COGNITIVE PLAYFULNESS, INNOVATIVENESS, AND BELIEF OF ESSENTIALNESS: CHARACTERISTICS OF EDUCATORS WHO HAVE THE ABILITY TO MAKE ENDURING CHANGES IN THE INTEGRATION OF TECHNOLOGY INTO THE CLASSROOM ENVIRONMENT

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Research on the adoption of innovation is largely limited to factors affecting immediate change with few studies focusing on enduring or lasting change. The purpose of the study was to examine the personality characteristics of cognitive playfulness, innovativeness, and essentialness beliefs in educators who were able to make an enduring change in pedagogy based on the use of technology in the curriculum within their assigned classroom settings. The study utilized teachers from 33 school districts and one private school in Texas who were first-year participants in the Intel® Teach to the Future program. The research design focused on how cognitive playfulness, innovativeness, and essentialness beliefs relate to a sustained high level of information technology use in the classroom.

The research questions were: 1) Are individuals who are highly playful more likely to continue to demonstrate an ability to integrate technology use in the classroom at a high level than those who are less playful? 2) Are individuals who are highly innovative more likely to continue to demonstrate an ability to integrate technology use in the classroom at a high level than those who are less innovative? 3) Are individuals who believe information technology use is critical and indispensable to their teaching more likely to continue to demonstrate an ability to integrate technology use in the classroom at a high level than those who believe it is supplemental and not essential?

The findings of the current study indicated that playfulness, innovativeness, and essentialness scores as defined by the scales used were significantly correlated to an individual's sustained ability to use technology at a high level. Playfulness was related to the educator's level of innovativeness, as well. Also, educators who believed the use of technology was critical and indispensable to their instruction were more likely to be able to demonstrate a sustained high level of technology integration.

Further research is recommended to investigate numerous personality traits, such as playfulness, innovativeness, creativity, and risk-taking that might relate to technology adoption. Doing so may lead to modifications of professional development, assisting individuals in adapting better and faster to systemic change.

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And lastly, I give praise to God who gives me every day. May I spend each one wisely.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Problem Statement

As a result of funding initiatives such as the Telecommunications Infrastructure Fund (TIF) and the E-rate discounts, general knowledge indicates that most schools in Texas have:

- At least some computers in almost every classroom
- Internet access in most classrooms
- Some form of productivity software available for student and teacher use
- Most teachers trained in basic technology skills
- Technology integration as one of the goals in the district long-range plan
- Administrators who give at least superficial support for technology integration

Yet many classroom teachers in Texas remain only sporadic users of information technology. For the purposes of the current study, the term information technology refers not only to computers, but several other semi-conductor-based tools, such as personal digital assistants, Smartboards®[1], digital cameras, digital video cameras, Web cams, GPS units, and related peripherals, such as probes, used in the process of instruction. The focus of the current study was not on the use of particular information technologies, but the integration of information technologies into the curriculum.

The term "technology integration" holds different meanings for different people. For some, it is using computers for word processing reports; for others, technology

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[1] SMART Technologies, Inc., http://www.smarttech.com/

integration requires multiple pieces of equipment, software, and Internet access. For the purposes of the current study, *technology integration* was defined by the researcher as *a high level of technology use* in which information technology is so ubiquitous and essential to the educational experience that the use of technology as a tool is assumed and is not the focus of the lesson. In the field of educational technology, *technology use* begins to be referred to as *technology integration* at the point in time when a teacher's use of technology in the classroom affects the overall learning environment, shifting the focus from teacher-directed learning to the use of student-directed, collaborative, project-based activities, more actively engaging students in the learning process (Dwyer, Ringstaff, and Sandholtz, 1991; Rieber and Welliver, 1989). Everett Rogers (1995) coined the word "routinization" to describe such a level of technology adoption. Rogers defined routinization as the point where use becomes "incorporated into the regular activities of the organization, and the innovation loses its separate identity" (1995, p. 399). The innovation becomes simply an integral tool that one selects to complete a project. Items that have become routinized in the classroom include pencils/pens, crayons/markers, textbooks, overhead projectors, chalk/whiteboards, etc. Teachers do not plan lessons based on these items. They simply plan their lessons and use whatever tool is appropriate to meet the educational objectives. Marcinkiewicz (1994) defined this level of adoption as the point at which a teacher views information technologies as not just supplemental but as critical and indispensable to the instructional process. However, in many classrooms today, the use of information technology is still used simply to support isolated activities unrelated to a central instructional theme, concept, or topic (Moersch, 1995). For the purposes of the current study, anything at this level of adoption is considered as technology use and not technology integration.

Most school districts have technology integration as a targeted objective in their long-range plan. Yet when questioned, few members of the educational community can easily communicate what is meant by this phrase. The vagueness of the target may, at least in part, explain why technology integration remains so elusive. Perhaps someday, when administrators review their long-range plans and become aware that technology use is so integrated in the curriculum that listing technology integration as a goal is inconsequential, true technology integration may be observed.

Purpose of the Study

Much research has been done in business, agriculture, and other fields on the adoption of innovations, but relatively few innovation adoption studies have been directed toward the positive factors related to technology adoption in education and fewer still delve into the aspect of making an enduring change. Two early studies on innovation adoption, Mort (1953) and Carlson (1965), emphasized innovativeness and personal networks as key components in adoption rate. While several adoption models have been developed, the most popular and most quoted is Rogers' Individual Innovations Theory (1995). Rogers classified people into groups based on their innovativeness as: 1) Innovators, 2) Early Adopters, 3) Early Majority, 4) Late Majority, and 5) Laggards and claimed these groups together approximated the standard bell curve.

The purpose of the study was to examine the personality characteristics of cognitive playfulness, innovativeness, and essentialness beliefs in educators who were able to make an enduring change in pedagogy based on the usage of technology. The goal was to develop a theoretical model that, while acknowledging the multitude of external and internal factors that affect the adoption of any innovation, attempted to isolate the characteristic of playfulness to explain why some educators routinely integrate technology into their lessons more often, and at a higher level, than others.

The belief of this researcher was that Innovators are integrating information technology in their classrooms now at whatever levels their financial and curricular situations allow. They view technology as an integral part of the lesson and are constantly encouraging and empowering students and fellow educators to apply appropriate technologies as tools to enhance learning and problem solving. They have reached the level of routinization of technology use in the classroom. For the purpose of the current study, this level of adoption was labeled as enduring change if it had persisted for three years following the individual's Intel®[2] Teach to the Future training session. This program is discussed in more detail below.

It was also suspected that the Early Adopters and the Early Majority are just beginning to reach this level, integrating technology into at least one or two projects a year. However, these projects often still have the technology itself as the target. They know they are expected to use technology with their students so they often append it to their lessons more than integrate it into the lesson.

Unfortunately, educational innovations in general have historically shown very slow adoption rates. According to Rogers (1995), the concept of kindergarten took 50 years to reach complete adoption, driver's education took 18 years and modern math

[2] Intel Teach to the Future, www.intel.com/education/teach

took 5 years. According to Moore's law (Schaller, 1996), technology makes major changes (doubles in the number of transistors on a chip) every 18 months. Since changes not only in technology but also in our lives in general continue to occur at an unbelievably rapid rate, the educational community will find it difficult to keep up with these technological changes at the current rate of adoption.

Information technology has become generally ubiquitous in most schools in Texas and basic technology skills have been taught; yet many educators still do not feel comfortable utilizing technology as they do other tools in their classroom. The research questions identify additional factors that may be utilized to help the educational community manage the rampant changes in technology. Given similar situations, why do some people fully adopt a new technology when others do not? What personality factors are most common among classroom teachers who thoroughly adopt the use of information technology? Is there a relationship between certain personality traits such as cognitive playfulness, and an individual's full adoption (routinization) of information technology over an extended period?

Significance of the Study

Technology plays a major role in most facets of life today and continues to change at an astounding rate. Technological changes mold both culture and society in immeasurable ways. Research on adoption of innovations is largely limited to the factors and barriers affecting immediate change. Little research outside the field of clinical psychology considers factors leading to enduring or lasting change.

Learning implies a change--a change in knowledge, a change in attitude, a change in belief, or a change in behavior. If the factors involved in the successful generation of enduring or lasting change were better understood, educators might be able to make use of these factors to extend the positive effects of the lessons they deliver. Scores of studies, such as those discussed below, relate to the presence of, effectiveness of, barriers to, the attitudes toward, and the positive and negative effects of technology use in the classroom.

Some characteristics may prove hard to define, but the value to information science, education, psychology and many other fields is clear. Determining whether the critical illusive attribute is spontaneity, creativity, cognitive playfulness, risk-taking, enthusiasm, cognitive differentiation, or some other factor will require extensive research. However, if one can determine the qualities integral for routinization of information technology use in the classroom, perhaps a method for strengthening these qualities can be developed to assist individuals in dealing with the amazing speed of change and subsequent modifications of technology usage, which, for the foreseeable future, seems inevitable.

Theoretical Framework

Over the past two decades, two major models of adoption have been proposed and repeatedly tested. The Technology Acceptance Model (TAM) designed by Davis (1989) was proposed to predict the use of an information system. The second theory, the Theory of Planned Behavior (TPB) (Ajzen, 1985), was designed to predict behavior in many contexts and has been applied often to the adoption of information systems. The latter theory, built upon the Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975), added the construct of perceived behavioral control. A comparison study of these models (Mathieson, 1991) found that although both models provided good predictive validity in reference to an individual's intention to use an information system, TAM slightly outperformed the TPB and TAM was found to be easier to use. The TAM proposed that perceived usefulness and perceived ease of use, both of which are determined by external variables, predict an individual's attitude. Davis (1989) also suggested that this attitude predicts a behavioral intention to use and that this behavioral intention predicts actual use of the system.

Although both the TAM and the TPB explained much of the variance in an individual's intention to adopt an innovation, several other major theories incorporated factors that were not included in either of these two theories. Supported by a significant body of research in psychology, the Motivational Model (MM) (Deci, 1971; Davis, Bagozzi, and Warshaw, 1992) applied the motivational theory factors, extrinsic and intrinsic motivation, to technology adoption. Also based on psychological research, the Social Cognitive Theory (SCT) (Bandura, 1977) was further extended by Compeau and Higgins (1995) to explore an individual's use of technology. The Model of PC Utilization (MPCU) was especially appropriate for predicting an individual's acceptance and use of technology, as it was designed to predict actual usage instead of just intention to use (Thompson, Higgins, and Howell, 1991). Moore and Benbasat (1991) adapted Rogers' (1995) Innovation Diffusion Theory (IDT) to study the adoption of technology acceptance, including the characteristics of the innovation itself.

In an effort to combine these competing theories into a single unified theory, Venkatesh, Morris, Davis, and Davis (2003) proposed a composite model based on eight of the currently utilized models and combinations of those models. The Unified

Theory of Acceptance and Use of Technology (UTAUT) theorizes that four constructs -- performance expectancy, effort expectancy, social influence, and facilitating conditions -- serve as direct determinants of user acceptance and usage behavior. The theory also predicted that gender, age, experience, and voluntariness of use act as moderating variables on various numbers of the direct determinants. Venkatesh and his colleagues suggested that future research should attempt to "test additional boundary conditions of the model in an attempt to provide an even richer understanding of technology adoption and usage behavior (Venkatesh et al., 2003, p. 470)." The current study examined the construct of cognitive playfulness as an additional moderating variable on technology adoption that was not included in any of the models from which the UTAUT was composed.

Play is a basic human instinct, easily recognizable but often difficult to define. Play is evidenced by activities, but the construct itself is more of an attitude than a display of specific types of activity. Abundant evidence suggests that play is part of the normal personality (Barnett, 1990, 1991; Lieberman, 1977). Brenner (2001, p.6) describes play as "the serious things that we do all day merely infused with a playful spirit." Barnett (1990, 1991) defines play as a predisposition to engage in playful activities and interactions.

Playfulness is easy to observe in the world around us and comes in many forms, yet also eludes a clear and concise definition as. Playfulness can be readily observed in infancy and is a major feature in the lives of young children. It tends to be demonstrated throughout the teenage years in most individuals, yet many societies begin to view playfulness as inappropriate somewhere around early adulthood. Csikszentmihalyi

(1975) proposed the flow theory as a construct for understanding and studying playfulness in human interactions with computers. In flow theory, the subjective human-computer interaction is viewed as playful and exploratory. Playfulness can result in individual and organizational learning (Lieberman, 1977; Miller, 1973) and creativity (Csikszentmihalyi, 1975). The playfulness of interest in the current study, while most likely related to playfulness of children and adolescents, is a more cognitive playfulness, a characteristic within an individual that causes them to "play" with a problem until the problem is solved. It was this conception of playfulness as an exploratory, intrinsic, individual tenacity that was the focus of the current study.

Early research demonstrated that playfulness in the workplace can effect an individual's perceptions, attitudes, subjective experiences, motivations, and performance related to work (Csikszentmihalyi, 1975; Lieberman, 1977; Miller, 1973). Recent research in this area is limited and largely focuses on a group of researchers, Martocchio, Webster and their colleagues, who developed the parsimonious Adult Playfulness Scale (APS) and found evidence to support playfulness as a predictor in microcomputer interactions (Glynn and Webster, 1992). Playfulness was also positively associated with a positive mood and with personal satisfaction during interactions with computers. Individuals rated higher in playfulness exhibited higher task evaluations, involvement, and performance. Glynn and Webster's results suggest the importance of studying the impact of playfulness in the adoption of information technologies and the viability of the scale for this purpose.

Several studies in various fields (Hurt, Joseph, and Cook, 1977; Kirton, 1976, 1978; Leavitt and Walton, 1975) have posited innovativeness as a personality trait related to adoption and developed scales attempting to measure innovativeness. Defined by Hurt et al. (1977) as one's willingness to change, innovativeness was also proposed by Marcinkiewicz (1993, 1994) as a factor in innovation adoption. Marcinkiewicz (1994) found that innovativeness was one of the strongest predictors of a teacher's use of technology.

Marcinkiewicz also categorized teachers' computer use into three levels, non-use, utilization, and integration using a 4-question Level of Use (LU) assessment tool. Non-use implies the absence of any use of computers at all for teaching. Teachers who use technology in the classroom are placed into one of the two remaining groups based on how expendable they feel technology is to their personal teaching style. Essentialness beliefs are explored as a possible predictor variable in the current study.

None of the previously discussed instruments explicitly measure an individual's intrinsic motivation. The specific area of intrinsic motivation of concern not captured by these instruments was voluntariness (Moore and Benbasat, 1991) or self-determination (Deci, 1985). The construct of voluntariness represents the degree of freedom of use of the innovation. If the use is indeed completely voluntary, an individual performs a certain activity simply because they want to. Self-determination, the degree to which an individual perceives their use of information technology as voluntary, has shown to moderate social influences, a direct determinant of intention to use (Venkatesh et al., 2003). The current study employs self-determination as a categorizing factor on usage leading to a greater level of adoption and permanence of use. Since gender, age, and experience have been shown to be moderators in the UTAUT model, demographic information were collected but were not posited to have any significant effect on adoption level and permanence of use.

Research Questions

The following research questions were addressed by the current study:

1. Are individuals who are highly playful more likely to continue to demonstrate an ability to integrate technology use in the classroom at a high level than those who are less playful? Studies by Glynn and Webster (1992) found that individuals rated higher in playfulness exhibited higher task evaluations, involvement, and performance than those with lower playfulness scores. Playfulness was defined by Glynn and Webster as being composed of the constructs of cognitive spontaneity, creativity, expressiveness, fun, and silliness. A sustained high level of information technology use was demonstrated when information technology was used over time to empower students, enhance learning, and encourage problem solving. During the Apple Classroom of Tomorrow (ACOT) project, Dwyer, Ringstaff, and Sandholtz (1991) identified five evolutionary stages of technology integration through which individuals progress when learning to use information technology in the classroom. The first three stages, Entry, Adoption, and Adaption, focus on skill acquisition and the use of technology to support existing teaching methods. ACOT stages 4 and 5, Appropriation and Invention, focus on the ability to integrate technology in a way that result in major modifications in the way instruction is delivered and the engagement of students in the learning activities. The ACOT stages are discussed further in the Instrumentation section of Chapter 3. For the purposes of the current study, teachers at ACOT stages 4 and 5 were defined as demonstrating the ability to integrate technology at a high level. This ability to integrate technology at a high

level was considered for the purposes of the current study to be sustained if the level was present three years after the initial Intel Teach to the Future professional development experience. Creating and delivering lessons that implement technology to support these higher-level thinking skills requires creativity, expressiveness, and a sense of fun. Also, due to the uncertainties involved when using technology, spontaneity would also be useful in those situations where things do not go exactly as planned. There should be a significant difference in playfulness scores between educators who are able to demonstrate a high level of information technology use as an integral part of their teaching and educators who do not.

2. Are individuals who are highly innovative more likely to continue to demonstrate an ability to integrate technology use in the classroom at a high level than those who are less innovative? Using a version of the Innovativeness Scale by Hurt et al. (1977), Marcinkiewicz (1994) found that innovativeness was one of the strongest predictors of a teacher's use of technology. Using a similar version of the same scale, Okolica and Stewart (1996) found a significant relationship between individual innovativeness and the extent of an individual's use of the advanced aspects of voice mail. There are not many good examples of high-level information technology integration in the field of education. A large number of educators simply use technology to teach the same way they always have but with different tools, e.g. showing a PowerPoint presentation instead of using transparencies on the overhead. However, it is likely that the more innovative educators would be using technology in a more creative, student-centered

manner. Therefore, there should be a significant difference in innovativeness scores between educators who are able to demonstrate a high level of information technology use in their teaching and educators who cannot.

3. Are individuals who believe that information technology use is critical and indispensable to their teaching more likely to continue to demonstrate an ability to integrate technology use in the classroom at a high level than those who believe that it is supplemental and not essential? Rieber and Welliver (1989) established the use of the attribute of expendability in their model of instructional transformation. By categorizing teachers' computer use into three levels -- non-use, utilization, and integration -- a significant pedagogical transformation can be identified by an individual's perceived dependence on technology as essential for a desired educational experience (Marcinkiewicz, 1993). Individuals who believe that information technology use in the classroom is both critical and indispensable should be more likely to demonstrate a high level of information technology use as an integral part of their teaching than individuals who believe it to be supplemental and not essential.

Hypotheses

The following null hypotheses were tested:

1. There is no positive relationship between an individual's ability to sustain a high level of information technology usage as measured by an individual's Apple Classroom of Tomorrow (ACOT) stage and the individual's level of cognitive playfulness as measured by their score on the Adult Playfulness Scale (APS).

2. There is no positive relationship between an individual's ability to sustain a high level of information technology usage as measured by an individual’s ACOT stage and their level of innovativeness as measured by the individual's score on Marcinkiewicz’s Innovativeness Scale (IS).
3. There is no positive relationship between an individual's ability to sustain a high level of information technology usage as measured by an individual’s ACOT stage and their perception of essentialness of information technology use as measured by the individual's score on Marcinkiewicz’s 4-question Level of Use (LU) assessment instrument.

Limitations of the Study

This correlational study utilized classroom teachers from 33 school districts and one private school in North Central Texas who were first-year participants in a 3-year educational technology integration grant program, Intel® Teach to the Future. Not all participants involved in the first year of the program were still available. Some had moved and several had been promoted to other positions in the district or had taken jobs in the business sector. Also, since the sample of educators selected represented only individuals from North Central Texas, the current study may have limited generalizability to other locations.

Human memory is known to be short and susceptible to modification over time; therefore, self-report was an issue to the validity of a study such as this. Change initiation for this group occurred three years ago and memories can become quite vague after that long. Every attempt was made to add validation support mechanisms to the study design. Also to be considered is the fact that actual use often deviates slightly from the intended use, but it is a major assumption in this field of study that the difference can be viewed as non-significant.

Self-report was also an issue particularly when the factors relate to personality. Research in the field of psychology has long supported a theory of the existence of a difference between personality and self-concept (Epstein, 1973). This theory suggests that we develop a view of ourselves early in adulthood that may persist despite actual changes in our real nature brought on by life experiences. This paradox could certainly affect the validity of self-reported personality traits.

The constructs in the current study are by their very nature indistinct and difficult to clearly define. For the purposes of the current study, limitations on their definitions are applied and the definitions may not necessarily coincide exactly with the definition of the study participants. Every attempt to clarify constructs with the participants was made.

Definitions

Cognitive Playfulness -- Operationally defined for the current study, cognitive playfulness was described as a characteristic within an individual, composed of cognitive, affective, and behavioral components, that causes the individual to "play" with a problem until it is solved. A playful individual is apt to have a predisposition to engage in certain activities in a non-serious or fanciful manner. Playful interactions tend to be enjoyable, engaging, and not a function of external needs.

Cognitive Spontaneity -- This term represents a key construct of playfulness that encompasses curiosity, inventiveness, and the need to play with ideas.

Critical / Essential -- Information technology is viewed as an integral part of the lesson. The curricular objective of information technology use is to empower students, enhance learning, and encourage problem solving.

Enduring Change -- For the purposes of the current study, enduring change was defined as a change persisting for at least 3 years since the individual's first exposure to the Intel Teach to the Future program.

Essential Question -- "…provocative questions designed to engage student interest and guide inquiry into the important ideas in a field of study. Rather than yielding pat answers, essential questions are intended to stimulate discussion and rethinking over time" (Wiggins, McTighe, & McTighe, 1998, p. 277). Essential questions are open-ended, concept-based, universal, and abstract. Essential questions are also multi-layered, have no one right answer, and may be global enough to serve as a focus for an entire year's curriculum. Essential questions reside at the top of Bloom's Taxonomy (Bloom, 1956), requiring students to evaluate, synthesize, and analyze to formulate meaning from the information gathered.

Information Technology -- The term not only refers to computers but several other semi-conductor-based tools, such as personal digital assistants, Smartboards®, digital cameras, digital video cameras, Web cams, GPS units, and related peripherals, such as probes, used in the process of instruction.

Non-user -- Any educator who uses no information technology in their instruction, but may or may not use information technology on a limited basis as a productivity or presentation tool was considered a non-user.

Pedagogy -- Pedagogy is the art or science of teaching (SIL International, 1999). The construct covers a broad range of skills and abilities including essential subject knowledge, prescriptive methods, use of organizers, and other factors relating to teaching and learning styles. The element of pedagogy referred to in the current study was an effortless use of technology beyond simple productivity, such as word processing of reports. The pedagogy sought included the use of various information technologies to accomplish a variety of instructional and management goals and the development of new learning environments that are constructivist-based; that is, where learning is student-directed.

Routinization -- This term was coined by Rogers (1995, p. 399) as the point where use becomes "incorporated into the regular activities of the organization, and the innovation loses its separate identity."

Sustained High-level Technology Integration – Sustained high-level technology integration is evidenced in the classroom when the use of technology is effortless on the part of both the teacher and the students. Usage goes beyond simple productivity, such as word processing of reports. Students are regularly seen using various information technologies to accomplish a variety of instructional and management goals in learning environments that are constructivist-based. An ability to integrate technology at a high level was considered for the purposes of the current study to be sustained if the level was present three years past the initial professional development experience.

Supplemental/Not essential -- Information technology in the classroom is treated as an auxiliary activity for the students.

Technology Integration -- Technology integration is demonstrated when the use of technology in the classroom affects the overall learning environment, shifting the focus from teacher-directed learning to more student-directed, collaborative, project-based activities, engaging students more actively in the learning process. Technology integration implies technology use, but on a higher level than simple technology use.

Technology Use -- Any use of computers or other information technology, regardless of purpose or method of use.

Unit/Unit Plan -- The curriculum of the Intel Teach to the Future program uses the term *unit (*or *unit plan)* to refer to teaching plans that integrate technology into project work in the classroom (Appendix A). Individuals develop a unit based on a lesson currently taught with emphasis placed on integrating technology in a way that focuses on standards-based learning goals, project-based learning, authentic and open-ended tasks, group work, and performance assessment (Intel Education: Unit & Project Plans, 2004). Although the Intel Teach to the Future curriculum utilizes Microsoft®[3] Office products and the Internet, the focus of that professional development was the support information technologies can give to the classroom curriculum, not the use of specific technologies.

[3] Microsoft Corporation, www.microsoft.com

CHAPTER 2

LITERATURE REVIEW

Adoption of Information Technology

Using theories on the diffusion of innovation discussed below, several researchers have attempted to develop models related to the integration of information technology. Daniel Surry (1997) classified these studies as falling into one of two major categories: Macro and Micro. Macro theorists such as Leonard-Barton and Deschamps (1988) focused on reforming and restructuring educational institutions and making systemic changes. Micro theorists, such as Farquhar and Surry (1994), attempted to increase the adoption and utilization of specific instructional products by a specific set of potential adopters. The current study addressed enduring changes at the Micro level.

In the theory of Adoption Analysis, Farquhar and Surry further divided the categories of theories into sub-categories based on the philosophy of technology and technological change: Technological Determinism (Developer-centered) and Technological Instrumentalism (Adopter-centered). These philosophies span a continuum and are based largely on beliefs related to autonomy and continuity. Determinists view technology as the primary cause of social change occurring in revolutionary steps, an autonomous force beyond our control. Determinists are commonly either radically utopian or dystopian. Karl Marx well represents the most utopian side of this philosophical camp, with George Orwell falling into the latter category. The Developer-centered (Determinist) theorist believes that diffusion can be attained solely through the efficiency, effectiveness, and elegance of an innovation reflecting a build-it-and-they-will-come attitude. Determinists believe that based on superiority alone, a technological product or system will replace inferior products and systems. Top-down reform is an example of this way of thinking. Hall and Hord (1987) discussed the reasons behind the failure of many such projects.

Instrumentalists, on the other hand, argue that technology is a powerful force for change, yet is only a tool. Instrumentalists view social conditions and human aspiration as the primary causes of change. Also, Instrumentalists consider technological growth to be a more gradual, evolutionary change. They direct their attention to the human and interpersonal aspects of the innovation. Instrumentalists often cite the failure of the Dvoark keyboard, a theoretically superior technological innovation, as an example of the influence of human factors in the adoption of a new technology. Ernest Burkman (1987) developed a product utilization theory from an instrumentalist's view insisting that the opinions, needs, and perceptions of the potential user were of primary importance to the acceptance of an innovation. Burkman’s User-Oriented Instructional Development theory also included the idea of post-adoption support. Burkman cited failure to include this support as one of the primary causes of failure in change attempts. Mehlinger's (1994) Bottom-Up reform theory and Hall and Hord's (1987) Concerns-Based Adoption Model (CBAM) are examples of the instrumentalist's attempt at creating a systemic model, focusing on the point of view of the potential adopters.

Historical Adoption Models

A large number of models in the literature attempt to explain the relationship between innovations and adoption levels and serve as a launching point for further related research. Rogers' landmark and often-quoted book, *Diffusion of Innovations*, begins with a statement of the common problem, the need for organizations to "speed up the rate of diffusion of an innovation" (Rogers, 1995, p. 1). This is still a problem faced today if education is going to keep from falling further behind in the application of technology. Although not concerned with information technology directly, diffusion theory offers a global framework for the study of innovation adoption.

Rogers' theory lists four major factors that influence the diffusion process: the qualities of the innovation itself, the communication channels, time, and the nature of the social system in which the innovation exists. In order to be adopted, the innovation itself must be perceived as 1) having a relative advantage (being better than the existing situation), 2) being consistent with the user's existing values, experiences, and needs, 3) easy to understand and use, 4) easy to try out, and 5) easily observable. The adoption of information technology in the classroom may fail in many of these areas because 1) information technology is expensive compared to the classic methods that appear to work, 2) it often requires a radical systemic change on the part of educators, 3) technology has a very distinctive vocabulary and appears to require specialists to keep it running, 4) the often prohibitive costs make teachers fear that if they have availability of technology they will be expected to use it, and 5) teaching is a closed-door profession that often makes successful use of technology hard to view. Despite all of these barriers, some teachers in some schools still succeed in fully integrating technology into their curriculum.

The successful integration of information technology often can be attributed to the communication channels available to the individual. Communication channels can range from the team teacher next door to formal professional development to formal post-graduate education. Thanks to advanced communication techniques, such as email and the Internet, and a plethora of online educational opportunities, most educators now have the ability to attain almost any knowledge they desire. Yet only a few teachers search it out. Certainly most educators understand the value of education. The question was why do some continually strive to grow and others stay in their comfort zone.

A common reason given by teachers for the lack of technology integration in their classrooms is a perceived shortage of time. Often the people who seek out new experiences and knowledge opportunities are individuals who make the time when there is adequate personal value associated with the effort. Also, at the speed at which technological innovations are occurring today, there is little time to adopt a new technology before it is replaced by a newer technology.

Another issue is the nature of the social system in which the educator exists. Some school environments are much more conducive to innovation, experimentation, and risk taking than others. Some have a lock-step curriculum where teachers are forced to cover certain topics on certain days using certain methods. It is doubtful that teachers in those situations are fully integrating technology in their classrooms. However, in schools that encourage innovation, there are still educators who hesitate and others who refuse to budge out of their rut.

The only remaining factors to be found are individual differences in people. The Innovation Decision Process Theory (also referred to as Innovation Diffusion Theory) posited by Rogers (1995) asserts that in the process of adopting an innovation, people go through five distinct stages: Knowledge, Persuasion, Decision, Implementation, and

Confirmation. The question remains how to get educators to move through these stages more quickly.

Geoffrey Moore (1991) modified Rogers' theory slightly by suggesting that there are actually cracks in the bell curve that vary in width. Moore proposed that the variance in the width of these cracks was due to the group members' psychographic profiles. Psychographic profiles are the combination of psychology and demographics that affect the adoption profiles of the groups. Moore categorized each group as follows:

- Innovators are techno-centric, fascinated with any fundamental change in technology. Members of this group must accept the innovation before the adoption will proceed to the other groups. Innovators tend to score higher on risk taking and adventure seeking and also generally tend to rank higher on education and wealth than individuals in other groups.
- Early Adopters are not technologists, but they can see the value of an innovation as it relates to fulfillment of a personal or professional need. They often adopt an innovation based on intuition rather than on referrals from other people.
- Members of the Early Majority are extremely practical and want many others actively using the innovation before they adopt it. The innovation must be easy for these people to adopt. These traits cause the relatively large gap between the Early Majority and the Early Adopters.
- Members of the Late Majority wait until the usage of the innovation is well established by a significant group of others. These individuals need much support and tend to buy from large, well-established companies.
- Laggards don't want anything to do with the innovation.

The purpose of the study was to examine the personality characteristics of cognitive playfulness, innovativeness, and essentialness beliefs in educators who were able to make an enduring change in pedagogy based on the usage of technology. It is hoped that later studies can attempt to determine if cognitive playfulness can be modified to boost an individual's innovativeness (move them to the next adoption group faster or narrow the "chasm" of Moore's model) and make the changes last.

The last three decades have produced a number of integrated theories with roots in psychology, sociology, and management information systems that include various psychological traits as well as situational variables. For reviews see Dillon and Morris, 1996; Venkatesh et al (2003). The Theory of Reasoned Action (TRA) was an early model by Fishbein and Ajzen (1975). Based in social psychology, this theory uses measurements of an individual's attitude toward performing a given behavior and subjective norms concerning this behavior. The TRA has been used to attempt to predict a broad range of intentions and behaviors. It is important to note that Fishbein and Ajzen suggested that attitudes are formed by both cognitive and affective components. This delineation is significant in differentiating between perceived usefulness and intrinsic motivators discussed later. Subjective norms represent perceptions of how others who are important to individuals expect the individual to behave. The TRA proved to be exceptionally robust and offered extraordinary predictive validity even outside of the original boundary conditions of the theory. See Sheppard, Hartwick, and Warshaw (1988) for a more complete review of this theory.

Based on the TRA, Ajzen (1985) proposed the Theory of Planned Behavior (TPB), adding perceived behavioral control as an additional predictive determinant of intention and behavior. This additional construct, a factor also found within the perceived ease of use (Davis, 1989), is similar to the psychological construct of locus of control focusing on internal and external constraints on behavior (Taylor and Todd, 1995) and to self-efficacy (Bandura, 1977). Ajzen (1991) presented a review of several studies that utilized TPB in a variety of settings as support for his model.

Davis (1989) posited the Technology Acceptance Model (TAM), a parsimonious model also based on the TRA, by excluding the social norm construct arguing that the impact of social norm is context driven (Davis et al., 1992). Davis and his colleagues believed that the technology use involved in their study was of a personal and individual nature and not likely to be affected by social influences. The TAM originally included only the constructs of perceived usefulness and perceived ease of use. Perceived usefulness was defined in TAM as the degree to which a person believes that use of the system will enhance his or her performance and ease of use is defined as the degree to which a person believes that use of the system will be free from effort (Davis, 1989). The user's attitude was defined as feelings of favorableness or unfavorableness toward the system. Although research consistently shows that behavioral intention is the strongest predictor of actual use (Ajzen, 1991; Davis, Bagozzi, and Warshaw, 1989; Knezek, Christensen, Hancock, and Shoho, 2000; Taylor and Todd, 1995), in the case of mandatory settings subjective norms were shown to have an impact on behavioral intention and usage and therefore were added back in as additional predictors in a modified version of the TAM.

In addition to the removal of social norms as a factor, the original TAM displays other major differences from the TRA. First, TAM suggests an extremely strong direct relationship between perceived usefulness and behavioral intention. TAM also posits perceived ease of use as both a direct effect on behavioral attitude and an indirect effect through perceived usefulness (Davis, 1989) although these relationships were not found to be as strong as the direct relationship between perceived usefulness and behavioral attitude. In his study, Davis (1989) reported a shared variance (R^2) of between .47 (time 1) and .51 (time 2) when using TAM as a predictor of behavioral intention. These variances compare to .32 and .26, respectively, for the TRA. TAM has proven to be robust in several studies (Adams, Nelson, and Todd, 1992; Agarwal and Prasad, 1998; Keil, Beranek, and Konsynski, 1995; Mathieson, 1991; Venkatesh and Morris, 2000). Adams et al. (1992) found the effects of both perceived usefulness and perceived ease of use may change over time through prolonged use of the technology. Although several studies have attempted to determine the antecedents of perceived usefulness and perceived ease of use (Karahanna and Straub, 1999; Venkatesh and Davis, 1996), concern for the antecedents was beyond the scope and tangential to the objectives of the present study.

The Model of PC Utilization (MPCU) (Thompson et al., 1991) adapted from the work of Trandis (1971) included the constructs of job-fit, complexity, long-term consequences, and facilitating conditions in addition to social factors. The goal of the MPCU was to predict actual behavior, not behavioral intention, in the context of personal computer (PC) use by knowledge workers in an optional use environment. Job-fit and complexity are constructs very similar to perceived ease of use as described by Davis (1989) and long-term consequences related very closely to perceived usefulness. The findings of Thompson et al. confirmed the effects of social factors, complexity, job-fit, and long-term consequences on PC use but contrary to other studies, failed to find evidence that affect and facilitating conditions influenced PC use.

Around the same time, Moore and Benbasat (1991) were modifying Rogers (1995) Innovation Diffusion Theory (IDT) to study individual technology acceptance by adding the constructs of voluntariness and image to Roger's variables of relative advantage, compatibility, complexity, observability, and trialability. Image was defined as the degree to which use of an innovation is perceived to enhance one's image or status in one's social system (Moore and Benbasat, 1991). Rogers’ (1995) included image as part of relative advantage. Image also demonstrated strong similarities to parts of the constructs of perceived usefulness and social factors. Perceived voluntariness, the degree to which use of the innovation is perceived as being voluntary, or of free will, was also considered a necessary factor and found to be more than a binary variable. Although this approach to the study of adoption focused largely on the perceptions of the technology itself provides a strong context and an excellent general theory, it offers little explicit treatment of the personality constructs involved in adoption.

The field of psychology supplies a significant body of research to support the value of extrinsic and intrinsic motivation in the prediction of an individuals' behavior with several motivational models. Vallerand (1997) provided a reasonably comprehensive review of this theoretical foundation. Research on motivation has been approached over several decades from a number of theoretical perspectives (Freud, 1962; Hull, 1943; Skinner, 1953). Originally conceived as a one-dimensional construct, motivation is currently viewed as multi-dimensional, divided primarily between extrinsic and intrinsic motivations (Deci, 1971, 1975). An individual is said to be extrinsically motivated when their behavior occurs as a means to an alternate end, rather than for the sake of result of the behavior itself (Deci, 1975). Although research continues in an attempt to further identify and sub-divide the construct of extrinsic motivation, for the purposes of the current study, extrinsic motivators are considered to be factored in through Davis' (1989) construct of Usefulness and therefore included in the model.

The individual's characteristic that focuses on the enjoyment of the behavior itself and not the final product is termed intrinsic motivation (Davis et al., 1992; Deci, 1975; Igbaria, Parasuraman, and Baroudi, 1996). Previous research found individuals who are high in intrinsic motivation tend to show more creativity (Amabile, 1996), grasp concepts better (Grolnick and Ryan, 1987), and tend to retain the material longer (Conti, Amabile, and Pollak, 1995). Individuals who reported high intrinsic motivation were also found to be more persistent and showed a preference for novel and difficult tasks (Gottfried, 1990). Lasting changes in behavior often require a higher level of creativity, persistence, and a preference for novel and difficult tasks, thus implying that intrinsic motivation may prove to be a major factor in the permanence of an individual's adoption of an innovation. Research in the area of playfulness as discussed below (Webster and Martocchio, 1992) found that the usage of technology might be stimulated by intrinsic enjoyment and fun.

Compeau and Higgins (1995) modified a landmark psychological theory on behavior, the Social Cognitive Theory (SCT) (Bandura, 1986) to predict technology use behavior. The new model was developed to test the influence of computer self-efficacy, outcome expectations, affect, and anxiety on computer usage. The results of a second, longitudinal study (Compeau, Higgins, and Huff, 1999) strengthened the original findings by demonstrating continuing predictive capability of self-efficacy and performance-related outcome expectations. Self-efficacy also was found to be a significant predictor of affect, anxiety, and use at the end of the year-long study. Taking into account direct and indirect effects, self-efficacy explained 18% of the variance in an individual's use of technology (total effect = 0.43).

Unified Theory of Acceptance and Use of Technology

Recently, Venkatesh et al. (2003) developed a model unifying 25 constructs from the major existing theories in a continuing attempt to better predict intention to use and actual usage of technology. The Unified Theory of Acceptance and Use of Technology (UTAUT) contains four key constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions. Four modifying variables -- gender, age, experience, and voluntariness -- mediate the various core constructs.

Performance expectancy defined by Venkatesh et al. (2003, p. 447) as "the degree to which an individual believes that using the system will help him or her better attain significant rewards" is found in almost all adoption models and is the strongest predictor of intention, significant in both mandatory and voluntary settings. As supported by previous research, Venkatesh's construct, developed from the constructs of perceived usefulness (TAM and TPB), extrinsic motivation (from several psychological models), job-fit (MPCU), relative advantage (IDT), and outcome expectations (SCT), demonstrated a good model for predicting behavioral intention.

Effort expectancy, the degree of ease of use of the system, is founded on the constructs of perceived ease of use (TAM), complexity (MPCU), and ease of use (IDT). Although effort expectancy is significant at the beginning in both mandatory and voluntary settings, it becomes non-significant over periods of extended use (Agarwal and Prasad, 1998; Davis et al., 1989; Thompson et al., 1991). The effect of effort expectancy was found to be stronger on women, older workers, and individuals with limited experience. Because the effect of effort expectancy was found to diminish with experience and the participants' first known exposure to information technology was over 3 years ago, effort expectancy should not be highly significant in the determination of an individual's behavioral intention in the current study.

Social influence is defined as the degree to which an individual perceives that important others believe he or she should use a new system (Fishbein and Ajzen, 1975). Similar to the constructs of subjective norm (TRA, the modified version of TAM, and TPB), social factors (MPCU) and image (IDT), the construct of social influence has been found to be significant only in situations of mandatory use (Venkatesh et al., 2003). Even in mandatory situations, social influence appears to become non-significant over time due to experience with the system (Venkatesh and Davis, 2000). Like effort expectancy, due to the extended length of time since the participants' first known exposure to information technology, social influences should not be highly significant in the determination of an individual's behavioral intention in the current study.

Facilitating conditions, the degree to which an individual believes that organizational and technical infrastructures exist to support the use of the system (Venkatesh et al., 2003), have historically been considered by educators as major barriers to usage of information technology. The construct of facilitating conditions in the UTAUT model was formed from perceived behavioral control (TPB), facilitating conditions (MPCU), and compatibility (IDT) and refers to the various barriers to usage.

Venkatesh (2000) found that effort expectancy fully mediated the effect of facilitating conditions on intention. Therefore, if performance expectancy and effort expectancy are taken into account, facilitating conditions are not expected to be highly significant in predicting intention.

The UTAUT model proved robust, predicting 70% of the shared variance (adjusted R^2) in usage intention with four main effects and four moderators (Venkatesh et al., 2003). The real question now becomes, what is it about some educators that, despite all the possible barriers to using information technology in their classrooms, drives them to treat technology as critical and indispensable to the instructional process. While individuals' past experiences with information technology may flavor their opinions, some educators have bad experiences and still go back and try it again. Why do some educators have this tenacity? Individual characteristics appear to be the only remaining variable that may explain variances in technology usage.

Enduring or Lasting Change

Many individuals make changes in their lives only to revert back to their original behaviors a short time later. Yet, a certain number of individuals succeed in making an enduring change. A search of the literature found that the use of the terms *enduring, lasting, long-term,* and *longitudinal* is relative and varies from a few hours to decades depending on the topic being studied. However, when the search was limited to the fields of education and personality studies, a large number of *longitudinal* studies ran for a period of 3 years (Fuligni and Witkow, 2004; McGinnis, Kramer, and Watanabe, 1998; van Leeuwen, de Fruyt, and Mervielde, 2004). Therefore, for the purposes of the current study, an enduring change in pedagogy was defined as an ability to use information technology at a high-level in the classroom that has persisted for at least 3 years.

Research, primarily found in the field of clinical psychology, has shown that certain characteristics must be present in order for change to endure. Kottler (2001) found that in order for change to endure, it must be internalized by the individual and be significant enough to alter the individual's behavior. Kottler observed that lasting change required certain factors of personality and interpersonal style. According to Kottler, the best predictor of lasting change is self-efficacy, the confidence in your ability to reach and maintain your goal. Self-efficacy, discussed in more detail below, is subsumed in the UTAUT construct of effort expectancy.

Most theories of innovation adoption discussed earlier include attitudes toward information technology in one form or another as a large factor in determining an individual's level of technology adoption. Few explored individual differences in much detail other than the standard demographic factors, such as age and gender. Agarwal and Prasad (1999) defined individual differences as any dissimilarity across individuals, such as personality, demographic, and situational variables. The current study focused on the personality trait of cognitive playfulness, its composite factors, and its relationship to the depth and endurance of an individual's ability to use information technology in the classroom at a high level.

Cognitive Playfulness

The difficulty of defining playfulness has frustrated researchers for decades and even led some researchers to suggest that the category of playfulness is so vague that it should be dropped altogether as a category for research (Berlyne, 1969). Huizinga

(1955, originally published 1938) highlighted the importance of play as an essential prerequisite and characteristic of social interaction. Freud (1962, originally published in 1923) made reference to play as an expression of personality patterns and internal desires. Piagetian theories of child development view play as a window into a child's mind (Piaget, 1951).

Interest in the construct of play is not new and types of play have been organized in many ways. Piaget (1951) posited the following categories of play:

- Practice play is an individual activity in which functions or activities are performed simply for the intrinsic value of the activity. It was this form of play that was the focus of the current study.
- Symbolic play involves make-believe activities and representations of absent objects. Symbolic play may contain essentials of practice play, but practice play is never symbolic.
- Games with arbitrary rules that are imposed by agreement of the players.

Practice play often includes repetition of activities, often in apparently aimless ways, in order to test the limits of a newfound ability or object. Miller (1973, p. 92) termed this activity "galumphing" meaning "patterned, voluntary elaboration or complication of process, where the pattern is not under the dominant control of goals." Miller used this term to describe the attention a two-year old gives to a new object or the focus of an adult who buys a new camera and "plays with" the knobs and controls for an extensive period of time. There is often "deliberate complication" (Piaget, 1951) in this kind of play, as in selecting not to read the manual or instructions. These activities are seldom efficient or focused on a specific task. The process becomes play when it is the process itself that is interesting. Huizinga (1955) maintained that play could be very serious if the act of doing was clearly rewarding and encouraged repetition of the activity.

There are three general approaches to defining play (Barnett, 1991). Early studies of play (Piaget, 1951) focused on observable categories of behavior that conformed to specific behavioral definitions and have been criticized a great deal in the literature for using a simplistic view of play and for lacking statistical robustness generated by observational inconsistencies. The second approach examined the play context or physical environment describing the characteristics that are likely to encourage playful behaviors. The situation-specific nature of this approach brought to question its validity as a descriptor of an individual's playful nature.

The third and most commonly used approach in the current literature defined play as a psychological predisposition or set that serves to note its occurrence and to distinguish it from other genres of behavior, thus putting the focus on the individual and not the physical context (Barnett, 1991). The philosophy of psychological predisposition employed by Lieberman (1966, 1977), Singer and Rummo (1973), and other contemporary researchers was the approach to the study of play in the current research.

Play is easily evidenced by activities, but the construct itself is more of an attitude than any given activity. Barnett (1990, 1991) defined the construct as a predisposition to engage in playful activities and interactions, and suggested that there exists a more general playful personality trait or style that is independent from situational contexts and tasks. Until the mid-90s, most of the research on playfulness studied children (Papert, 1980; Piaget, 1951) substantiating the presence of play in infancy and confirming the construct as a major feature in the lives of young children. Play tends to continue to be demonstrated throughout the teenage years in most individuals, yet many societies begin to view play as inappropriate somewhere around early adulthood. However, Cattell (1979) has shown that characteristics of preschool children's playful tendencies are also distributed across many adult personality factors.

Playfulness is easy to observe in the world around us and comes in many forms, yet also eludes a clear and concise definition. A substantial body of evidence suggests that play is part of the normal personality (Barnett, 1990, 1991; Lieberman, 1977). Lieberman (1966) was among the first to postulate the construct of playfulness in children as a trait and to focus on the child instead of the setting. Lieberman’s work served as the foundation for many of the studies discussed below. Lieberman defined five components of the quality of playfulness in children: cognitive spontaneity, social spontaneity, physical spontaneity, manifest joy, and sense of humor. From these five constructs, Lieberman developed the Children's Playfulness Scale (CPS). Barnett and Kleiber (1982) replicated Lieberman's work and confirmed the five playfulness factors with preschool children, but noted that the components of playfulness were mediated by gender, intelligence, divergent-thinking ability, and home environment. The instrument was revised and proved to be fairly robust with alpha coefficients from .70 to .87 for the five component factors and .77 to .80 for the scale as a whole (Barnett, 1991). Lieberman (1977) extended her own work to adolescents and found additional forms of playfulness such as horseplay, a large range of social activities, hostile wit, and hurtful pranks.

Singer and Rummo (1973) studied classroom behaviors of students in Kindergarten and labeled one of the behaviors as playfulness. The attributes that loaded significantly on this construct were similar to those found by Lieberman: imaginativeness, humorous and playful attitude, emotional expressiveness, novelty seeking, curiosity, openness, and communicativeness. The playfulness quality was found to be significantly but only moderately stable over a 1-year period, perhaps suggesting that students were convinced very early that school is not play, it is work.

Csikszentmihalyi (1975) proposed the flow theory and it has proved to be useful as a construct for understanding and studying playfulness in human interactions with computers. In flow theory, the subjective human-computer interaction is viewed as playful and exploratory. According to flow theory, flow states occur during optimal and enjoyable experiences in which we feel "in control of our actions, masters of our own fate…we feel a sense of exhilaration, a deep sense of enjoyment" (Csikszentmihalyi, 1990, p. 3). In order to experience a flow state, the activity must challenge the individual enough to encourage playful, exploratory behaviors, without being beyond their capabilities (Webster, Trevino, and Ryan, 1993). If the activity is too challenging, anxiety will result. If the activity is not challenging enough, the individual becomes bored. Woszczynski, Roth, and Segars (2002) suggested that playfulness was actually divided into observable playful behaviors and a latent variable referred to as flow state. Research characterized flow state as a self-reinforcing optimal experience (Csikszentmihalyi, 1975) that can cause users to become so absorbed that they lose track of time and individuals who enjoy an activity will probably want to repeat it. Research on flow state adds credence to the belief that playfulness may be a factor in an individual's adoption of an innovation. Trevino and Webster (1992) suggested four factors of flow in relation to computer interactions: a sense of control over the interaction, a heightened state of cognitive curiosity about the interaction, an intrinsic interest in the interaction, and a perception of focus on the interaction.

Although playfulness is a multifaceted construct existing on multiple levels, the current study focused on cognitive playfulness as an individual trait. In agreement with Glynn and Webster (1992), the current study proposed that a playful individual has a predisposition to engage in certain activities in a non-serious or fanciful manner. Starbuck and Webster (1991) suggested that immediate pleasure and involvement in the activity were major factors in the definition of playfulness. Both of these concepts relate directly to the concept of flow discussed above in which Csikszentmihalyi (1975) suggested that playful interactions tend to be enjoyable, engaging, and not a function of external needs. Glynn and Webster (1992) posited that playfulness included cognitive, affective, and behavioral components. Barnett (1991) held that individuals who scored high in playfulness tended to be guided by internal motivation and self-imposed goals, tended to disregard externally-imposed rules, and tended to be an active participant. Playfulness was found to be positively correlated with such personality characteristics as an individual's intrinsic motivational orientation and innovative attitudes (Glynn and Webster, 1993).

The playfulness of interest in the current study, while most likely related to playfulness of children and adolescents, was more specifically a cognitive playfulness, a characteristic within an individual that causes them to "play" with a problem until the problem is solved. It was this conception of cognitive playfulness as an exploratory, intrinsic, individual characteristic that was the focus of the current study.

Play and work have long been considered a dichotomy (Kabanoff, 1980) although play and work may actually be points on a continuum. Although many people use the word *play* to refer to taking part in leisure activities outside of work hours, an overabundance of phrases permeates our language and strongly suggests several different meanings for the word *play*. Terms such as play along with, play both ends against the middle, play catch-up ball, play down, played out, play for time, play into someone's hands, play one's cards right, and play up are just a few examples of colloquialisms using the word *play* while referring to aspects of work. Hiemstra (1983) reported that employees often use the word *play* in reference to computer interactions. Anecdotal evidence suggested that this use of the word *play* might be quite common.

Early research demonstrated that playfulness in the workplace can affect an individual's perceptions, attitudes, subjective experiences, motivations, and performance related to work (Csikszentmihalyi, 1975; Lieberman, 1977; Miller, 1973). Carroll and Mack (1984) suggested that individuals with a capacity to treat work as play tend to be successful adult learners and problem solvers. Playfulness can result in increased individual and organizational learning (Lieberman, 1977; Miller, 1973) and creativity (Csikszentmihalyi, 1975). Recent research in this area is limited, and largely focuses on the group of researchers, Martocchio, Webster and their colleagues, who studied what they referred to rather interchangeably in various articles as both microcomputer playfulness and cognitive playfulness (Glynn and Webster, 1992, 1993; Martocchio, 1992; Martocchio and Webster, 1992; Webster and Martocchio, 1992, 1993; Webster et al., 1993). Through various studies, the same researchers developed the Adult Playfulness Scale (APS) and found evidence to support playfulness as a predictor in microcomputer interactions (Glynn and Webster, 1992). Playfulness was also positively associated with a positive mood and with personal satisfaction during interactions with computers. Individuals rated higher in playfulness exhibited higher task evaluations, involvement, and performance. Simply labeling work as "play" caused younger employees to demonstrate higher motivation to learn and to perform better on an objective test (Webster and Martocchio, 1993). The differences were not found when the task was labeled "work."

There are several possible positive outcomes of playfulness at work. A playful response is a creative one that develops an individual's flexibility (Ellis, 1973). More effective learning caused by higher motivation may result in higher quality output, more organizational creativity, and greater individual and corporate flexibility (Levy, 1983; Miller, 1973; Starbuck and Webster, 1991; Webster and Martocchio, 1993) making the organization more adaptable to change.

Several negative outcomes are also possible. Playfulness is not appropriate in all situations and should not be encouraged where speed is essential. Playfulness may waste time if the best procedure is already known. Webster and Martocchio (1992) suggested that future research is needed to determine the extent to which playfulness represents an important ingredient to adaptability.

Webster et al. (1993) found that curiosity and intrinsic interest appeared to be highly interdependent in interactions with computers and that these factors encouraged repetition of use of the technology. Curiosity and intrinsic interest are so interdependent that Webster and her colleagues went so far as to suggest that they might be treated as a single dimension when studying flow. High intrinsic motivation has also been associated with a tendency to lose track of time (Conti, 2001). The positive subjective experience associated with the flow state has been shown to be a significant predictor in the performance of an activity (Csikszentmihalyi, 1975). This particular type of intrinsic interest was described as that which accompanies cognitive arousal and use of the imagination.

Personality characteristics such as playfulness and intrinsic motivation exist on multiple levels. An individual can exhibit a given characteristic on a global level that is demonstrated in their general personality across time and situations, a contextual level pertaining to a certain life domain or role, or a state level determined by a transient current situation. According to Vallerand (2000), there is a top-down effect of an individual's intrinsic motivation at each of these hierarchical levels. An individual who is highly intrinsically motivated at the global or personality level is likely to demonstrate a high level of intrinsic motivation at both the contextual and situational levels. Because of Vallerand's findings, for the purpose of the current study playfulness and intrinsic motivation were measured as traits at the global level.

Vallerand and Bissonnette (1992) and Vallerand (2000) subdivided intrinsic motivation into three more specific constructs: the need to know, the need to accomplish, and the need to experience the stimulation. These terms more clearly define the elements of the construct of intrinsic motivation that drives some individuals to perform certain behaviors with a tenacity not necessarily shared with their peers or co-workers. Vallerand and Bissonnette's proposed constructs lend clarification to the exploration of cognitive curiosity and the desire to attain competence with the technology (Webster et al., 1993). Individuals with playful dispositions appear to be guided more by internal motivation, self-imposed goals, a focus on pretense and non-literality, a freedom from externally-imposed rules, and active involvement (Rubin, Fein, and Vandenberg, 1983). Studies suggest that intrinsic motivation fosters experiential involvement. Individuals who are highly intrinsically motivated tend to experience activities as pleasurable and interesting and therefore tend to pursue the activities as an end unto themselves (Wild, Kuiken, and Schopflocher, 1995). Highly-motivated individuals would be expected to show more tenacity in their interactions with technology.

The perception of focus on the interaction found in individuals in the flow state often results in a modification of their perception of time passage. The terms cognitive absorption (Roche and McConkey, 1990; Tellegen and Atkinson, 1974), cognitive engagement (Webster and Ho, 1997), and openness to experience (McCrae and Costa, 1983) have much in common with this focused condition, also often resulting in an individual "losing track of time." The trait of cognitive absorption reflects a readiness to engage in experiential, non-instrumental functioning (Wild et al., 1995). Non-instrumental functioning -- performing an activity with no particular purpose, goal, or direction -- corresponds closely to the definition of cognitive playfulness. Vallerand (1997) proposed cognitive absorption as a situational intrinsic motivator. Agarwal and Karahanna (2000) viewed cognitive absorption as composed of the four dimensions of flow (Trevino and Webster, 1992), playfulness (Webster and Martocchio, 1992), and ease of use (Davis, 1989). Cognitive engagement (Webster and Ho, 1997) is defined as flow without the notion of control.

Cognitive spontaneity is a construct found in early studies by Lieberman (1977). Cognitive spontaneity represents a key construct of playfulness that encompasses curiosity, inventiveness, and the need to play with ideas. Although cognitive spontaneity is the basis for the cognitive component of playfulness, it does not address the emotional or social qualities of play. Cognitive spontaneity and cognitive playfulness are often used synonymously (Martocchio and Webster, 1992).

The construct of creativity is common in many studies of playfulness (Amabile, 1988; Lieberman, 1977). A large body of research on creativity reveals that creativity requires persistence and energy. Both of these characteristics would seem to be required for an individual to reach a high level of technology integration in the classroom. The paradox of the relationship of creativity to playfulness is that creativity is often demonstrated in response to a need (Amabile, 1988) and individuals who score high on playfulness often disregard needs (Miller, 1973).

A few studies (Anthony, Clarke, and Anderson, 2000; Holt and Crocker, 2000) have utilized Costa's NEO Five Factor model incorporating five dimensions of personality: neuroticism, extroversion, openness, agreeableness, and conscientiousness (Costa and McCrae, 1992). Individuals with a lower openness rating tended to avoid unfamiliar situations including the highly unstable environment of technology. Individuals who rated higher on openness tended to be more unconventional and more open to broader and more innovative experiences using novel cues to draw inferences about the state of the world around them. These are the risktakers. Openness appears to be a multi-dimensional construct (Wild et al., 1995) that remains a promising area for future research.

A large body of research is available on risk taking and risk perception, mostly related to negative connotations, and was outside the scope of this paper. However, a limited survey of pertinent studies found that intolerance for ambiguity significantly related to the concern about the dangers of technology and that both desire for control and ambiguity intolerance were significant factors in an individual's risk perception (Myers, Henderson-King, and Henderson-King, 1997). Risk perception, risk taking, and risk aversion appeared to exist in a self-fulfilling loop. Individuals who are more willing to take risks did so more often. Individuals who took risks and succeeded were more willing to do so the next time based on the amount of psychological, emotional, or physical value resulting from the success. Individuals who failed were less likely to take risks again based on the amount of damage caused by the failure.

Locus of control refers to one's perception of their ability to control the external events of their world (Presno, 1998). Individuals with an external sense of control believe that individuals external to themselves, such as supervisors or higher management, have control over situations and an individual is unable to enact change because of this perceived lack of control. Self-efficacy, closely related to the construct of locus of control, represents a belief in one's personal abilities. Albert Bandura introduced the construct as a central concept of his Social Cognitive Theory (Bandura, 1977). A number of studies exist correlating the effects of both global and domain-specific self-efficacy to behaviors (Bandura, 1995). In a recent study on the relationship between computer self-efficacy and outcome expectancy, Compeau et al. (1999) found that outcome expectancy as a result of self-efficacy had an impact on how individuals feel about technology and their resultant uses of technology. An individual's self-efficacy level reflects a sense of control over the environment and can enhance or impede motivation (Schwarzer, Mueller, and Greenglass, 1999). Positive self-efficacy, often colloquially labeled a can-do attitude, has a positive impact on motivation.

Woszczynski et al. (2002) proposed that playfulness in computer interactions was a result of an individual's openness to experience and their emotional stability under stressful conditions. The possibility that self-efficacy, risk perception, and tolerance for ambiguity are related to openness and emotional stability may indicate that self-efficacy, risk perception, and tolerance for ambiguity may be measures of an individual's level of playfulness. This cyclical line of thought opens an interesting area for future research.

Innovativeness

Research in the mid-1970s produced several attempts at defining the construct of innovativeness and developing an instrument with which to measure it. Despite a lack of support from previous literature on the value of pursuing the concept of innovativeness as a global trait not directly related to rate of adoption or the number of innovations adopted from a given list, Leavitt and Walton (1975) believed attempting to predict adoption behavior would be valuable to the marketing community. Based on their survey of previous research, Leavitt and Walton (1975, p. 549) defined an innovative individual as an individual who is "open to new experiences and often goes out of his way to experience different and novel stimuli particularly of the meaningful sort." The reliability of their scale was determined to be quite high and the results of the study indicated a moderate degree of independence for the construct of innovativeness. Using this scale, Craig and Ginter (1975) determined seven factors: concern for wastefulness, social desirability, novelty seeking, risk aversion, style consciousness, satisfaction with the status quo, and other directedness. A study by Irani (2000) confirmed these factors, suggesting that early adopters may be intrinsically motivated to adopt a new technological innovation, ignoring minor disadvantages and risks. Skinner (1996) found that the need for uniqueness, somewhat related to novelty seeking, was also substantially correlated to innovativeness.

Kirton (1976) proposed an adaption-innovation continuum related to an individual's preferred cognitive strategies for dealing with change. Kirton considered an individual's position on the adaption-innovation scale as a style, stable across time and situations, with links to certain personality traits (Kirton, 1989). Kirton found three factors related to variations in innovation: originality (the number of ideas that individuals generate), efficiency (coping with tasks in systematic and precise ways), and rule-group conformity (preference to operate within rules and structures). Using the social and cultural dimensions of Kirton's scale as a foundation, Oner (2000) determined that among Turkish adults, innovativeness was encouraged within the context of work, science, and technology, but it was not preferred within the family and interpersonal relationships. This small study involved a group with strong cultural traditions, but the effect of social context on innovation adoption remains a promising field for future study.

Marcinkiewicz (1993) found that innovativeness was a strong predictor of a teacher's use of technology. Innovativeness, defined by Hurt, Joseph, and Cook (1977) as one's willingness to change, contrasts with earlier definitions of innovativeness that focused on the speed at which one adopts (Rogers and Shoemaker, 1971). For the purposes of the current study, the focus was on a sustained high level of adoption and not the rate of adoption. Innovative attitudes were also found to be positively correlated to playfulness (Glynn and Webster, 1993).

More recently, Parasuraman (2000) posited the construct of technology readiness and developed a scale composed of four components related to opinions about technology: optimism (a positive view of technology), innovativeness (a tendency to be a technology pioneer and thought leader), discomfort (perceived lack of control over technology), and insecurity (distrust of technology and skepticism about its ability to work properly). Parasuraman believed these factors moderated the relationships in TAM. According to Yi, Tung, and Wu (2003), individuals ranking high in technology innovativeness have a stronger intrinsic motivation to use new technologies and enjoy the stimulation related to the process of experimentation. According to Yi, Tung, and Wu's findings, both optimism and innovation moderate perceived usefulness and behavioral intention, but neither interacts with perceived ease of use, suggesting that for more innovative individuals, perceived usefulness becomes less of a factor in adoption.

Essentialness Beliefs

The use of the attribute of expendability was established by Rieber and Welliver (1989) in their model of instructional transformation to describe the continuum of teacher involvement with technology. Initial exposure to technology includes becoming familiar with the technology (familiarization). The teacher then begins to use the technology in the classroom (utilization). As technology use becomes critical to the teacher’s style of delivery (integration), the teacher becomes more aware of the changes in their role as teacher. At that point, the teacher begins to readjust the student-teacher-computer relationship (reorientation). When this relationship has been optimized, the teacher enters the final level (evolution) and continues to improve instruction through the systematic implementation of information technology.

Marcinkiewicz (1993) inverted the attribute of expendability to develop the construct of essentialness. Marcinkiewicz categorized teachers' computer use into three levels -- non-use, utilization, and integration -- using a forced-choice, 4-question Level of Use (LU) assessment tool. Non-use implies the absence of any use of computers at all for teaching. Teachers who use technology in the classroom are placed into one of the two remaining groups based on how expendable they feel technology is to their personal teaching style. The teacher must decide if they feel the use of instructional technology is critical and indispensable to their instruction or if the use of instructional technology is supplemental and not essential.

CHAPTER 3

METHODOLOGY

Introduction

This correlational study focused on the personality characteristics of cognitive playfulness, innovativeness, and essentialness beliefs in PK-12 Texas educators who were able to make an enduring change in pedagogy based on the use of technology in the curriculum. The goal was to develop a theoretical model that, while acknowledging the multitude of external and internal factors that affect the adoption of any innovation, attempted to isolate the characteristic of playfulness to explain why some educators routinely integrate technology into their lessons more often and at a higher level than others. The conditions required for innovation adoption found in previous research were organized into one or more of three broad categories. The first category included variables regarding values and risks, such as an individual's beliefs about the value of information technology, the role of the educator, and society's expectations. It also included the individual's concerns regarding self-image, possible damage to or misuse of the equipment, and lack of time. The second category included personal skills from the individual's past experiences and education, both formal and informal, and their perceptions of external support. The third category, which was the focus of the current study, included intrinsic motivational factors such as the individual's personality characteristics of cognitive playfulness, innovativeness, and an individual's essentialness beliefs. The proposed model in found in Appendix B. Based on existing research, the constructs of cognitive spontaneity, expressiveness, fun, creativity, and silliness form the factors of playfulness. Cognitive playfulness may have either a direct or an indirect effect on the probability of an individual's making an enduring change.

This chapter covers the following topics: identified population, identified sample, research hypotheses, research design, pilot study, instrumentation, data collection procedures, data analysis procedures, and human subjects protection.

Identified Population

The population for the current study was public and private PK-12 teachers in Texas who participated in the Intel® Teach to the Future program. This international program, funded by grants from the Intel Foundation and by the Bill & Melinda Gates Foundation, began in January 2000 and with a replication grant from the Texas Telecommunications Infrastructure Fund (TIF), continued through December 2003. Through additional support from the Intel Foundation, the program remains funded through December 2004. The University of North Texas (UNT) continues to serve as one of the two Regional Training Agencies (RTAs) for Texas, supporting school districts and private schools in north and west Texas. The RTA at Texas A&M University supports south and east Texas districts. It is estimated that by December 31, 2003, approximately 40,000 Texas teachers had participated in this program and that number continues to grow.

Intel and the Institute of Computer Technology (ICT) trained Senior Trainers (STs) in the delivery of the 40-hour Intel Teach to the Future curriculum. More information about the Intel Teach to the Future program and curriculum can be found at www.intel.com/education/teach. The curriculum, written by ICT and pilot tested through the Intel Applying Computers in Education (ACE) program, focuses on thematic unit development including technology integration and the educational concept of essential questions. Essential questions are "…provocative questions designed to engage student interest and guide inquiry into the important ideas in a field of study. Rather than yielding pat answers, essential questions are intended to stimulate discussion and rethinking over time" (Wiggins, McTighe, & McTighe, 1998, p. 277). In addition, essential questions are open-ended, concept-based, universal, and abstract. Moreover, essential questions are multi-layered, have no one right answer, and may be global enough to serve as a focus for an entire year's curriculum. Essential questions also reside at the top of Bloom's Taxonomy (Bloom, 1956), requiring students to evaluate, synthesize, and analyze to make meaning from the information gathered. For more information on essential questions see Wiggins, McTighe, and McTighe (1998).

Essential questions form the foundation of the Intel Teach to the Future unit plan around which the 40-hour curriculum is built. The curriculum of the Intel Teach to the Future program uses the term *unit (*or *unit plan)* to refer to teaching plans that integrate technology into project work in the classroom (Appendix A). Individuals develop a unit based on a lesson currently taught with emphasis placed on integrating technology in a way that focuses on standards-based learning goals, project-based learning, authentic and open-ended tasks, group work, and performance assessment (Intel Education: Unit & Project Plans, 2004). Although the project is PC-based using Microsoft® Office products, the format is flexible enough to use with any platform or productivity software. Little of the curriculum addresses hardware or software training. The focus of the 40-hour curriculum is project-based learning, integrating technology where appropriate.

Identified Sample

Participants in the correlational study were classroom teachers from 33 school districts and one private school in north central Texas who were selected to be 1st-year Participant Teachers in a 3-year information technology grant program, Intel® Teach to the Future. Districts involved in the first year of the study included districts of almost all sizes (extremely small to extremely large) in rural, suburban, and urban settings. A private school also participated in the first year of the study. Participating teachers, who represented a wide variety of grade levels and teaching fields, were required to have basic technology skills and access to classroom technology in order to participate in the program. While this was not a statistically random selection of teachers throughout the state, it does reflect a broad demographic scope. Because these districts self-selected to participate in the first year of program, it is recognized that the results of the current study are only generalizable to other participants in this program and may be limited to only first year participants. First-year participants were chosen in order to maximize the demonstration of enduring change evidenced over a 3-year period.

Intel Senior Trainers trained and certified 100 selected teachers from the area served by the University of North Texas (UNT) RTA as Intel Master Teachers (MTs) during the summer of 2000. The Master Teachers were each expected to deliver the same training to 20 classroom teachers, called Participant Teachers (PTs), in their own districts during the following school year. As would be expected, not all MTs had full classes of 20. The total number of first-year PTs was 1,748. Of these, 31 contact records contained no email addresses. Many of the remaining email addresses were no longer valid. Although it was estimated that approximately 1,500 of the emails would still reach the Participant Teachers, this estimate proved to be high. Two attempts were made to locate valid email addresses for all emails that bounced.

Using the Participant Teachers from the Intel Teach to the Future program was expected to provide a relatively normally-distributed sample based on the teacher's level of adoption and assured that participants not only had the basic technology skills but had also been exposed to methods for technology integration into the curriculum. It also assumed that they had at least some access to the technology and the Internet in their classrooms, as this was a requirement for participation in the grant. Martin, Gersick, Nudell, and McMillan-Culp (2002) found that 78% of the teachers completing the Intel Teach to the Future training implemented their unit in their classroom that same year. This fact demonstrated the teachers' ability to integrate technology into their curriculum, but did not in itself demonstrate enduring change. Instead, the teacher's current ability to use technology at a high level in the classroom approximately three years after their initial training was used to demonstrate enduring change.

Hypotheses to be Tested

The following null hypotheses were tested:

1. There is no positive relationship between an individual's ability to sustain a high level of information technology usage as measured by an individual’s Apple Classroom of Tomorrow (ACOT) stage and the individual's level of cognitive playfulness as measured by their score on the Adult Playfulness Scale (APS).
2. There is no positive relationship between an individual's ability to sustain a high level of information technology usage as measured by an individual’s ACOT

stage and their level of innovativeness as measured by the individual's score on Marcinkiewicz’s Innovativeness Scale (IS).

3. There is no positive relationship between an individual's ability to sustain a high level of information technology usage as measured by an individual’s ACOT stage and their perception of essentialness of information technology use as measured by the individual's score on Marcinkiewicz’s 4-question Level of Use (LU) assessment instrument.

Research Design

Due to the exploratory nature of the current study, correlations (Pearson and Kendall tau-b) and descriptive statistics were used to investigate relationships between the predictor variables and the criterion variable. No joint effects of the predictor variables were hypothesized.

The predictor variables were playfulness, innovativeness, and essentialness beliefs. The criterion variable was a sustained ability to use information technology at a high-level in the classroom as evidenced by the individual's ACOT stage using the Apple Classroom of Tomorrow Stages of Technology Integration.

Pilot Study

A pilot study was conducted by sending emails containing the instrument URL to the second-year Master Teachers and requesting them to have one of their Participant Teachers respond to the survey. Second-year Master Teachers were from different districts than Master Teachers participating in the first year of the program. This assured a group similar to, but mutually exclusive from, the actual target sample. Of the 100 emails sent, 22 responses were received. 20 of the respondents answered all questions on the survey.

The internal consistency reliability (Cronbach's Alpha) for the Adult Playfulness Scale was .66. Although this is generally considered within the acceptable range, it was much lower than the literature had suggested. Because Glynn and Webster (1992) found the scale to have consistently high reliabilities (alpha µ .87), and a test-retest reliability of .84, suggesting strong internal consistency and homogeneity of items, the playfulness scale was deemed acceptable for use in the actual study.

The Innovativeness Scale demonstrated an internal consistency reliability (Cronbach's Alpha) of .64. Again, supported by the literature asserting the scale to have an internal reliability of .89 (Hurt et al., 1977, p. 61), it was determined that the moderate reliability may be an effect of the small sample size and the instrument was deemed acceptable for use.

Marcinkiewicz's Level's of Use Scale proved more problematic than expected. Ten of the 22 respondents (46%) gave inconsistent responses to the forced-choice questions, bringing into doubt the clarity and specificity of the wording used. Despite this situation, it was decided to include the instrument in the final survey and investigate the inconsistent answers further.

Although the sample size was small, data analysis showed interesting results. The measure of the criterion variable, the ACOT stages, demonstrated a normal curve with a slight skew toward the higher end. Measured on a scale of 1 - 5, with 1 representing Entry stage use and 5 representing Invention stage use, it was not unexpected that results showed few or no stage-1 responses as all respondents theoretically had availability to information technology and training in integration of information technology prior to the survey.

Playfulness scores exhibited a normal distribution with a "high playfulness" group appearing at a score above 120. Playfulness scores were found to be significantly correlated to the ACOT stages (p = .49), significant at the .05 level on a 1-tailed test). These results were deemed promising.

Innovativeness scores in the pilot group appeared to be bi-modal with an inordinate percentage clustering on the low innovativeness end of the scale while a suspicious bubble of scores appeared on the high innovativeness end of the scale. It was determined that if this bi-modal distribution appeared in the final results, these two groups would be analyzed separately as well as together. While the innovativeness scores on the pilot did not demonstrate a significant correlation to the ACOT stages, innovativeness scores and ACOT stages may still be related.

As discussed above, individuals had trouble with the essentialness test. When including the inconsistent responses, Kendall's tau-b showed no significant correlation. However, when the inconsistent responses are removed, Kendall's tau-b showed a significant correlation (.42, significant at the .05 level on a 1-tailed test). Those who viewed instructional technology as supplemental *and* not essential appeared to have lower ACOT stages than those who viewed instructional technology as critical *and* indispensable. Consistent with the other pilot data, these results supported further research in these areas.

Instrumentation

A review of the availability, appropriateness, and fiscal feasibility of measurement tools for the predictor variables and the assessment of technology adoption revealed several suitable instruments. The Adult Playfulness scale (APS) (Glynn and Webster, 1992) was selected as a measurement of the individual's cognitive playfulness, and the Innovativeness Scale (IS) and the Levels of Use Scale (LU) (Marcinkiewicz, 1994) were chosen to measure the individual's innovativeness and essentialness beliefs, respectively. The Apple Classroom of Tomorrow (ACOT) Stages of Technology Integration was administered as a measure of the criterion variable, the ability to use information technology at a high level. General demographic information, technology use information, other technology opinion data, and information on the impact of the training received in the Intel Teach to the Future program were gathered. Although not all of the latter data was analyzed for the current study, future research might deem the data useful. The demographics and other questions for future research comprised the first section of the final instrument used in the current study. The Innovativeness Scale, the Levels of Use Scale, the Adult Playfulness Scale, the ACOT Stages of Technology Integration, and two open-ended questions comprised the remaining sections. The final instrument (Appendix C) was placed on the Web at http://insight.southcentralrtec.org/ilib/dissertation/dissertation.html for electronic delivery and response.

The Innovativeness Scale (IS) (Marcinkiewicz, 1994) is a 10-item, self-report measure and comprised the first 10 questions of section 2. Each item was scored from 1 to 7 (extremely disagree, quite disagree, slightly disagree, neither, slightly agree, quite agree, and extremely agree respectively). Seven items (questions 1, 2, 3, 4, 6, 8, and 10) were reverse scored in order for a higher score to indicate a higher degree of innovativeness. The items were summed to calculate a single Innovativeness Score. Possible scores ranged from 10 to 70.

Based on the 20-item innovativeness scale developed by Hurt et al. (1977), the scale appeared one-dimensional and demonstrated good predictive validity. The shortened, 10-item form was used to expedite completion of the survey instrument. The shortened form consists of 10 of the original 20 items selected because the items had the highest item-total correlations. The shorter version demonstrated an internal reliability of alpha = .89 (Marcinkiewicz, 1994) and a correlation with the long form of .92. Internal reliability of the Innovativeness Scale with the current sample was good (alpha = .77).

Questions 11 and 12 of section 2 of the instrument for the current study referred to usefulness and ease of use concepts and were not calculated as part of the Innovativeness Scale.

The Level of Use Scale (LU) (Marcinkiewicz, 1993) formed section 3 and measured the variable operationally defined as essentialness beliefs. The LU consists of four paired comparison questions using the adjectives *not essential*, *supplemental*, *critical*, and *indispensable*. The response procedure uses a forced-choice method that should result in two patterns of response. There was also an appropriate selection if the teacher does not use technology in the classroom at all. Participants who do not use technology at all in their classrooms were analyzed separately. Participants submitting inconsistent responses on this section were not included in the analyses related to essentialness beliefs. This instrument demonstrated content and face validity. An item used in the original scale was used to calculate criterion-related validity. The LU scale was found to have a high Coefficient of Reproducibility (*CR* = .96, kappa = .72) (Marcinkiewicz, 1993).

Nominal scores of 0, 1, and 2 represented valid responses as defined by Marcinkiewicz (1993). Scores of 3 were calculated in the current study in order to analyze a group that Marcinkiewicz did not. Scores of 9 represented inconsistent responses that did not fit into the categories receiving scores of 0, 1, 2, or 3 in the current study. Further explanation of the nominal scores follows.

Individuals who answered all 4 questions (#13 - #16) with option C ("I do not use information technology for teaching at all.") were given an LU score of 0 and were considered non-users (Figure 1).

13.	a. In my instruction, the use of technology is supplemental.
	b. Technology is critical to the functioning of my instruction.
	c. I do not use information technology for teaching at all.
14.	a. The use of technology is not essential in my instruction.
	b. For my teaching, the use of technology is indispensable.
	c. I do not use information technology for teaching at all.
15.	a. Technology is critical to the functioning of my instruction.
	b. The use of technology is not essential in my instruction.
	c. I do not use information technology for teaching at all.
16.	a. For my teaching, the use of technology is indispensable.
	b. In my instruction, the use of technology is supplemental.
	c. I do not use information technology for teaching at all.

Figure 1. Response Pattern Assigned LU = 0

Individuals were given an LU score of 1 if they selected option A on questions #13 and #14 AND option B on questions #15 and #16. Responses in this pattern represented an individual who believed that in their instruction, the use of technology was supplemental AND that the use of technology was not essential in their instruction (Figure 2).

13.	a. ◉ In my instruction, the use of technology is supplemental.
	b. ○ Technology is critical to the functioning of my instruction.
	c. ○ I do not use information technology for teaching at all.
14.	a. ◉ The use of technology is not essential in my instruction.
	b. ○ For my teaching, the use of technology is indispensable.
	c. ○ I do not use information technology for teaching at all.
15.	a. ○ Technology is critical to the functioning of my instruction.
	b. ◉ The use of technology is not essential in my instruction.
	c. ○ I do not use information technology for teaching at all.
16.	a. ○ For my teaching, the use of technology is indispensable.
	b. ◉ In my instruction, the use of technology is supplemental.
	c. ○ I do not use information technology for teaching at all.

Figure 2. Response Pattern Assigned LU = 1

Individuals were given an LU score of 2 if they selected option B on questions #13 and #14 AND option A on questions #15 and #16. Responses in this pattern represented an individual who believed that technology was critical to the functioning of their instruction AND that for their teaching, the use of technology was indispensable (Figure 3).

13.	a. ◯ In my instruction, the use of technology is supplemental.
	b. ◉ Technology is critical to the functioning of my instruction.
	c. ◯ I do not use information technology for teaching at all.
14.	a. ◯ The use of technology is not essential in my instruction.
	b. ◉ For my teaching, the use of technology is indispensable.
	c. ◯ I do not use information technology for teaching at all.
15.	a. ◉ Technology is critical to the functioning of my instruction.
	b. ◯ The use of technology is not essential in my instruction.
	c. ◯ I do not use information technology for teaching at all.
16.	a. ◉ For my teaching, the use of technology is indispensable.
	b. ◯ In my instruction, the use of technology is supplemental.
	c. ◯ I do not use information technology for teaching at all.

Figure 3. Response Pattern Assigned LU = 2

Because the LU consists of four paired-comparison questions using the forced-choice method, Marcinkiewicz (1993) considered the patterns described above as the only consistent responses. However, a relatively large group (18 respondents) demonstrated a fourth consistent pattern, causing some reflection. Individuals in this group selected option A on questions #13 and #15 AND option B on questions #14 and #16 (Figure 4). Responses in this pattern represented an individual who believed that for their teaching, the use of technology was indispensable (#14) AND critical (#15) but that for their instruction, the use of technology was supplemental (#13 and #16). This pattern may represent an acceptance of the value of information technology, but that the use of technology is still considered as a supplemental tool.

13.	a. ◉ In my instruction, the use of technology is supplemental.
	b. ○ Technology is critical to the functioning of my instruction.
	c. ○ I do not use information technology for teaching at all.
14.	a. ○ The use of technology is not essential in my instruction.
	b. ◉ For my teaching, the use of technology is indispensable.
	c. ○ I do not use information technology for teaching at all.
15.	a. ◉ Technology is critical to the functioning of my instruction.
	b. ○ The use of technology is not essential in my instruction.
	c. ○ I do not use information technology for teaching at all.
16.	a. ○ For my teaching, the use of technology is indispensable.
	b. ◉ In my instruction, the use of technology is supplemental.
	c. ○ I do not use information technology for teaching at all.

Figure 4. Response Pattern Assigned LU = 3

All remaining response patterns were deemed inconsistent responses and were not analyzed. Three examples of possible inconsistent responses (LU = 9) as defined by Marcinkiewicz (1993) follow:

1. Responses from an individual who selected option A for all 4 questions (Figure 5) would be interpreted to mean that the individuals believed:

- In their instruction, the use of technology was supplemental,
- The use of technology was not essential in their instruction,
- Technology was critical to the functioning of their instruction, and
- For their teaching, the use of technology was indispensable.

Since an individual could not reasonably consider technology not essential to their instruction while at the same time believing it to be critical and indispensable, such patterns were deemed to represent inconsistent response patterns and were assigned LU scores = 9.

13.	a. In my instruction, the use of technology is supplemental.
	b. Technology is critical to the functioning of my instruction.
	c. I do not use information technology for teaching at all.
14.	a. The use of technology is not essential in my instruction.
	b. For my teaching, the use of technology is indispensable.
	c. I do not use information technology for teaching at all.
15.	a. Technology is critical to the functioning of my instruction.
	b. The use of technology is not essential in my instruction.
	c. I do not use information technology for teaching at all.
16.	a. For my teaching, the use of technology is indispensable.
	b. In my instruction, the use of technology is supplemental.
	c. I do not use information technology for teaching at all.

Figure 5. Example 1 of Response Pattern Assigned LU = 9

2. Responses from an individual who selected option A for the first question and B for the remaining questions (Figure 6) would be interpreted to mean that the individuals believed:

- In their instruction, the use of technology was supplemental,
- For their teaching, the use of technology was indispensable, and
- The use of technology was not essential in their instruction.

Since an individual could not reasonably consider technology not essential to their instruction while at the same time believing it to be indispensable, such patterns were deemed to represent inconsistent response patterns and were assigned LU scores = 9.

13	a. ◉ In my instruction, the use of technology is supplemental.
	b. ○ Technology is critical to the functioning of my instruction.
	c. ○ I do not use information technology for teaching at all.
14	a. ○ The use of technology is not essential in my instruction.
	b. ◉ For my teaching, the use of technology is indispensable.
	c. ○ I do not use information technology for teaching at all.
15	a. ○ Technology is critical to the functioning of my instruction.
	b. ◉ The use of technology is not essential in my instruction.
	c. ○ I do not use information technology for teaching at all.
16	a. ○ For my teaching, the use of technology is indispensable.
	b. ◉ In my instruction, the use of technology is supplemental.
	c. ○ I do not use information technology for teaching at all.

Figure 6. Example 2 of Response Pattern Assigned LU = 9

3. Responses from an individual who selected option A for the first three questions and B for the last question (Figure 7) would be interpreted to mean that the individuals believed:

- In their instruction, the use of technology was supplemental,
- The use of technology was not essential in their instruction,
- Technology was critical to the functioning of their instruction.

Since an individual could not reasonably consider technology not essential to their instruction while at the same time believing it to be critical, such patterns were deemed to represent inconsistent response patterns and were assigned LU scores = 9.

13	a. ◉ In my instruction, the use of technology is supplemental.
	b. ○ Technology is critical to the functioning of my instruction.
	c. ○ I do not use information technology for teaching at all.
14	a. ◉ The use of technology is not essential in my instruction.
	b. ○ For my teaching, the use of technology is indispensable.
	c. ○ I do not use information technology for teaching at all.
15	a. ◉ Technology is critical to the functioning of my instruction.
	b. ○ The use of technology is not essential in my instruction.
	c. ○ I do not use information technology for teaching at all.
16	a. ○ For my teaching, the use of technology is indispensable.
	b. ◉ In my instruction, the use of technology is supplemental.
	c. ○ I do not use information technology for teaching at all.

Figure 7. Example 3 of Response Pattern Assigned LU = 9

The scoring rubric was complex and better described in graphic form (Table 1).

Table 1

Scoring Rubric for Levels of Use Instrument - Essentialness Belief Scores

If 1st 2 responses =	AND second 2 responses =	Score	Meaning
3	3	0	Does not use technology
1	2	1	Supplemental AND not essential
2	1	2	Critical AND indispensable
1 & 2 (respectively)	1 & 2 (respectively)	3	Critical AND indispensable but use is supplemental
All other response combinations are inconsistent		9	Inconsistent responses

Section 4 contained the Adult Playfulness Scale (APS). Each item was scored from 1 to 7 (extremely disagree, quite disagree, slightly disagree, neither, slightly agree, quite agree, extremely agree, respectively). Items 2, 3, 5, 6, 8, 12, 14, 16, 17, and 19 were reverse scored in order for a higher score to represent a higher level of playfulness. The scores were summed to calculate a single Playfulness Score. Possible scores ranged from 21 to 147. Internal reliability of the innovativeness scale with the current sample was very good (alpha = .81).

The APS was developed as a scale suitable for the workplace with the goal of distinguishing high playfulness from low playfulness (Glynn and Webster, 1992). This 21-item, self-rated, context-free scale attempts to measure playfulness as a multidimensional construct comprised of cognitive, affective, and behavioral components. Previous scales such as those created by Jackson (1984) were found by Costa and McCrae (1988) to lack the behavioral element. Also, Jackson's cognitive scale included adjectives such as *logical* and *rational* later found to be unrelated to the construct of playfulness.

Although directly related to the Micro-Computer Playfulness scale (Webster and Martocchio, 1992), the APS measures the relatively stable trait of playfulness as opposed to a situation-specific playfulness by instructing the individual to "describe how you would characterize yourself *in general*." The scale demonstrated consistently high scale reliabilities (alpha ≥ .87) and a test-retest reliability of .84 (Glynn and Webster, 1992). Results of Glynn and Webster's initial assessment of the instrument also supported concurrent, convergent, incremental, and predictive validity. The adjectives selected for the final instrument demonstrated good discriminate validity in differentiating work from play and good face validity as a personality measure. Using the original longer version, Glynn (1992) found spontaneity, expressiveness, fun, creativity, and silliness to account for 57.5% of the variance in her study, correlating to traits found in the playfulness of children and adolescents in previous research (Lieberman, 1977). Playfulness was described as unconstrained, voluntary, and need independent (Factor I - Spontaneous, alpha = .83), evocative and enjoyable (Factor II - Expressiveness, alpha = .82), humorous and fun-loving (Factor III - Fun, alpha = .78), inventive (Factor IV - creative, alpha = .81), and purposeless or irrational (Factor V - Silly, alpha = .73). The scale showed good distributional properties across 5 studies done by Glynn and Webster (1992), and evidenced good internal consistency and homogeneity of items. The final short version of the Adult Playfulness Scale used in the current study loaded high on the factors of creativity, spontaneity, and inquisitiveness (Allen, 1998).

Section 5 consisted of the Apple Classroom of Tomorrow (ACOT) Stages of Technology Integration, in which the individual described their current level of understanding, use, and ability to integrate information technology in their teaching. ACOT stages range from stage 1 (I am trying to learn the basics of using technology.) to stage 5 (I am prepared to develop entirely new learning environments that utilize technology as a flexible tool.). Figure 8 lists the wording of the Stages of Technology Integration scale as presented in the survey (Appendix C). This scale used by permission of David Dwyer, Tom Clark, and the Apple Education Foundation.

ACOT 1: Entry I am trying to learn the basics of using technology.
ACOT 2: Adoption I can successfully use technology on a basic level (e.g., use drill and practice software in classroom instruction).
ACOT 3: Adaptation I am discovering technology's potential for increased productivity (e.g., use of word processors for student writing).
ACOT 4: Appropriation I can use technology "effortlessly" as a tool to accomplish a variety of instructional and management goals.
ACOT 5: Invention I am prepared to develop entirely new learning environments that utilize technology as a flexible tool.

Figure 8. ACOT Stages of Technology Integration

ACOT scores represent self-reported stages of technology adoption (Dwyer et al., 1991). Entry stage (ACOT = 1) refers to a teacher who is still learning the basics of a technology, e.g. how to set up the equipment and operate it. At the Adoption stage (ACOT = 2), the teacher is beginning to use the technology for management duties, e.g. grade books and quizzes, to support traditional instruction. The teacher enters the Adaption stage (ACOT = 3) when use of software such as word processors and spreadsheets or commercially-produced content area programs supports instruction. At the Appropriation stage (ACOT = 4), the focus turns to new approaches to teaching, such as collaborative, project-based technology use, and technology becomes one of several instructional tools. At the Invention stage (ACOT = 5), the highest ACOT stage, teachers report a readiness to adjust their fundamental perceptions of instruction toward the usage of technology as a flexible tool. The limitations of the descriptions and range of the ACOT stages are discussed in Chapter 5.

Background of ACOT Project

The Apple Classroom of Tomorrow Project (ACOT), begun in 1985, was a collaborative long-term research and development effort between public schools, universities, research agencies, and Apple Computer, Inc. ACOT initially included seven classrooms that represented a cross-section of America's elementary and secondary schools. The goal of the project was to study how access to and routine use of interactive computer technologies by teachers and students might change teaching and learning (Apple Classroom of Tomorrow, 2004). The ACOT program adhered to the constructivist philosophy of collaborative, student-directed learning. Results of the study can be found at www.apple.com/education/k12/leadership/acot/library.html.

Basis of ACOT Stages

The ACOT research produced an adoption model for the use of technology in the classroom known as the Stages of Instructional Evolution and a related scale referred to as the Stages of Technology Integration. Based on interviews with the teachers, classroom observations, teacher self-reports, email, and other documents collected during a 3-year qualitative, longitudinal study, David Dwyer and his colleagues developed a grounded theory generalizing the experience of dozens of elementary and high school teachers in five cities. The data were triangulated to assure veracity of the observations. The model demonstrates strong face validity, evident from the number of responses received to articles, presentations, and a book that resulted from the work (D. Dwyer, personal communication, June 17, 2004). The ACOT study has served as a framework for many doctoral dissertations and continues to be referenced as "a foundation for research related to using technology as an integral part of teaching and learning." (Barron, Kemker, Harmes, and Kalaydjian, 2003, p. 496).

External Validity of ACOT Instrument

According to Newhouse (2001), the ACOT model and other concerns-based adoption models (CBAM), such as the instructional transformation model and the Project Information Technology (PIT) model are based on Fuller’s model (Fuller, 1969), but are specific to the implementation of computers in schools. Currently, many of the models being used in research on technology in the classroom have their foundations in the CBAM project from the Southwest Educational Development Laboratory at the University of Texas (Newhouse, 2001).

The CBAM model originally consisted of three dimensions: stages of concern (SoC), levels of use (LoU), and innovation configuration (IC). SoC and LoU focus on the implementor and the IC considers the nature of the innovation. The SoC describes an individual's perception and feelings about an innovation; the LoU describes at what level the individual is using the innovation (see Table 2). Most current research centers on the implementor. Hall, Loucks, Rutherford, and Newlove (1975) proposed the LoU as a measure of the level of use of an innovation and many researchers have employed this scale to report the level of technology utilization since that time (Christensen and Knezek, 2001, Collis, 1994; Knezek and Christensen, 2002).

Table 2

Stages of Concern and Levels of Use

Stages of Concern		Levels of Use
0 Awareness	0	Nonuse
1 Informational	I	Orientation
2 Personal	II	Preparation
3 Management	III	Mechanical Use
4 Consequence	IV A	Routine
5 Collaboration	IV B	Refinement
6 Refocusing	V	Integration
	VI	Renewal

Over the past decade, researchers have increasingly come to utilize the ACOT five-step process (Sandholtz, Ringstaff, and Dwyer, 1997), which is based on the work of Hall and Loucks (1977), as an indicator of an educator's ability to integrate technology into the classroom (Miller, Meier, Payne-Bourcy, Shablak, Newmann, Wan, Casler, and Pack, 2003). According to Miller et al (2003), ACOT teacher stages span the same continuum of the time-intensive process of integrating technology into the classroom as the six stages of adoption of technology (Table 3) "used extensively in research done by Soloway and Norris (1999), which adapted the earlier work of Christensen and Knezek (1998)" (Miller et al, p. 5). Indeed, an analysis of data gathered in Texas in 2003 appears to confirm the shared communality of ACOT, CBAM LoU, and Stages of Adoption of Technology as measures of ability to integrate technology into the classroom. Research involving 1,179 K-12 teachers from a suburban school district in North Texas has shown strong concurrent validity between the ACOT Stages of Technology Integration Scale employed in the current study and the LoU scale of the CBAM (r = .562, p < .0001, R^2 = .32), as well as between the ACOT Stages of Technology Integration Scale and Stages of Adoption of Technology (r = .632, p < .0001, R^2 = .40) (Christensen, personal communication, July 6, 2004).

Table 3

Stages of Adoption of Technology and ACOT Stages

Stages of Adoption of Technology	ACOT Stages
1 Awareness	1 Entry
2 Learning the Process	2 Adoption
3 Understanding and application of the process	3 Adaption
4 Familiarity and confidence	4 Appropriation
5 Adaptation to other contexts	5 Invention
6 Creative application to new contexts	

The combined works by previous researchers and the validity studies conducted in Texas establish the ACOT Stages of Technology Integration scale as a viable instrument for assessing an educator's ability to integrate technology into the classroom environment.

Data Collection Procedures

Although some of the original participant teachers (PTs) were known to have left their districts and were no longer available, 1,081 email addresses were available and presumed valid for the remaining participants. Because of their participation in the Intel Teach to the Future program, those 1,081 teachers were assumed to be users of the Internet and email, making online delivery of the survey instrument possible, thus reducing costs and delivery time, and making the return of the survey instruments much easier. The survey instrument was posted as a single unit to a secure server at the Texas Center for Educational Technology at the University of North Texas in Denton, Texas. The delivery form automatically fed into an Excel spreadsheet minimizing data entry errors. Participants could exit the survey at any time and no default values were set for any question.

Each PT in the sample received an email informing them of the study and requesting their participation. Full disclosure as required by human subjects research guidelines was given. The email included the URL required to access the survey instrument. Any participant who wished to register for a drawing for a key-disk memory device could do so by entering their email address at the end of the survey. Participants' email addresses were used only for the drawing and will not be used for any other purpose in the future.

Unfortunately, the email requesting participation was sent on the same day that a major worldwide virus attack occurred. In order to protect themselves, some email services and many school districts temporarily closed their networks in order to contain the effects of the virus. This policy caused the delivery failure of many participation request emails. Even when the second request was emailed, few additional respondents replied. Because of this unforeseen event, the deadline was extended and another request for participation was sent via email two weeks later. The third request resulted in an improved response rate.

Data Analysis Procedures

Descriptive statistics were collected and analyzed for the following demographic items: age, gender, and years of experience with technology. Other responses regarding pedagogy and technology use were also analyzed. Hypothesis testing was carried out using the appropriate correlation coefficient for each major research question.

1. Research question 1: Pearson product-moment correlation between ACOT stages and Playfulness scores
2. Research question 2: Pearson product-moment correlation between ACOT stages and Innovativeness scores
3. Research question 3: Kendall's tau-b correlation between ACOT stages and Essentialness Belief scores (a nominal variable)

The results were analyzed using the Statistical Program for the Social Sciences® (SPSS 12.0 for Windows) data analysis software (©SPSS, Chicago, IL, www.spss.com).

Human Subjects Protection

The survey used in the current study contained questions regarding the use of information technology in the classroom, attitudes toward information technology, and some personality and demographic questions. Filling out the online survey was estimated to take between 30-45 minutes. The evaluation was used to determine the relationship between certain personality traits and information technology use. Determining the personality characteristics of the various levels of information technology users may be helpful in improving design of professional development, curriculum, and support systems to encourage a higher level of information technology use by educators and students to prepare them for the future.

There were no foreseeable risks to completing the online survey. The individual was free to withdraw consent and discontinue participation in the study at any time without consequences. There might be unforeseen circumstances that develop under which an individual's participation may be terminated by the investigator. Answers to the survey are stored on a secure server at the University of North Texas. Only the researchers and their research assistants have access to the data using a secure password. Only the last 4 digits of social security numbers are used as a key for the database. School name was only used in the unlikely occurrence of a duplicate key.

There is a possibility that data from this survey could be used for further research beyond the initial study. Such a study would be initiated only upon additional approval from the University of North Texas Institutional Review Board. The board would examine any request for further research and would require stringent control of confidentiality and security of the data. Written and oral reports will never contain information about an individual person nor will any person be identified in such reports.

This research study has been reviewed and approved by the UNT Committee for the protection of Human Subjects. UNT IRB can be contacted at (940) 565-3940 or http://www.unt.edu/ospa/irb/contact.htm with any questions or concerns regarding this study. (See Appendix D for complete form.) Data collection did not occur until approval was granted from the IRB.

CHAPTER 4

FINDINGS

Introduction

The current study examined the relationships of cognitive playfulness, innovativeness, essentialness beliefs, and a sustained high level of use of information technology in the classroom. Demographic information, as well as the findings and analyses of each research question, are presented in this chapter. The following null hypotheses were tested:

1. There is no positive relationship between an individual's ability to sustain a high level of information technology usage as measured by an individual’s Apple Classroom of Tomorrow (ACOT) stage and the individual's level of cognitive playfulness as measured by their score on the Adult Playfulness Scale (APS).
2. There is no positive relationship between an individual's ability to sustain a high level of information technology usage as measured by an individual’s ACOT stage and their level of innovativeness as measured by the individual's score on Marcinkiewicz’s Innovativeness Scale (IS).
3. There is no positive relationship between an individual's ability to sustain a high level of information technology usage as measured by an individual’s ACOT stage and their perception of essentialness of information technology use as measured by the individual's score on Marcinkiewicz’s 4-question Level of Use (LU) assessment instrument.

Pearson product-moment correlations were computed to investigate the relationship between the predictor variables of playfulness and innovativeness and the criterion variable, the individuals' ACOT stages. Due to the non-interval nature of the LU scale, a Kendall's tau-b correlation was computed to investigate the relationship between the predictor variable of essentialness beliefs and the criterion variable, the individuals' ACOT stages. The SPSS PC statistical package version 12.0 for Windows was used to perform the statistical analysis.

Description of Participants

The participants in the current study were Participant Teachers (PTs) from the first year of the Intel Teach to the Future program. During 2000, 6,971 PTs were trained in the United States (Martin, K., personal communication, May 26, 2004). The total number of first-year PTs enrolled in the program through the UNT RTA was 1,748. Of these, 31 records contained no email addresses. As anticipated, many of the remaining email addresses were no longer valid but the number of emails returned as non-deliverable was larger than expected. Although due to the nature of the Internet it was difficult to be absolutely certain, it was estimated that approximately 636 emails did not reach the Participant Teachers; that is, notification was received that the emails were non-deliverable. Little success was gained from the two additional attempts to locate valid email addresses for all emails that were not delivered. Out of the 1,081 email contacts presumed to have reached the intended recipients, 281 responses were received, representing a response rate of approximately 26% of the contacted participants. It must be noted that unfortunate timing on the part of the researcher resulted in the initial request for participation being sent on the same day as a major virus attack when many districts had just shut down their email systems and many people were afraid to open emails from unknown senders. Of the responses received, 75 individuals did not respond to the question determining the individual's ACOT stage. Because the ACOT stage was the criterion variable, these 75 responses were removed from the data set leaving an *N* = 206. Because of incomplete questionnaires, the number of cases for each scale and each correlation were not identical.

The respondents were 86% female (*n* = 178) and 14% male (*n* = 28) (Table 4), which was fairly representative of the teaching profession (Texas PK-16 Public Education Information Resource, 2004) and of the Intel Teach to the Future Participant Teachers, as well (K. McMillan-Culp, personal communication, May 24, 2004). Ages of respondents (Table 5) ranged from 27 to 68 (*M* = 45.79, *SD* = 10.02). The distribution of the ages appeared to be bi-modal, with a dichotomization point of 38 (Figure 9). This finding was relatively consistent with other research that found teachers were typically awarded veteran status around the age of 36 (Robinson, 2002). Therefore, the ages were dichotomized with ages 27 to 37 representing the younger group and ages 38 to 68 representing the older teachers. Five percent of the respondents reported less than 5 years experience with technology, 39% reported 5 to 9 years experience with technology, and 55% reported 10 or more years experience with technology (Table 6). Ninety-six percent (*n*=197) reported using computers at home (Table 7). Current research has found that usage of a computer at home was a major correlate to usage at work (Christensen and Knezek, 2003).

Table 4

Frequencies of Gender of Participants

Gender	Frequency	Percent
F	178	86.4
M	28	13.6
Total	206	100.0

Table 5

Statistics of Age, Experience, and Computer Use at Home

		Age	Experience	Computer use at home
N	Valid	203	205	206
	Missing	3	1	0
Mean		45.79	2.91	.96
Median		47.00	3.00	1.00
Std. Deviation		10.02	1.13	.205
Minimum		27	1	0
Maximum		68	5	1

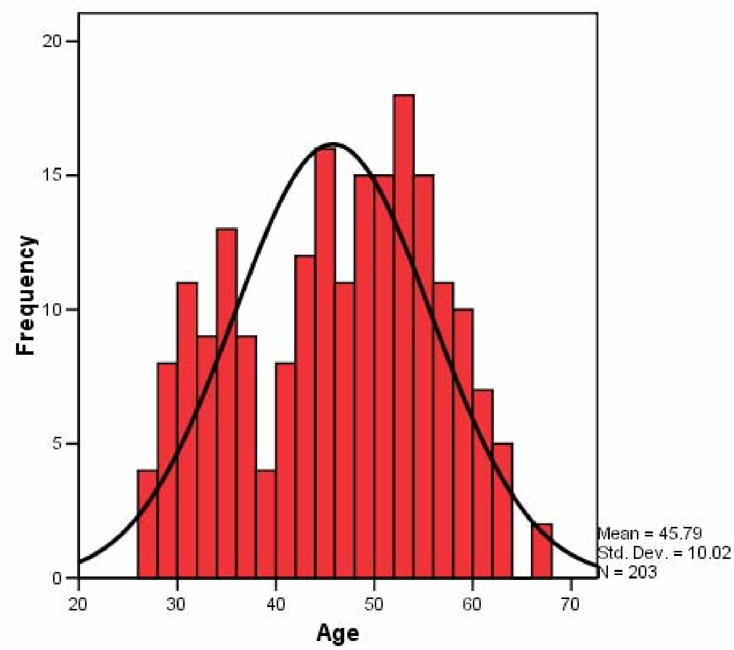


Figure 9. Age Distribution

Table 6

Frequencies of Experience

Experience		Frequency	Percent
Valid	< 5 Yrs	10	4.9
	5-9 Yrs	81	39.3
	10-14 Yrs	59	28.6
	15-19 Yrs	27	13.1
	> 20 Yrs	28	13.6
	Total	205	99.5
Missing	System	1	.5
Total		206	100.0

Table 7

Frequencies of Computer Use at Home

Use Computers at Home	Frequency	Percent
No	9	4.4
Yes	197	95.6
Total	206	100.0

Availability of information technology has historically been reported as a major barrier to technology usage in the classroom. However, 82% of the respondents in the current study reported the use of classroom computers, 72% reported the use of computer labs, 31% reported the use of mobile labs, and 63% reported the use of computer presentation devices. Only 5 of the respondents reported no use of technology in the classroom in the form of classroom computers, computer labs, or mobile labs. Sixty-five percent reported the use of digital cameras, 13% reported the use of digital video, 8.9% reported the use of hand-held devices, and 3.2% reported the use of web-cams. Two teachers reported use of Geographical Positioning System (GPS) devices (Figure 10).

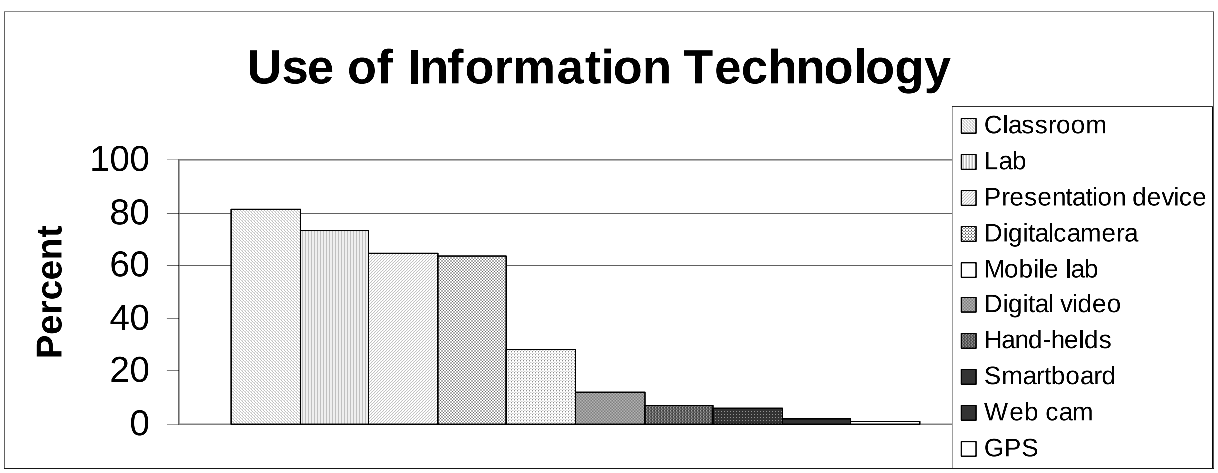


Figure 10. Use of Information Technology

Responses to questions regarding Usefulness (question #11) and Ease of Use (question #12), generally accepted to be major factors in technology adoption, were extremely skewed. Of the respondents, 92.5% agreed that the use of technology was relevant to teaching and 93% of the respondents reported feeling capable to competently use technology in teaching (Figure 11). These results were not unexpected considering the high training levels and information technology use levels of the sample. Usefulness and Ease of Use scores of 6 and 7 represent "quite agree" and "extremely agree," respectively.

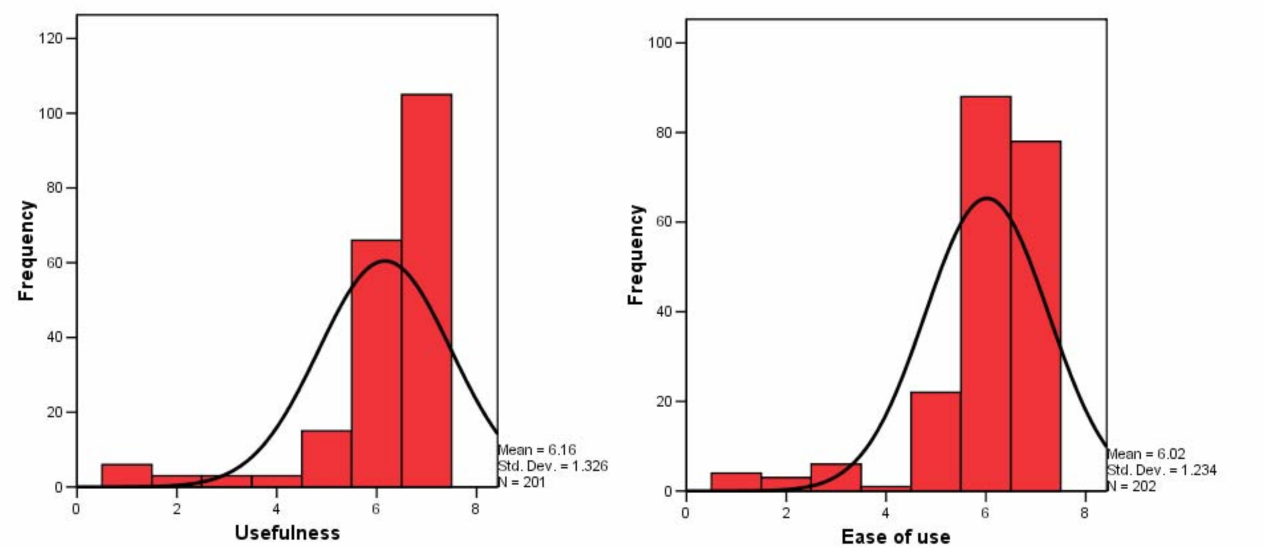


Figure 11. Usefulness and Ease of Use Distributions

Seventy-three percent of the respondents reported using the units they developed in their Intel Teach to the Future professional development with their students (Table 8). This was reasonably consistent with the national average of 78% reported by Martin et al. (2002). Although all respondents were participants in the Intel Teach to the Future program, not all respondents necessarily completed the course or the development of their class units. About 50% of those not using their first units appeared to have not completed the initial unit. Fifty-eight percent of the respondents reported making or modifying more than 2 units in the style learned in the Intel Teach to the Future program and almost 1/3 reported making or modifying more than 5 units (Figure 12). Due to the unusual percentage of respondents modifying more than 5 units, the latter group was analyzed separately.

Table 8

Frequency of Use of 1st Unit

	Frequency	Percent
Used 1st unit	150	72.8
Did not use unit	56	27.2
Total	206	100.0

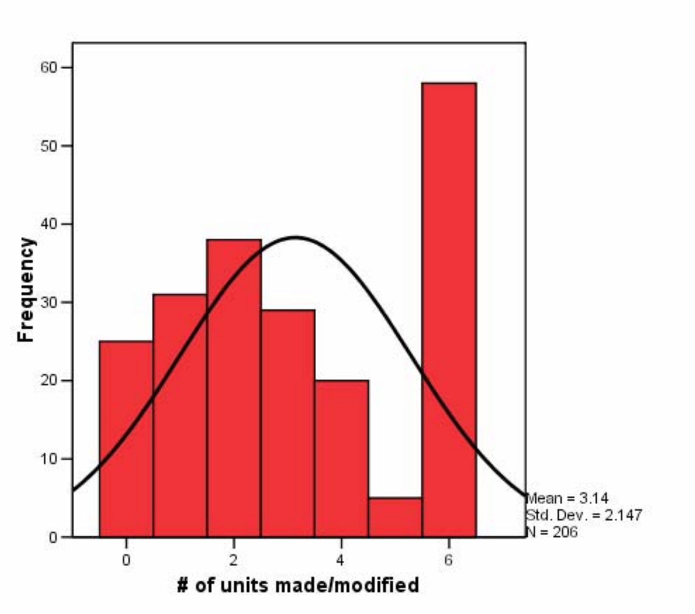


Figure 12. Number of Units Made or Modified

The distribution of responses to questions concerning the perception of choice to use information technology (voluntariness) and the amount of change resulting from the Intel Teach to the Future program both appeared to be bi-modal. On the question

"Please rate how much choice you have in using technologies in your classroom," responses from 1 to 3 represented respondents who believed that technology use in the classroom was "extremely mandatory" to "slightly mandatory" respectively. Scores from 5 to 7 represented responses from "slightly voluntary" to "extremely voluntary" respectively. A score of 4 was interpreted as "neither." Both of these groups were analyzed separately as well as together (Figure 13).

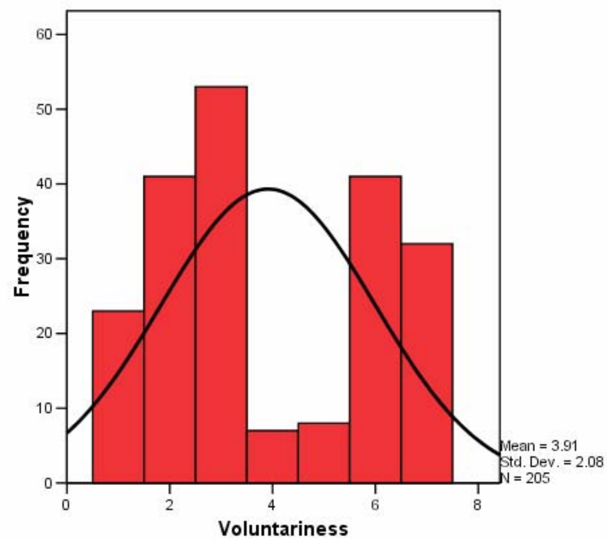
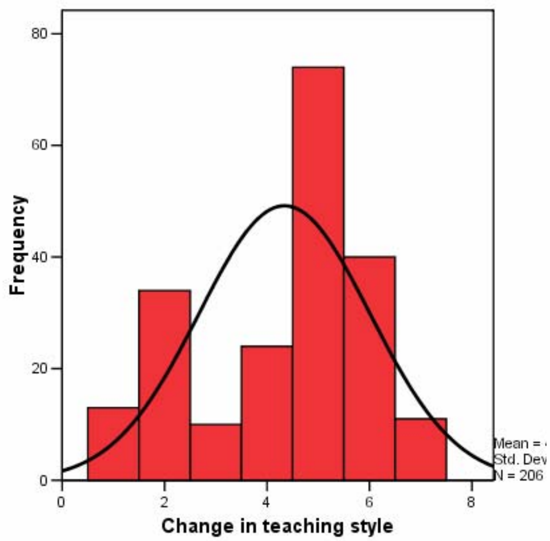


Figure 13. Distributions of Voluntariness

Sixty-one percent of the respondents reported that their teaching style was "slightly different" to "extremely different" since taking the Intel Teach to the Future Program. Sixty-nine percent reported considering essential questions, a major tenet in the Intel Teach to the Future program, "slightly often" to "extremely often" when developing lesson plans now (Figure 14).



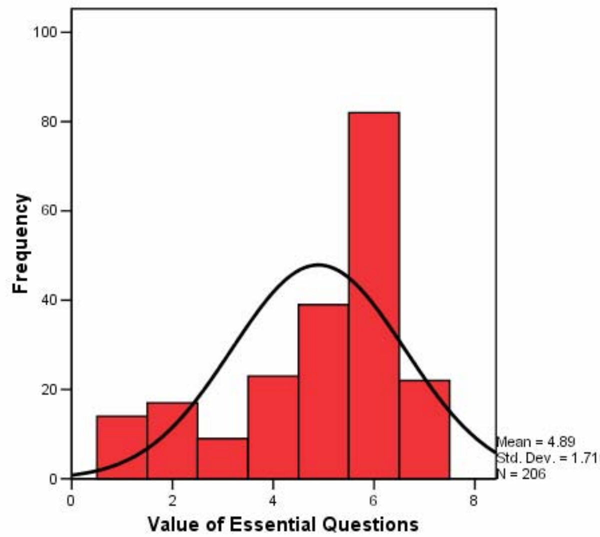


Figure 14. Distributions of Change in Teaching Style and Value of Essential Questions

Responses to the three predictor-variable scales, Playfulness, Innovativeness, and Essentialness Beliefs (without inconsistent responses), and the criterion measurement, the ACOT stage, demonstrated reasonably normal distributions with a few exceptions (Table 9). The Adult Playfulness Scale showed a high kurtosis, possibly due to the homogeneity of the sample.

Table 9

Statistics of Playfulness, Innovativeness, and Essentialness Scores

		Playfulness score	Innovativeness score	Essentialness score	ACOT stage
N	Valid	199	202	162	206
N	Missing	7	4	44	0
Mean		102.19	53.74	1.62	3.74
Std. Deviation		12.785	7.552	.688	.877
Skewness		-.721	-.143	.321	-.686
Std. Error of Skewness		.172	.171	.191	.169
Kurtosis		2.985	-.167	-.443	.473
Std. Error of Kurtosis		.343	.341	.379	.337

The Playfulness scores ranged from 36 to 130, with a mean of 102.19 (*S.D.* 12.78). Consistent with the pilot test results, a bubble of high playfulness responses appeared at a score of about 120 (Figure 15). The 92nd percentile occurred at a score of 119. This group was analyzed separately as "high playfulness," as well as with the entire sample. The playfulness score from one respondent of 36 appears to be an outlier. The effect of this score was considered, as well.

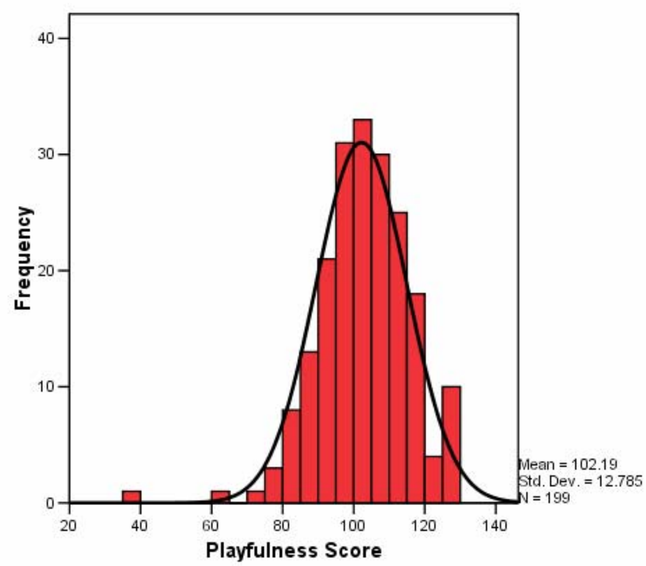


Figure 15. Distribution of Playfulness Scores

The Innovativeness scores ranged from 32 to 70, with a mean of 53.74 (*S.D.* 7.55). Again, a cluster appeared at the high end of the scale (Figure 16). The 98th percentile occurred at 68. This group was analyzed separately as "high innovativeness," as well as with the entire sample.

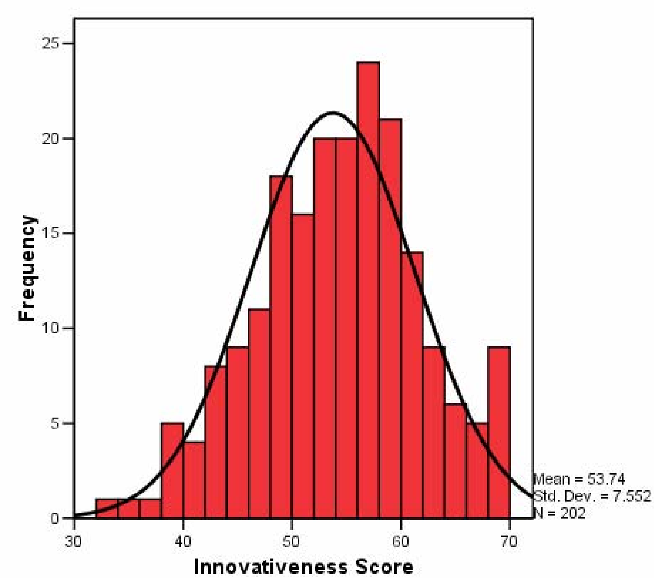


Figure 16. Distribution of Innovativeness Scores

Scores on the measure of Essentialness Beliefs demonstrated an almost even division between teachers who believed the use of technology was supplemental and not essential to their teaching (35%) and those teachers who believed that the use of technology was indispensable and critical to the functioning of their instruction (34.5%). These responses were scored as Essentialness = 1 and Essentialness = 2 respectively (Figure 17). Sixteen teachers (7.8%) responded that technology was indispensable and critical to the functioning of their instruction, but their use of technology was supplemental. Marcinkiewicz (1993) scored these responses as inconsistent and ignored them, but in the current study they were analyzed as a separate group (Essentialness = 3) as this response pattern may represent realistic interpretations of the questions and not inconsistent responses. Three respondents reported not using technology at all. The forty-three respondents (21%) giving inconsistent responses (Table 10) and the eight respondents not answering the LU were given an Essentialness score of 9. Inconsistent responses were not analyzed. While each of the valid response pattern groups was analyzed separately as well as together, such a large percentage of respondents providing inconsistent responses raises concerns regarding the LU scale (discussed in the Limitations of the Study section of Chapter 5).

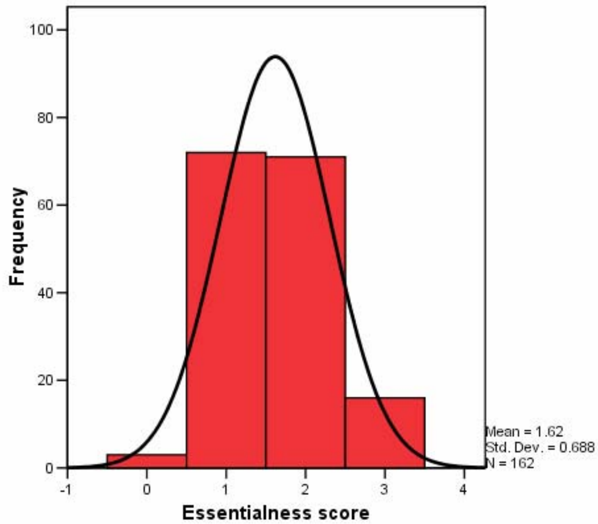


Figure 17. Distribution of Essentialness Scores

Table 10 Inconsistent Responses

Question				n
#13	#14	#15	#16	
a	a	b	a	1
a	a	c	b	1
b	a	b	a	1
b	a	b	b	1
b	b	a		1
b	b	b	a	1
c	a	b	c	1
b	b	a	b	2
a	a	a	a	3
a	a	a	b	4
a	b	b	b	12
a	b	a	a	15
Total Inconsistent				43

The distribution of scores on the ACOT Stages of Technology Integration (Figure 18) was sufficiently normal with the exception of Entry stage scores (ACOT = 1). This was expected because individuals in the sample reported using the equipment and had received intermediate experience on the use of the equipment during their Intel Teach to the Future training. While the group as a whole was analyzed, those with ACOT stages equal to 4 and 5 were of particular interest.

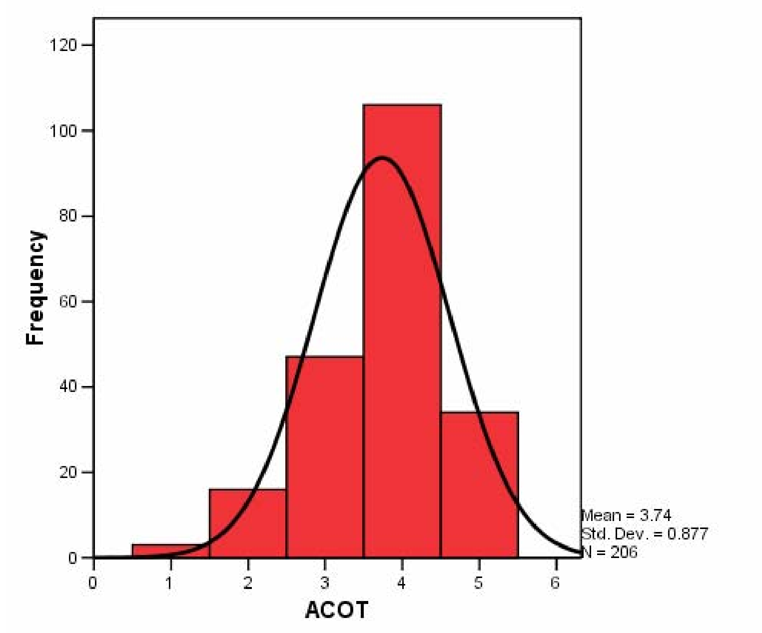


Figure 18. Distribution of ACOT Stages

Analysis of Hypothesis 1

Hypothesis 1: There is no positive relationship between an individual's ability to sustain a high level of information technology usage as measured by an individual's Apple Classroom of Tomorrow (ACOT) stage and the individual's level of cognitive playfulness as measured by their score on the Adult Playfulness Scale (APS).

Hypothesis 1 was tested by performing a Pearson product-moment correlation between the criterion variable as measured by the ACOT stage and the predictor variable as measured by the Adult Playfulness Scale. The mean and standard deviations for each scale are presented in Table 11.

Table 11

Statistics of ACOT Stages and Playfulness Scores

Descriptive Statistics	Mean	*SD*	*N*
ACOT	3.73	.884	199
Playfulness score	102.19	12.785	199

As shown in Table 12, the correlation between the ACOT stages and the Playfulness scores was significant at the .01 level ($p < .0001$) for the study sample.

Table 12

Correlation of ACOT Stages to Playfulness Scores

	Correlations	ACOT	Playfulness score
ACOT	Pearson Correlation	1	.276**
	Sig. (1-tailed)	.	.000
	N	199	199
Playfulness score	Pearson Correlation	.276**	1
	Sig. (1-tailed)	.000	.
	N	199	199

** Correlation is significant at the 0.01 level (1-tailed).

Therefore, the null hypothesis of no positive relationship between an individual's ability to sustain a high level of information technology usage and the individual's level of cognitive playfulness was rejected and the alternative hypothesis accepted. There is a positive relationship between an individual's sustained ability to use information technology high level and the individual's level of cognitive playfulness (see also Table 13 and Figure 19).

Table 13

Means of Playfulness Scores by ACOT Stages

ACOT	Playfulness Mean	N	Std. Deviation
1	89.00	3	14.000
2	96.06	16	6.486
3	99.29	45	12.804
4	103.13	102	11.336
5	107.42	33	16.447
Total	102.19	199	12.785

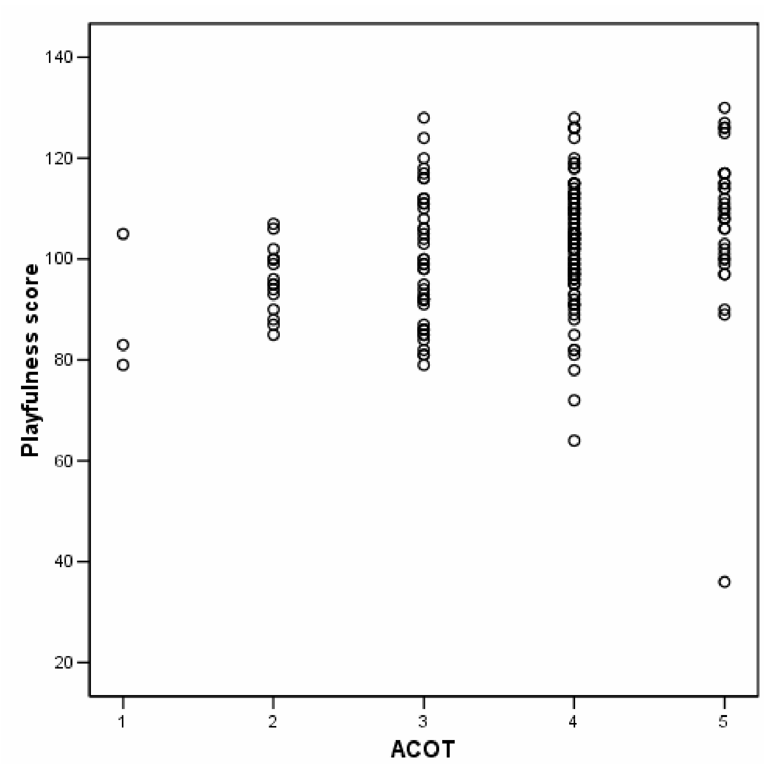


Figure 19. Scatterplot of Playfulness Scores and ACOT Stages

Removal of the outlier playfulness response increased the correlation to .339, also significant at the .01 level. The effect on the means was inconsequential.

Additional Findings

Although only significant at the .05 level on a 1-tailed test, post hoc analysis found that individuals' Playfulness scores were positively correlated to the number of units that were made or modified (Table 14, Table 15, and Figure 20).

Table 14

Correlation of Playfulness Scores to Number of Units Made or Modified

		Playfulness score	# of Units Made/Modified
Playfulness score	Pearson Correlation	1	.145*
	Sig. (1-tailed)	.	.021
	N	199	199
# of Units Made/Modified	Pearson Correlation	.145*	1
	Sig. (1-tailed)	.021	.
	N	199	206

* Correlation is significant at the 0.05 level (1-tailed).

Table 15

Means of Playfulness Scores by Number of Units Made or Modified

# of Units Made/Modified	Playfulness Mean	N	Std. Deviation
0	96.16	25	15.356
1	100.06	31	11.573
2	103.03	35	10.802
3	104.54	28	12.491
4	105.37	19	9.051
5	103.80	5	6.760
6 or more	103.14	56	14.377
Total	102.19	199	12.785

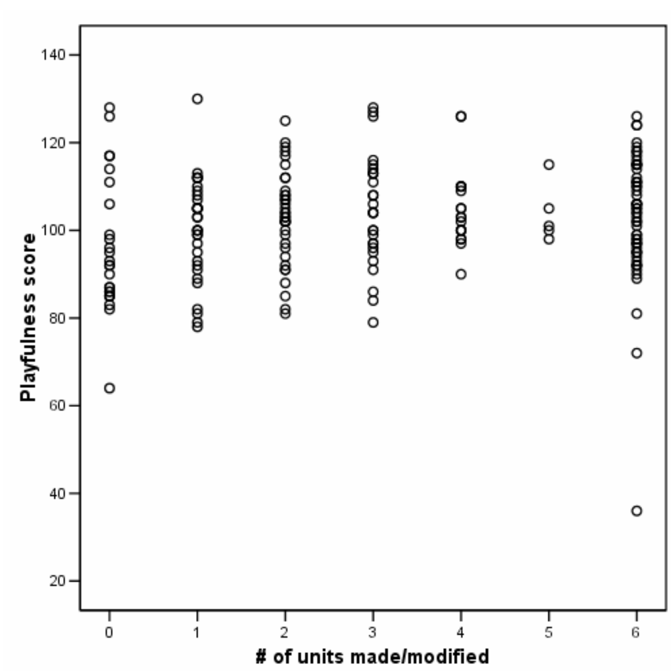


Figure 20. Scatterplot of Playfulness Scores and Number of Units Made or Modified

Removal of the outlier playfulness response increased the correlation of Playfulness scores to Number of Units Made/Modified to .194, which was significant at the .01 level (*p* < .0001). The mean for the group producing 6 or more units was substantially increased (Table 16).

Table 16

Means of Playfulness Scores (without outlier) by Number of Units Made or Modified

# of Units Made/Modified	Mean of Playfulness	N	Std. Deviation
0	96.16	25	15.356
1	100.06	31	11.573
2	103.03	35	10.802
3	104.54	28	12.491
4	105.37	19	9.051
5	103.80	5	6.760
6	104.36	55	11.204
Total	102.53	198	11.914

However, for the high playfulness group (playfulness score μ 120), the correlation of playfulness scores to the number of units made or modified, although not significant, actually became negative (Table 17). A possible explanation would be that individuals scoring high on playfulness would be expected to be novelty-driven and reproducing multiple units in the same fashion would be counter-intuitive to such motivation.

Table 17

Pearson Correlation of High Playfulness Scores to Number of Units Made

		Playfulness score	# of Units Made or Modified
Playfulness score	Pearson Correlation	1	-.442
	Sig. (1-tailed)	.	.057
	N	14	14
# of Units Made/Modified	Pearson Correlation	-.442	1
	Sig. (1-tailed)	.057	.
	N	14	14

Suspicious of the small sample size of the high playfulness group on the Pearson correlation, a Kendall tau-b correlation coefficient was also performed (Table 18). The results showed that high playfulness scores were positively, but still not significantly correlated (.285, *n*=14) to ACOT stages.

Table 18

Kendall's Tau-b Correlation of High Playfulness Scores to Number of Units Made

			Playfulness score	ACOT
Kendall's tau_b	Playfulness score	Correlation Coefficient	1.000	.285
		Sig. (1-tailed)	.	.112
		N	14	14
	ACOT	Correlation Coefficient	.285	1.000
		Sig. (1-tailed)	.112	.
		N	14	14

Playfulness scores appeared to be independent of voluntariness for participants in the current study. Voluntariness scores were partitioned with scores of 1, 2, 3, 4 representing the attitude that technology use in the classroom was considered mandatory (assigned value = 0) and 5, 6, and 7 representing the attitude that technology use in the classroom was considered voluntary (assigned value = 1). Due to the non-interval characteristic of the resulting measures, a Kendall's tau-b was used to measure the correlation between an individual's perceived choice in using classroom technology and the individual's Playfulness score (Table 19). No significant correlation was found.

Table 19

Correlation of Playfulness Scores to Perception of Choice

			Mandatory vs. voluntary	Playfulness score
Kendall's tau-b	Mandatory vs. voluntary	Correlation Coefficient	1.000	-.071
		Sig. (2-tailed)	.	.227
		N	206	199
	Playfulness score	Correlation Coefficient	-.071	1.000
		Sig. (2-tailed)	.227	.
		N	199	199

Analysis of Hypothesis 2

Hypothesis 2: There is no positive relationship between an individual's ability to sustain a high level of information technology usage as measured by an individual’s ACOT stage and their level of innovativeness as measured by the individual's score on Marcinkiewicz’s Innovativeness Scale (IS).

Hypothesis 2 was tested by performing a Pearson product-moment correlation between the criterion variable as measured by the ACOT stage and the predictor variable as measured by the Innovativeness Scale. The mean and standard deviations for each scale are presented in Table 20.

Table 20

*Statistics of ACOT S*tages *and Innovativeness Scores*

	Mean	*SD*	*N*
ACOT	3.74	.877	206
Innovativeness score	53.74	7.552	202

As shown in Table 21, the correlation between the ACOT stages and the Innovativeness scores was significant at the .01 level ($p < .0001$) for the study sample.

Table 21

*Correlation of ACOT S*tages *to Innovativeness Scores*

		ACOT	Innovativeness score
ACOT	Pearson Correlation	1	.305**
	Sig. (1-tailed)	.	.000
	N	206	202
Innovativeness score	Pearson Correlation	.305**	1
	Sig. (1-tailed)	.000	.
	N	202	202

** Correlation is significant at the 0.01 level (1-tailed).

Therefore, the null hypothesis of no positive relationship between an individual's ability to sustain a high level of information technology usage and the individual's level of innovativeness was rejected and the alternative hypothesis accepted. There is a positive relationship between an individual's sustained ability to use information technology at a high level and the individual's level of innovativeness (Table 22 and Figure 21).

Table 22

Means of Innovativeness Scores by ACOT Stages

ACOT	Innovativeness Mean	N	Std. Deviation
1	42.00	3	4.359
2	50.81	16	5.456
3	51.83	46	7.493
4	54.22	104	7.295
5	57.36	33	7.487
Total	53.74	202	7.552

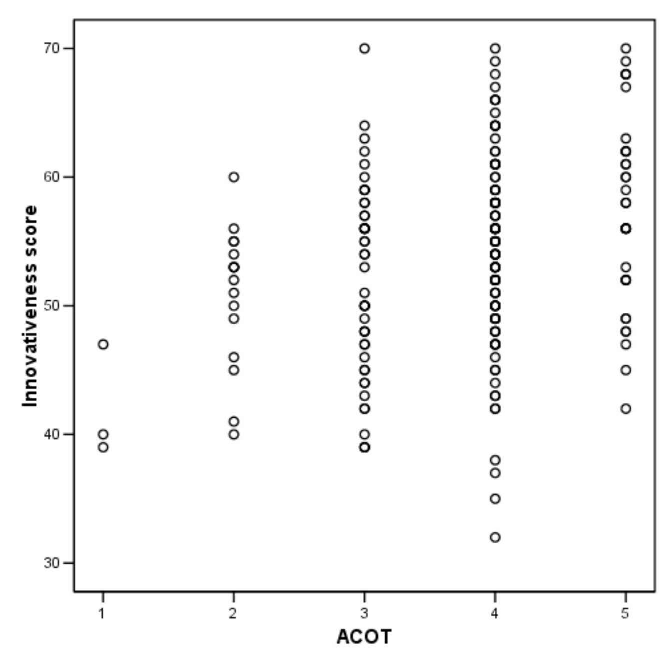


Figure 21. Scatterplot of Innovativeness Scores and ACOT Stages

Additional Findings

A strong correlation of .462, significant at the .01 level ($p < .0001$), was also found between Innovativeness scores and Playfulness scores for the study sample (Table 23 and Figure 22). This relationship was expected as research discussed above suggested that individuals high in playfulness and high in innovativeness share several common characteristics including a high tolerance for risk, a high tolerance for ambiguity, and a high novelty-seeking drive.

Table 23

Correlation of Innovativeness Scores to Playfulness Scores

		Innovativeness score	Playfulness score
Innovativeness score	Pearson Correlation	1	.462**
	Sig. (1-tailed)	.	.000
	N	202	197
Playfulness score	Pearson Correlation	.462**	1
	Sig. (1-tailed)	.000	.
	N	197	199

** Correlation is significant at the 0.01 level (1-tailed).

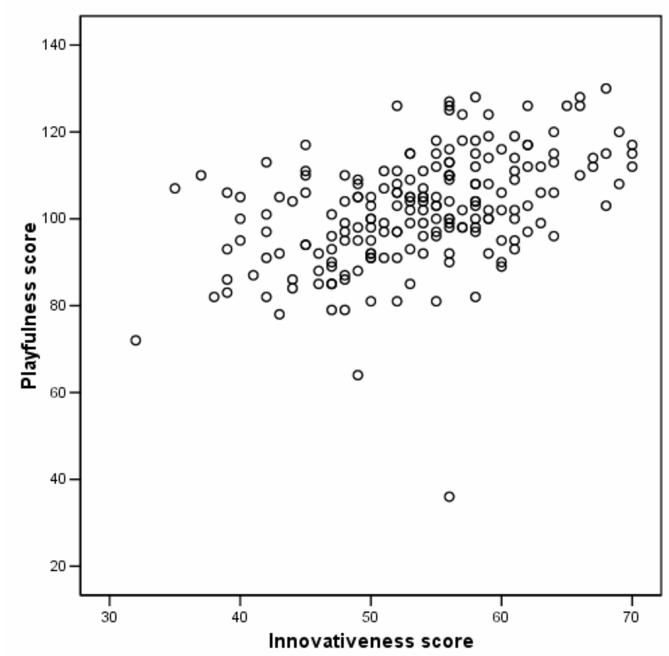


Figure 22. Scatterplot of Innovativeness Scores and Playfulness Scores

Innovativeness scores appeared to be independent of voluntariness for participants in the current study. Voluntariness scores were partitioned as for Playfulness scores above. An assigned value of 0 represented an attitude that technology use in the classroom was considered mandatory and an assigned value of 1 represented the attitude that technology use in the classroom was considered voluntary. Due to the non-interval characteristic of the resulting measures, a Kendall's tau-b was used to measure the correlation between an individual's perceived choice in using classroom technology and the individual's Innovativeness score. No significant correlation was found (Table 24).

Table 24

Correlation of Innovativeness Scores to Perception of Choice

			Mandatory vs. voluntary	Innovativeness score
Kendall's tau-b	Mandatory vs. voluntary	Correlation Coefficient	1.000	-.050
		Sig. (2-tailed)	.	.393
		N	206	202
	Innovativeness score	Correlation Coefficient	-.050	1.000
		Sig. (2-tailed)	.393	.
		N	202	202

Analysis of Hypothesis 3

Hypothesis 3: There is no positive relationship between an individual's ability to sustain a high level of information technology usage as measured by an individual’s ACOT stage and their perception of essentialness of information technology use as measured by the individual's score on Marcinkiewicz’s 4-question Level of Use (LU) assessment instrument.

Hypothesis 3 was tested by performing a Kendall's tau-b correlation between the criterion variable as measured by the ACOT stage and the predictor variable as measured by the Level of Use Scale excluding Essentialness Belief scores = 9 (inconsistent responses). The mean and standard deviations for each scale are presented in Table 25.

Table 25

Statistics of ACOT Stages and Essentialness Belief Scores

	Mean	*SD*	*N*
ACOT	3.72	.851	162
Essentialness score	1.62	.688	162

As shown in Table 26, when inconsistent responses were filtered from the data, the correlation between the ACOT stages and the Essentialness Belief scores was significant at the .01 level ($p < .0001$) for the study sample.

Table 26

Correlation of ACOT Stages to Essentialness Scores (inconsistent responses excluded)

			ACOT	Essentialness score
Kendall's tau-b	ACOT	Correlation Coefficient	1.000	.255**
		Sig. (1-tailed)	.	.000
		N	162	162
	Essentialness score	Correlation Coefficient	.255**	1.000
		Sig. (1-tailed)	.000	.
		N	162	162

** Correlation is significant at the 0.01 level (1-tailed).

Therefore, the null hypothesis of no positive relationship between an individual's ability to sustain a high level of information technology usage and the individual's essentialness beliefs was rejected and the alternative hypothesis accepted. There is a positive relationship between an individual's sustained ability to use information technology at a high level and the individual's essentialness beliefs (Table 27).

Table 27

Means of Essentialness Beliefs by ACOT Stages (inconsistent responses excluded)

ACOT	Mean of Essentialness Beliefs	N	Std. Deviation
1	.50	2	.707
2	1.38	13	.768
3	1.47	36	.654
4	1.66	88	.641
5	1.91	23	.733
Total	1.62	162	.688

Additional Findings

Using cross-tabulation (Table 28), it was noted that teachers with an Essentialness Belief score = 1 (teachers who believed that the use of technology was both supplemental and not essential to their teaching) represented 39.8% (*n* = 39) of the 98 respondents reporting the sustained ability to integrate technology at a high level (ACOT = 4 or ACOT = 5). However, those teachers with an Essentialness Belief score = 2 (teachers who believed the use of technology was both indispensable and critical to the functioning of their instruction) represented 60.2% (*n* = 59) of the 98 respondents reporting the sustained ability to integrate technology at a high level (ACOT = 4 or ACOT = 5). This finding strongly suggested that educators in the sample who believed the use of technology is indispensable and critical to the functioning of their instruction were more likely to demonstrate a sustained high level of technology usage than those who did not.

Table 28

Essentialness Belief Scores by High or Low ACOT Categories

			Essentialness score		
			1 Not Essential	2 Essential	Total
ACOT	Low (1, 2, 3)	Count	33	12	45
		Expected Count	22.7	22.3	45.0
ACOT	High (4, 5)	Count	39	59	98
		Expected Count	49.3	48.7	98.0
Total		Count	72	71	143
		Expected Count	72.0	71.0	143.0

Further testing revealed a Chi-square value of $X^2 = 13.875$ (df = 1, $p < .001$). The Fisher Exact Test was significant at $p < .0005$, confirming this finding. Therefore, the null hypothesis of no relationship between the ACOT categories (low and high) and the Essentialness categories (not essential and essential) was rejected and the alternative hypothesis that there is a relationship between these two variables is entertained.

A Phi correlation, a Pearson Product Moment correlation between two nominal variables, showed a modest relationship of .311 ($p = .0005$). However, the Odds Ratio of 4.16 (95% CI = 1.92, 9.03) indicated that if the individual is in the low category of Essentialness, the odds go up by 316% (4.16 * 100 - 100) that the individual will be in the ACOT low category, further supporting the alternative hypothesis (Table 29).

Table 29

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for ACOT (Low / High)	4.160	1.917	9.027
For cohort Non-Essential (Essentialness = 1)	1.843	1.364	2.489
For cohort Essential (Essentialness = 2)	.443	.266	.738
N of Valid Cases	143		

Summary

The current study examined the personality characteristics of cognitive playfulness, innovativeness, and essentialness beliefs in Texas PK-12 educators who were able to make an enduring change in pedagogy based on the usage of technology in the curriculum.

The following null hypotheses were tested:

1. There is no positive relationship between an individual's ability to sustain a high level of information technology usage as measured by an individual’s Apple Classroom of Tomorrow (ACOT) stage and the individual's level of cognitive playfulness as measured by their score on the Adult Playfulness Scale (APS).
2. There is no positive relationship between an individual's ability to sustain a high level of information technology usage as measured by an individual’s ACOT stage and their level of innovativeness as measured by the individual's score on Marcinkiewicz’s Innovativeness Scale (IS).
3. There is no positive relationship between an individual's ability to sustain a high level of information technology usage as measured by an individual’s ACOT

stage and their perception of essentialness of information technology use as measured by the individual's score on Marcinkiewicz’s 4-question Level of Use (LU) assessment instrument.

The respondents were 86% female and 14% male and ranged in age from 27 to 68. Ninety-five percent reported more than 5 years experience with technology and over half reported 10 or more years experience with technology. Ninety-six percent reported using computers at home.

Availability of information technology in the classroom did not seem to be a major barrier for teachers in the study sample. Eighty-two percent of the respondents in the current study reported the use of classroom computers, 72% reported use of computer labs, 31% reported use of mobile labs, and 63% reported use of computer presentation devices. Only 5 of the respondents reported no use of technology in the classroom in the form of classroom computers, computer labs, or mobile labs. Sixty-five percent reported use of digital cameras.

Of the respondents, 92.5% agreed that the use of technology was relevant to teaching (Usefulness) and 93% reported feeling capable to competently use technology in teaching (Ease of Use). These results were not unexpected considering the fact that all of the respondents had participated in the Intel Teach to the Future program, an intermediate-level training focusing on the integration of technology into the curriculum.

The three predictor variables, playfulness, innovativeness, and essentialness beliefs, each showed a significant correlation to an individual's sustained ability to integrate technology at a high level in the classroom. The testing of Hypotheses 1, 2, and 3 all revealed significant results at the .01 level. All null hypotheses were rejected. All predictor variables were correlated to the criterion variable for the study sample.

Further analysis of the sample data showed an educator's level of playfulness was related to the likelihood of continued development of such units by the teacher, as well as to the teacher's level of innovativeness. Also, educators in the study sample who believed the use of technology was indispensable and critical to the functioning of their instruction were more likely to demonstrate a sustained high level of technology use than those who did not.

CHAPTER 5

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

The current study adds to the body of research regarding the effects of playfulness, innovativeness, and beliefs of essentialness on educators who are able to make enduring changes. The use of information technology in the curriculum is important for the provision of a well-rounded education. For the purposes of the current study, teachers at ACOT stages 4 and 5 were defined as demonstrating the ability to integrate technology at a high level, as teachers at those stages are prepared to use technology to make major modifications in their pedagogy or teaching style. Teachers at ACOT stages 4 and 5 can integrate information technologies in the classroom as appropriate to support student-directed learning focusing on higher-order thinking and problem solving. This ability to integrate technology at a high level was considered for the purposes of the current study to be sustained if the level was present three years after the initial Intel Teach to the Future professional development experience.

It is evident that many educators believe in the importance of utilizing information technology by both their words and their actions. Districts often list technology integration as one of the major goals in the district's long-range plan, yet the term remains vaguely defined and few teachers achieve a high level of sustained information technology usage in their classrooms. Schools and districts continue to spend huge amounts of limited budgets on information technologies for the classroom, yet many of these tools remain under-utilized. Many teachers are trained in both skills of technology use and methods of technology integration, yet these activities often remain supplemental to the curriculum. The research questions of the current study attempted to identify additional factors that may be utilized to help the educational community better manage the rampant changes in technology and better utilize the resources teachers have.

Summary of Findings

The current study attempted to examine the personality characteristics of cognitive playfulness, innovativeness, and essentialness beliefs in educators who were able to make an enduring change in pedagogy based on the usage of technology in the curriculum. The element of pedagogy referred to in the current study was the effortless use of technology beyond simple productivity such as word processing of reports. The pedagogy sought included the use of various information technologies to accomplish a variety of instructional and management goals and the development of new learning environments that are constructivist-based. Based on this definition of change in pedagogy, the Apple Classroom of Tomorrow (ACOT) Stages of Technology Integration was administered as a measure of the criterion variable, the ability to use information technology at a high level. Entry stage (ACOT = 1) referred to a teacher who was still learning the basics of a technology. At the Adoption stage (ACOT = 2), the teacher was beginning to use the technology for classroom management duties and to support traditional instruction. A teacher enters the Adaption stage (ACOT = 3) when use of software, such as word processors and spreadsheets or commercially produced content area programs, supports the individual's original instruction style. At the Appropriation stage (ACOT = 4), the focus turns to new approaches to teaching, such as collaborative, project-based technology use, and technology becomes one of several instructional tools. At the Invention stage (ACOT = 5), the highest ACOT stage, teachers reported a readiness to adjust their fundamental perceptions of instruction toward the usage of technology as a flexible tool. For the purposes of the current study, teachers at ACOT stages 4 and 5 were defined as reporting the ability to integrate technology at a high level as teachers at those levels are prepared to use technology to make major modifications in the way instruction is delivered. This ability to integrate technology at a high level was considered for the purposes of the current study to be sustained if the level was present three years past the initial professional development experience.

The following null hypotheses were tested:

1. There is no positive relationship between an individual's ability to sustain a high level of information technology usage as measured by an individual's Apple Classroom of Tomorrow (ACOT) stage and the individual's level of cognitive playfulness as measured by their score on the Adult Playfulness Scale (APS).
2. There is no positive relationship between an individual's ability to sustain a high level of information technology usage as measured by an individual's ACOT stage and their level of innovativeness as measured by the individual's score on Marcinkiewicz's Innovativeness Scale (IS).
3. There is no positive relationship between an individual's ability to sustain a high level of information technology usage as measured by an individual's ACOT stage and their perception of essentialness of information technology use as measured by the individual's score on Marcinkiewicz's 4-question Level of Use (LU) assessment instrument.

Appropriate correlation coefficients were calculated for each research question using alpha = .01 as the criterion for rejection of the null hypotheses. Research question 1 examined whether individuals who were playful were more likely to continue to demonstrate an ability to use technology in the classroom at a high level than those who were less playful. A significant correlation was found in the sample group between Playfulness scores and ACOT stages. Post hoc tests revealed that there was also a relationship for individuals in the current study between the Playfulness scores and the number of units an individual made or modified. However, when those individuals who scored high in playfulness (120 and above) were analyzed separately, the correlation ceased to be significant and even became marginally negative. While this may be a factor of the small sample size of those with high playfulness scores, it may also reflect the fact that highly playful individuals tend to be novelty-driven and may find reproducing multiple units in the same fashion too repetitive. It is possible that individuals with high playfulness have already moved on to more creative educational endeavors, with or without the use of instructional technologies. Also, a high level of technology use may already be such an integral part of their pedagogy that its daily occurrences are no longer noticed.

Research question 2 addressed whether individuals who are highly innovative were more likely to continue to demonstrate an ability to use technology in the classroom at a high level than those who were less innovative. A significant correlation was found in the sample group between Innovativeness scores and ACOT stages. Post hoc tests revealed that a strong correlation also existed between innovativeness scores and playfulness scores for individuals in the current study sample. This was not surprising as the research describes the constructs of innovativeness and playfulness as encompassing several of the same characteristics: a high tolerance for risk, a high tolerance for ambiguity, a high level of creativity, and a high novelty-seeking drive.

Research question 3 asked if individuals who believed that information technology use was critical and indispensable to their teaching were more likely to continue to demonstrate an ability to use technology in the classroom at a high level than those who believed that it was supplemental and not essential. A significant correlation was found in the sample group between Essentialness Belief scores and ACOT stages. Post hoc tests also revealed that teachers in the current study sample who believed the use of technology was indispensable and critical to the functioning of their instruction represented a disproportionate amount of those individuals with high ACOT stages (ACOT = 4 or 5), further supporting the concept that essentialness significantly impacts the sustained high level of information technology use in the classroom.

Limitations of the Study

This correlational study utilized classroom teachers from 33 school districts and one private school in North Central Texas who were first-year participants in a 3-year educational technology integration grant program, Intel® Teach to the Future. Of the 1,748 participants who took part in the first year of the program through the UNT RTA, only 206 complete questionnaires were returned. Although 26% of those contacted returned questionnaires, the number of individuals returning completed questionnaires represented only 12% of the original class members. The small response rate places doubt on the generalizability of the results to Intel Teach to the Future participants as a group.

The individuals in the sample shared several unique features that may affect generalizability of the study results. The group represented individuals who worked in districts that applied to participate in the first year of the Intel Teach to the Future program. This fact may reflect a more general district-wide attitude toward innovation or risk-taking in these districts. While the incentives for the individuals to participate in the program varied from district to district, from "it's a condition of employment" to stipends of several hundred dollars, the districts did choose to participate in the program. Participating districts did, for the most part, strongly encourage individuals to participate in the program. Also, since the sample of educators selected represents only individuals from central Texas, the current study may have limited generalizability to other regions and districts.

The constructs in the current study are by their very nature indistinct and difficult to clearly define. For the purposes of the current study, limitations on their definitions are applied and the definitions may not necessarily coincide exactly with the definition of the study participants. Every attempt to clarify constructs with the participants was made.

Additional concerns developed throughout the study based on two of the measurement instruments selected. Marcinkiewicz's Levels of Use scale proved to be problematic. Many individuals had difficulty providing consistent response patterns as defined by Marcinkiewicz to the four-question, forced-answer instrument. Although Marcinkiewicz (1993) made reference to inconsistent answers, he made no reference to the percentage of respondents who gave inconsistent answers. In the current study, only 169 respondents produced consistent responses, while 112 either failed to answer that portion of the survey instrument or gave inconsistent responses to the four questions. Such a large percentage of respondents giving inconsistent responses brings the validity of the instrument into question.

The Apple Classroom of Tomorrow (ACOT) Stages of Technology Integration scale was used to measure the criterion variable of an individual's ability to use technology at a high level, in part because the ACOT program adhered to the constructivist philosophy of collaborative, student-directed learning. The ability to use technology at a high level was considered for the purposes of the current study to be sustained if it was still present three years after the initial exposure to the Intel Teach to the Future program. The instructions on the ACOT Stages of Technology Integration scale asked the individual to select the category that best described their current level of understanding and use of information technology for teaching. The ACOT stages ranged from stage 1 (I am trying to learn the basics of using technology.) to stage 5 (I am prepared to develop entirely new learning environments that utilize technology as a flexible tool.).

The descriptions given for Entry stage (ACOT = 1), Adoption stage (ACOT = 2), and Adaption stage (ACOT = 3) are fairly clear and understandable. However, at the Appropriation stage (ACOT = 4) and the Invention stage (ACOT = 5), when the focus was meant to be on new approaches to learning, such as collaborative, project-based technology use, the wording may not be concise or descriptive enough to convey the intended level of integration. For certain teachers who reported themselves at ACOT stage 4, the phrase "a variety of instructional and management goals" may still imply teacher-directed instructional goals and not constructivist goals. At the Invention stage (ACOT = 5), the highest ACOT stage, the phrase "prepared to develop" implies intention and not necessarily actual use. Because several previous studies (Ajzen, 1991; Davis, Bagozzi, and Warshaw,1989; Knezek, Christensen, Hancock, and Shoho, 2000; Taylor and Todd, 1995) consistently showed that behavioral intention is the strongest predictor of actual use, this was deemed acceptable.

It became evident by the end of the study, however, that the five stages of the ACOT scale may not have been enough levels to delineate a high level of technology usage well. Another difficulty was the difference of opinion among experts in the field regarding the use of the terms *technology use* and *technology integration.* The current study demonstrated the need to more stringently define these terms as the field of study matures. Such definitions are necessary to support robust research.

It is suggested that future studies consider the use of alternative scales, such as the Levels of Technology Implementation (LoTi) developed by Dr. Christopher Moersch (Moersch, 1995). Dr. Moersch developed the eight-level scale in an effort to accurately measure authentic classroom technology use. The LoTi scale focuses on the use of technology as an interactive learning medium integrated in an exemplary manner that supports purposeful problem-solving, performance-based assessment practices, and experiential learning. The eight levels of the scale appear to better differentiate a high level of technology integration than the five ACOT stages.

Discussion

In agreement with Adams et al. (1992), the effects of both perceived usefulness and perceived ease of use appeared to change over time through prolonged use of the technology. Responses to questions regarding perceived usefulness and perceived ease, historically the most major contributors to technology adoption (Davis, 1989), showed that the teachers in the current study, as a whole, believed that the use of technology was relevant to teaching and that they believed themselves capable to competently use technology in teaching. The factors of Usefulness and Ease of Use showed significant but only small correlations to the ACOT stages for individuals in the study sample. This may imply that although most individuals in the current study believe that educational technology is both useful and relatively easy to use, many may still not use it regularly at a high level into their educational practices.

Lack of technology has often been listed as one the major barriers to technology usage in the classroom. This sample of teachers appeared to have more than adequate use of technology both at school and at home as well as several years of experience using technology. Ninety-five percent reported using classroom computers, computer labs, or mobile computer labs, and having more than 5 years experience with technology. Over half of the respondents reported 10 or more years experience with technology. It appears that computers in the respondents' districts may be becoming almost as commonplace in the classroom as overhead projectors.

It is possible that in reference to the level of information technology use in the classroom, Usefulness and Ease of Use are becoming non-issues for the teachers in the current study. The reasons for this may relate to the popularity of computers at home and the use of home computers for both personal and professional activities. Ninety-six percent of the respondents reported using a computer at home. It is conceivable that personal computers may finally be reaching the point where they cease to be considered technology innovations and more often are considered a standard appliance, like a television or refrigerator, which one would expect to find in most homes.

Similar to the results of Moore and Benbasat (1991), the current study found perceived voluntariness, the degree to which use of the innovation was perceived as being voluntary, or of free will, to be more than a binary variable. However, the responses did produce a decidedly bi-modal distribution indicating that in the study sample there is a group of individuals who use technology in the classroom because it is mandated and another group who use it either because they want to or because they believe it is essential to the delivery of a well-rounded education. There did not, however, appear to be any significant correlation between voluntariness and any other variable with the group of teachers studied.

Over 60% of the respondents reported a change in their teaching styles and a focus on essential questions when planning their lessons after participating in the Intel® Teach to the Future program. Most educators would agree that this is good. This implied shift to a more constructivist attitude of teaching, however, does not directly imply a sustained high use of technology in the classroom. Constructivist lessons can be delivered with little or no technology integration. Yet moving teachers toward a constructivist style of teaching represents a logical step toward better utilizing whatever educational tools are available, be they technology-based or not.

The Playfulness scores in the current study were found to reflect a normal distribution. This supports the most commonly-used concept in the current literature that defines play as a psychological predisposition or global trait that has been found to be fairly stable across situations (Barnett, 1991; Lieberman, 1966, 1977; Singer and Rummo, 1973). Unfortunately, it is this same stability that may prove to make it difficult to alter an individual's playfulness level. However, the results of the current study imply potential value for such an attempt.

Playfulness at work can encourage creative ideas and aid in the development of an individual's flexibility (Ellis, 1973). Unfortunately, several negative outcomes are also possible. Time wasting may result if the best procedure is already known. Even when there are not actual negative effects from being too playful at work, there are also social mores that strongly suggest that playfulness at work and certain other times is inappropriate behavior. Perhaps changing social mores can be more easily addressed as an approach to encourage productive and creative playfulness in individuals than attempting to change personality traits.

Innovativeness, as well as playfulness, has been shown to be closely related to creativity, productive thinking and problem solving and should therefore continue to be explored as these qualities are highly valued in today's workplace. Yi, Tung, and Wu (2003), found that individuals ranking high in technology innovativeness have a stronger intrinsic motivation to use new technologies and enjoy the stimulation related to the process of experimentation.

Conclusions

According to Rogers' theory, for an innovation to be adopted it must be perceived as 1) having a relative advantage (being better than the existing situation), 2) being consistent with the user's existing values, experiences, and needs, 3) easy to understand and use, 4) easy to try out, and 5) easily observable. Based on the responses to questions regarding technology competency, the importance of using technology in the classroom, teaching styles, and use of technology, it would seem wise when offering professional development to focus less on teaching technology skills in isolation and more on modeling good teaching methods that actually integrate technology at a high level so that teachers can easily observe and try out these methods.

Barnett and Kleiber (1982) found that the home environment mediated components of playfulness in children. Based on those findings and the results of the current study, it is reasonable in situations in which the goal is for all group members to adopt a new innovation to attempt to create a more playful, open environment where risk taking is not only encouraged but even rewarded. Such an environment might place the participants in a more playful and innovative mind-set, thus facilitating innovation adoption. It is imperative that sufficient time for experimentation and play be included in the professional development agenda, as these activities do take longer than direct instruction.

Because the characteristics of both playfulness and innovation appear to be fairly normally distributed, it would seem reasonable to assume that regardless of the techniques employed to encourage expression of these characteristics, some individuals would remain on the low end of the curve. With this in mind, however, it is still a worthwhile goal to attempt to raise the median playfulness and innovativeness scores of a group if implementation of an enduring change is the goal.

Recommendations for Future Study

The results of the current study open several avenues for future research. On the topic of playfulness alone, there is a multitude of opportunities to delve more deeply into the various definitions of playfulness and create measurement instruments for each type. The only current Adult Playfulness Scale found created for use in the workplace (Glynn & Webster, 1992) covers five factors: spontaneity, expressiveness, fun, creativity, and silliness. Only two of those factors, spontaneity and creativity, specifically address the construct of cognitive playfulness. Factors from other studies mentioned above include social spontaneity, physical spontaneity, manifest joy, a sense of humor, horseplay, a large range of social activities, hostile wit, and hurtful pranks. These attributes are similar to those found by Lieberman: imaginativeness, humorous and playful attitude, emotional expressiveness, novelty seeking, curiosity, openness, and communicativeness. Perhaps some combination of these characteristics would more specifically define cognitive playfulness. It is also recommended that a study consider the effects of removing the terms *conscientious* and *erratic* from the Adult Playfulness Scale. Both had a negative inter-item correlation in the current study, suggesting that the use of the terms may not be completely clear.

In regard to innovativeness, the question must be raised as to when classroom technology will cease to be considered an innovation. Computers began appearing in classrooms around 1983, over 20 years ago, and a large percentage of the population now have them in their homes. Innovation seems like a strange word to attach to something that old that is in such common use. Perhaps it is time to study the under-utilization of technology in the classroom from a different perspective than innovation adoption theory.

The Essentialness Beliefs scale, based on the Level of Use Scale (Marcinkiewicz 1993, 1994), attempts to measure an interesting construct, but it appears that there are serious issues with the wording of the statements. Semi-structured interviews of a sample of the respondents might be useful in determining how the wording could be improved to clarify the construct.

Several other personality characteristics remain as possible factors that may affect a teacher's use of technology in the classroom. A large body of research exists concerning intrinsic motivation and this construct has recently been broken down into 3 more specific sub-constructs: the need to know, the need to accomplish, and the need to experience the stimulation. Measurement of these sub-constructs may prove useful in areas such as career counseling. Gottfried (1990) found that individuals who reported high intrinsic motivation were also found to be more persistent and showed a preference for novel and difficult tasks. An extension of that work may be appropriately applied to technology integration.

A desire for control and a tolerance for ambiguity were found to be significant factors in an individual’s risk perception (Myers, Henderson-King, and Henderson-King, 1997). The possibility that self-efficacy, risk perception, and tolerance for ambiguity are related to openness and emotional stability may indicate that self-efficacy, risk perception, and tolerance for ambiguity may be measures of an individual's level of playfulness. This cyclical line of thought opens an interesting area for future research. Perhaps placing individuals in situations that appear risky but are actually safe would give them successes and therefore build their risk tolerance.

Costa and McCrae (1992) used the NEO Five Factor model incorporating five dimensions of personality: neuroticism, extroversion, openness, agreeableness, and conscientiousness. That study found that individuals who rated higher on Openness tended to be more unconventional and more open to broader and more innovative experiences. Individuals with a lower openness rating tended to avoid unfamiliar situations, which would likely include the highly unstable environment of technology. Openness appears to be a multi-dimensional construct (Wild et al., 1995) and remains a promising area for future research.

The construct of creativity is common in many studies of playfulness. This area is relevant to future study, but is far too broad to be discussed in this paper. Since creativity often reflects similar characteristics to playfulness, continued research in this area is recommended.

Based on the findings of the current study it is recommended that further research be done to investigate the numerous personality traits, such as playfulness, innovativeness, openness, creativity, and risk-taking that might relate to technology adoption and usage. When attempting to implement a systemic change related to technology use, an individual's demonstration of such traits may be used as one consideration in selecting initial participants who may be expected to become opinion leaders for the remaining members of a group. Also, determining how to create a playful learning environment may well lead to modifications of professional development and other learning experiences to assist individuals in adapting better and faster to change.

APPENDIX A

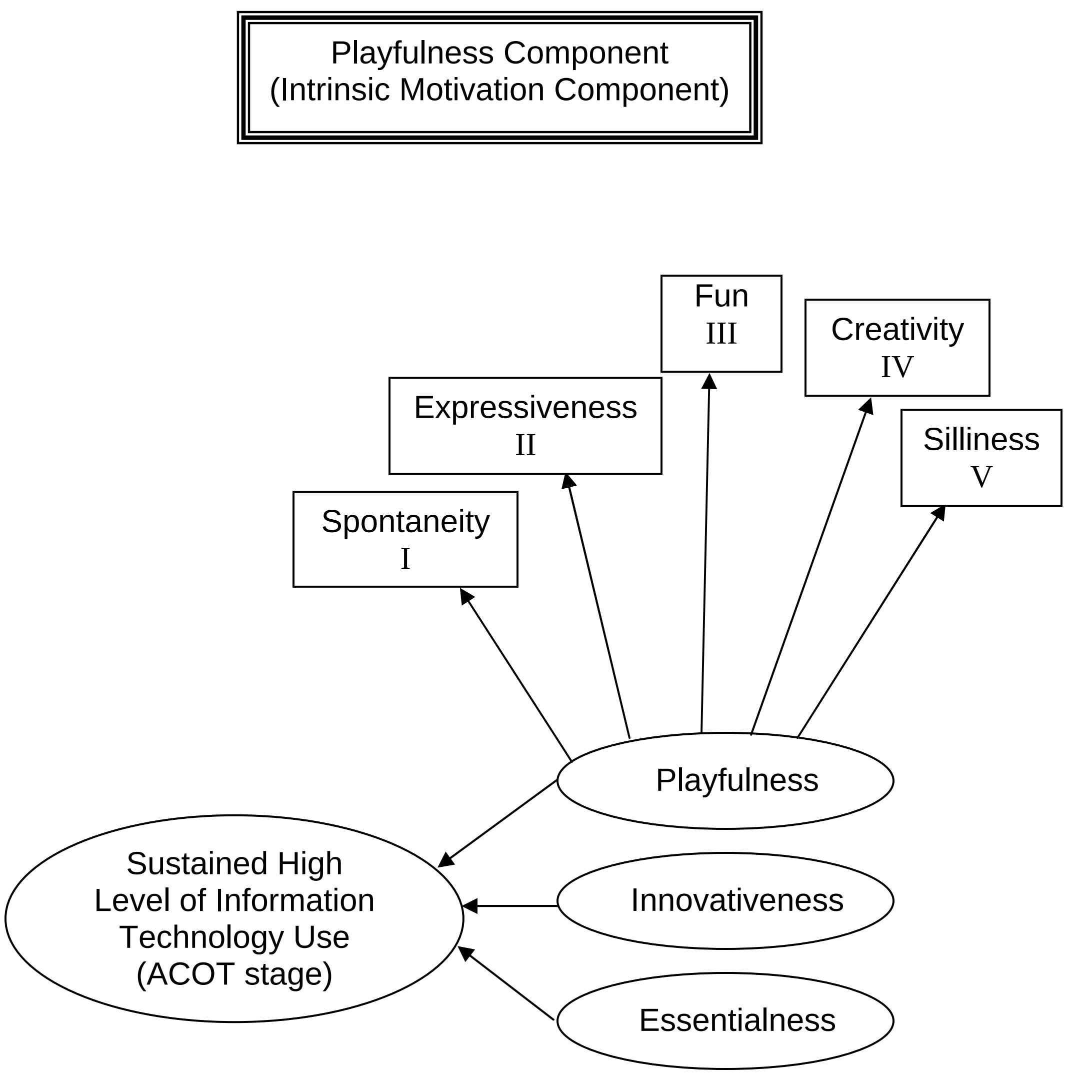
UNIT PLAN TEMPLATE

Unit Plan Information	
Project Title	
Name/Grade	
Subject/Topics	
Establish learning objectives	
Address content standards as you determine: What is essential for students to know or understand about the subject? If students remembered one thing about this study, what would it be?	
Determine acceptable evidence of understanding	
What should students be able to do or express when they understand the learning objectives?	
Plan instructional procedures	
Plan a sequence of instructional activities and assignments that address the learning objectives. Couch learning activities in simulations or authentic tasks that put students in charge of their learning. Plan work samples or performance tasks that allow students to express understanding of the learning objectives.	
Plan for technology	
The realistic nature of project work naturally leads students to use technology as they collaborate, solve problems, and share their work with others. How can technology support learning in this project?	
Develop curriculum-framing questions	
Essential, unit, and content questions spark interest and guide learning. Examples of each type are from a middle-school physical science unit. • **Essential questions** are provocative and make students think about the lessons within a greater context. Example: *How can we explain the things that happen around us?* • **Unit questions** focus attention on the important objectives of the project. Example: *Are there rules that affect the ways things move? What rules affect whether an object floats or sinks?* • **Content questions** lead to fundamental and specific answers. Example: *How are density, buoyancy, and displacement related? How can you measure volume of irregular solids?*	
Plan assessment	
Plan assessment that puts the learning objectives in operational terms. Build rubrics that identify what students must do or create to show evidence of understanding of each objective.	
Evaluate the unit plan	
Use the Intel Innovation in Education unit plan evaluation guide to assess and improve your plan.	

Presentation modified from the Intel® Teach to the Future Unit Plan template. Used with permission.

APPENDIX B

THEORETICAL MODEL


Playfulness Component
(Intrinsic Motivation Component)
Fun
III
Creativity
IV
Expressiveness
II
Silliness
V
Spontaneity
I
Playfulness
Sustained High
Level of Information
Technology Use
(ACOT stage)
Innovativeness
Essentialness

APPENDIX C

SURVEY INSTRUMENT

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Cognitive Playfulness and Technologies survey

The purpose of the following survey is to collect data for research related to a doctoral dissertation in Information Science. The survey consists of 6 sections consisting of 53 questions on 7 screens and should take less than 20 minutes to complete. Please allow enough time to complete the survey in one attempt and do not skip any of the first 51 questions. The last two questions are optional.

All responses are completely confidential. You may receive a descriptive summary of the results of this study and be entered into a drawing for a key disk by giving your email address at the end of the survey. Thank you for your support in this effort.

Please note: For the purpose of this study, the term information technology refers to not only computers, but several other semi-conductor-based tools such as personal digital assistants, Smartboards® , digital cameras, digital video cameras, Web cams, GPS units, and related peripherals such as probes used in the process of instruction.

☐ **I have read the Consent Form and I agree to it and wish to complete the survey.**

Proceed to section 1

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Section 1: Please answer all of the first 51 questions. The last two questions are optional. It is very important that you answer all questions as missing data may cause all of your responses to become invalid. Demographic information is for statistical purposes only and will be held strictly confidential. The survey should take less than 20 minutes.

Name:

Last 4 digits of your SSN:

Name of school district:

Years of experience with technology:

Less than 5	5-9	10-14	15-19	20 or more
◯	◯	◯	◯	◯

Enter the year of your birth : 19

What is your gender? ◯ male ◯ female

1. Did you use all or part of the unit you made in the Intel Teach to the Future training with your class?

◯ Yes ◯ No

2. Counting that unit, how many units in total have you made or modified that you have used with your class?

0	1	2	3	4	5	6 or more
◯	◯	◯	◯	◯	◯	◯

	extremely mandatory	quite mandatory	slightly mandatory	neither	slightly voluntary	quite voluntary	extremely voluntary
3. Please rate how much choice you have in using technology in your classroom?	◻	◻	◻	◻	◻	◻	◻
	extremely similar	quite similar	slightly similar	neither	slightly different	quite different	extremely different
4. How different is your teaching style now from before the Intel Teach to the Future training?	◻	◻	◻	◻	◻	◻	◻
	extremely seldom	quite seldom	slightly seldom	neither	slightly often	quite often	extremely often
5. Do you consider "essential questions" when you develop a lesson plan now?	◻	◻	◻	◻	◻	◻	◻

6. Which of the following items do you use for instructional purposes? (Mark all that apply.)

☐	Classroom computers
☐	Computer lab
☐	Mobile computer lab
☐	Personal digital assistants (PDAs)
☐	Presentation device
☐	Electronic whiteboard (e.g. Smartboard® or Mimeo® device)
☐	Digital camera
☐	Digital video camera
☐	Web cam
☐	GPS units
☐	Other equipment (e.g. probes that attach to computers, etc.)

7. Do you use a computer at home? Yes ☐ No ☐
Submit

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Section 2: Please read the following statements. Select the choice that most closely corresponds to your opinion of yourself. (Please answer all questions.)

	extremely disagree	quite disagree	slightly disagree	neither	slightly agree	quite agree	extremely agree
1. I am generally cautious about accepting new ideas.	☐	☐	☐	☐	☐	☐	☐
2. I rarely trust new ideas until I can see whether the vast majority of people around me accept them.	☐	☐	☐	☐	☐	☐	☐
3. I am aware that I am usually one of the last people in my group to accept something new.	☐	☐	☐	☐	☐	☐	☐
4. I am reluctant about adopting new ways of doing things until I see them working for people around me.	☐	☐	☐	☐	☐	☐	☐
5. I find it stimulating to be original in my thinking and behavior.	☐	☐	☐	☐	☐	☐	☐
6. I tend to feel that the old way of living and doing things is the best way.	☐	☐	☐	☐	☐	☐	☐
7. I am challenged by ambiguities and unsolved problems.	☐	☐	☐	☐	☐	☐	☐
8. I must see other people using new innovations before I will consider them.	☐	☐	☐	☐	☐	☐	☐
9. I am challenged by unanswered questions.	☐	☐	☐	☐	☐	☐	☐
10. I often find myself	☐	☐	☐	☐	☐	☐	☐

skeptical of new ideas.							
11. I believe that the use of technology is relevant to teaching.	○	○	○	○	○	○	○
12. I believe that I am capable of using technology competently in teaching .	○	○	○	○	○	○	○

Hurt, Joseph, & Cook, Scales for the Measurement of Innovativeness, 1997, vol. 4, pp 58-65, by permission of Oxford University Press.

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Section 3: For items 13–16, select the one statement from each pair that is more true for your situation. Click either a or b. If you do not use technology for teaching at all, select c for questions 13–16. (Please answer all questions.)

13	a. ○ In my instruction, the use of technology is supplemental.
	b. ○ Technology is critical to the functioning of my instruction.
	c. ○ I do not use information technology for teaching at all.
14	a. ○ The use of technology is not essential in my instruction.
	b. ○ For my teaching, the use of technology is indispensable.
	c. ○ I do not use information technology for teaching at all.
15	a. ○ Technology is critical to the functioning of my instruction.
	b. ○ The use of technology is not essential in my instruction.
	c. ○ I do not use information technology for teaching at all.
16	a. ○ For my teaching, the use of technology is indispensable.
	b. ○ In my instruction, the use of technology is supplemental.
	c. ○ I do not use information technology for teaching at all.

Adapted from the work by Henryk Marcinkiewicz and used with his permission.

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Section 4: On this screen are a number of adjectives that might be used to describe how you would characterize yourself in general . Please click on the circles that best describes you in general . (Please answer all questions.)

	extremely disagree	quite disagree	slightly disagree	neither	slightly agree	quite agree	extremely agree
Spontaneous							
Conscientious							
Unimaginative							
Experimenting							
Serious							
Bored							
Flexible							
Mechanical							
Creative							
Erratic							
Curious							
Intellectually Stagnant							
Inquiring							
Routine							
Investigative							
Constrained							
Unoriginal							
Scrutinizing							
Uninventive							
Inquisitive							
Questioning							

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Section 5: Select one from the list below that best describes your current level of understanding and use of information technology for teaching: (Please answer all questions.)

◯	**ACOT 1: Entry** I am trying to learn the basics of using technology.
◯	**ACOT 2: Adoption** I can successfully use technology on a basic level (e.g., use drill and practice software in classroom instruction).
◯	**ACOT 3: Adaptation** I am discovering technology's potential for increased productivity (e.g., use of word processors for student writing).
◯	**ACOT 4: Appropriation** I can use technology "effortlessly" as a tool to accomplish a variety of instructional and management goals.
◯	**ACOT 5: Invention** I am prepared to develop entirely new learning environments that utilize technology as a flexible tool.

Adapted from Apple Classrooms of Tomorrow (ACOT) by Tom Clark and used with his permission.

Submit

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Section 6 (Optional)**:** The two questions in this section are completely optional, but your input is very valuable. Your time required to answer these would be greatly appreciated.

Please describe how you would recognize when a classroom teacher is fully integrating technology in the classroom

What one thing could you or the district do to encourage more teachers to integrate technology into their teaching?

Thank you so much for participating in this study. If you wish to be entered in a drawing for a key disk memory, please enter your email address:

Submit

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Thank You

Thank you for your responses. To return to the INSIGHT homepage, click Home.

APPENDIX D

UNIVERSITY OF NORTH TEXAS COMMITTEE

FOR THE PROTECTION OF HUMAN SUBJECTS RESEARCH

CONSENT FORM

University of North Texas

Institutional Review Board

Research Consent Form

Subject Name ______ **Date** ______

Title of Study - Playfulness and Enduring Change

Principal Investigator - Lemoyne Dunn

Co-Investigator(s) - Dr. Tandra Tyler-Wood, Dr. Gerald Knezek

Before agreeing to participate in this research study, it is important that you read and understand the following explanation of the proposed procedures. It describes the procedures, benefits, risks, and discomforts of the study. It also describes the alternative treatments that are available to you and your right to withdraw from the study at any time. It is important for you to understand that no guarantees or assurances can be made as to the results of the study.

Start Date of Study - 12/15/2003 **End Date of Study** - 12/14/2004

Purpose of the Study

The purpose of the administration of the survey is to collect information concerning technology use as related to personality traits.

Description of the Study

The survey used in this study will contain questions regarding your use of information technology in your classroom, your attitudes toward information technology, and some personality and demographic questions.

Procedures to be used

You will be asked to fill out an on-line survey that should take between 30-45 minutes.

Description of the foreseeable risks

There are no foreseeable risks to completing this online survey.

Benefits to the subjects or others

This evaluation will be used to determine the relationship between certain personality traits and information technology use. Your involvement in this study is instrumental in attempting to establish this relationship. Determining the personality characteristics of the various levels of information technology users can be used to better design staff development, curriculum, and support systems to encourage a higher level of information technology use by educators and students to prepare them for the future.

Procedures for Maintaining Confidentiality of Research Records

Your answers to the survey will be kept on a secure server at the University of North Texas. Only the researchers and their research assistants will have access to the data using a secure password. Only the last 4 digits of your social security number will be used as a key for the database. Your school name will only be used in the unlikely occurrence of a duplicate key.

There is a possibility that data from this survey could be used for further research beyond the initial study. Such a study would be initiated only upon additional approval from the University of North Texas Institutional Review Board. The board would examine any request for further research and would require stringent control of confidentiality and security of the data.

Written and oral reports will never contain information about an individual person nor will any person be identified in such reports.

Review for the Protection of Participants
This research study has been reviewed and approved by the UNT Committee for the protection of Human Subjects. UNT IRB can be contacted at (940) 565-3940 or http://www.unt.edu/ospa/irb/contact.htm with any questions or concerns regarding this study.

Withdrawal from the study
You are free to withdraw your consent and discontinue participation in the study at any time without consequences. There may be unforeseen circumstances that develop under which your participation may be terminated by the investigator.

Payment for participation in the research
Participants who so chose at the end of the survey will be entered into a drawing for a key disk memory. Individuals choosing not to enter will receive no payment for completing the survey.

Legal Rights
You are NOT waiving any legal rights by completing this consent form.

Research Subject's Rights
I have read or have had read to me all of the above.

If you have any questions about this research, please contact Lemoyne Dunn, Texas Center for Educational Technology, University of North Texas, at 940.565.2431 or by email at dunn@coe.unt.edu.

I understand that I do not have to take part in this study and my refusal to participate or to withdraw will involve no penalty, loss of rights, loss of benefits, or legal recourse to which I am entitled. The study personnel may choose to stop my participation at any time.

I understand my rights as research subject and I voluntarily consent to participate in this study. I understand what the study is about, how the study is conducted, and why it is being performed. I have been told I will receive a signed copy of this consent form.

I wish to print a copy of this consent form.	I agree to the above statements and wish to complete the survey.	I do not wish to participate in this survey.

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