- 20 characters>

Instructions: The questionnaire should be taken in a quiet setting free from distraction. Please do your best to set aside 10 minutes to assure completion of the questionnaire in one sitting responding to the items in a relatively fast pace. This questionnaire has been designed to investigate ideas about intelligence. There are no right or wrong answers. I am interested in your ideas.

APPENDIX E

Questionnaire: Implicit Theories of Intelligence, Confidence, and Demographic Data

Using the scale below, please indicate the extent to which you agree or disagree with each of the statements by entering the number that corresponds to your opinion next to each statement.

1. Everyone has a certain amount of intelligence, and they can't really do much to change it.
( ) Strongly agree
( ) Agree
( ) Mostly agree
( ) Mostly disagree
( ) Disagree
( ) Strongly disagree

2. Someone's intelligence is something about them that they can't change very much.
( ) Strongly agree
( ) Agree
( ) Mostly agree
( ) Mostly disagree
( ) Disagree
( ) Strongly disagree

3. People can learn new things, but they can't really change their basic intelligence.
( ) Strongly agree
( ) Agree
( ) Mostly agree
( ) Mostly disagree
( ) Disagree
( ) Strongly disagree

4. Check the sentence that is most true for you.
( ) I usually think I'm intelligent
( ) I wonder if I'm intelligent

4. A- Now select how true the statement you chose above is for you.
( ) Very true for me
( ) True for me
( ) Sort of true for me

5. Check the sentence that is most true for you.
( ) When I get new work in school, I'm sure I will be able to learn it.
( ) When I get new work in school, I often think if I'll be able to learn it.

5. A- Now select how true the statement you chose above is for you.
( ) Very true for me
( ) True for me
( ) Sort of true for me

6. Check the sentence that is most true for you.
( ) I'm not very confident about my intellectual ability
( ) I feel pretty confident about my intellectual ability

6. A- Now select how true the statement you chose above is for you.
( ) Very true for me
( ) True for me
( ) Sort of true for me

7. Enter your completed years actively teaching in either a face-to-face classroom, online or both.
( ) Less than one year
( ) 1 to 5
( ) 6 to 10
( ) 11 to 15
( ) 15 to 20
( ) 21 or more years

8. Enter your completed years of actively teaching online.
( ) One year
( ) 2 to 3
( ) 4 to 5
( ) 6 to 7
( ) 8 to 9
( ) 10 or more years

9. Select the education level that most accurately describes your current educational status.
( ) 12th grade or less
( ) Graduated high school or equivalent
( ) Some college, no degree
( ) Associate degree
( ) Bachelor's degree
( ) Master's degree
( ) Doctoral degree