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Predicting the Probability for Adopting an Audience Response System in Higher Education

Tan Fung Ivan Chan
Walden University

Walden University

COLLEGE OF EDUCATION

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Tan Fung Ivan Chan

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Review Committee
Dr. Marianne Borja, Committee Chairperson, Education Faculty
Dr. Brett Welch, Committee Member, Education Faculty
Dr. Mary Batiuk, University Reviewer, Education Faculty

Chief Academic Officer

Eric Riedel, Ph.D.

Walden University
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Abstract

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by

Tan Fung Ivan Chan

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Instructional technologies can be effective tools to foster student engagement, but university faculty may be reluctant to integrate innovative and evidence-based modern learning technologies into instruction. It is important to identify the factors that influence faculty adoption of instructional technologies in the teaching and learning process. Based on Rogers' diffusion of innovation theory, this quantitative, nonexperimental, one-shot cross-sectional survey determined what attributes of innovation (relative advantage, compatibility, complexity, trialability, and observability) predict the probability of faculty adopting the audience response system (ARS) into instruction. The sample for the study consisted of 201 faculty who have current teaching appointments at a university in the southeastern United States. Binary logistic regression analysis was used to determine the attributes of innovation that predict the probability of faculty adopting the ARS into instruction. The data indicated that the attributes of compatibility and trialability significantly predicted faculty adoption of ARS into instruction. Based on the results of the study, a professional development project that includes 3 full days of training and experiential learning was designed to assist faculty in adopting ARS into instruction. Because the current study only included the faculty at a single local university, future studies are recommended to explore a more holistic view of the problem from different institutions and from other stakeholders who may contribute to the process of instructional technology adoption. The project not only contributes to solving the local problem in ARS adoption, but it is also instrumental in promoting positive social change by fostering evidence-based teaching strategies and innovations that maximize student learning.

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Dedication

I would like to dedicate this study to my loving family for their patience and support.

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I would like to show my gratitude to the members of my doctoral committee and the professors at Walden, who have guided me through this journey of doctoral study. My utmost appreciation goes to my committee chair, Dr. Marianne Borja, who challenges me to think critically through the untiring process of iteration.

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Section 1: The Problem

Introduction

The advancement of technology and telecommunication shapes every aspect of modern life including the way individuals socialize, play, work, and learn. Prensky (2001) popularized the term *digital native*, using it to describe the first generations of students who have grown up with digital technology. He further asserted, “Today’s students are no longer the people our education system was designed to teach” (Prensky, 2001, p. 1). Digital technologies such as computers, tablets, video games, digital media players, smartphones, and other gadgets of the digital age inundate students (Frand, 2006). It is not surprising that these students are eager to incorporate technologies to enhance their educational experience (Van De Werf & Sabatier, 2009). Researchers have also suggested that current and future students envision roles of emerging technologies in education differently than previous generations (Prensky, 2001; Project Tomorrow, 2011). New generations of students anticipate emerging instructional technologies to help create a new learning environment to engage them in contextually based contents (Frand, 2006; Project Tomorrow, 2014). In addition, these digital natives also expect to leverage emerging instructional technologies to enable greater personalization of the learning process, and to allow greater flexibility to explore knowledge (Frand, 2006; Prensky, 2001; Project Tomorrow, 2014).

Davidson and Goldberg (2010) argued that pedagogical methods have largely remained unchanged for years. The educational innovations that faculty have accepted and consistently employed are primarily limited to PowerPoint slideshows and course management systems adopted by their institutions (Davidson & Goldberg, 2010). Based on current evidence, instructional technology is an efficient way to foster student learning (Bernard, Borokhovski, Schmid, Tamim, & Abrami, 2014; Lai, Khaddage, & Knezek, 2013). However, it cannot be effective if educators are not using technology conscientiously and judiciously as an instructional delivery system to facilitate teaching and learning (Tamim, Bernard, Borokhovski, Abrami, & Schmid, 2011). In order to target the supports, training, and resources necessary for successful adoption of instructional technology, it is important to identify the factors influencing faculty adoption of instructional technology in the teaching and learning process (Bingimals, 2009).

Definition of the Problem

In a university in the southeastern United States where I teach, faculty adoption of instructional technology, such as the audience response system (ARS) has been inconsistent and slow. Although the university has promoted the use of various types of instructional technology and offered training and support for their adoption, few faculty members utilize devices from the Workplace Instructional Technology Services (WITS; L. L. Fothergill & K. Boone, personal communication, July 7, 2014). The usage data provided by L. L. Fothergill and K. Boone (personal communication, July 7, 2014), technology trainer and manager of the WITS, respectively, provided insight into faculty resistance and reluctance toward adopting instructional technology, specifically the ARS. Researchers have supported the use of ARS to change a static, one-way transmission of lecture information into a dynamic and student-centered learning experience, which improves student participation, interaction, and engagement in the learning process (Heaship, Donovan, & Cullen, 2014; Hinde & Hunt, 2006; Martyn, 2007). However, gauging from observation and aforementioned usage data, the current adoption rate for ARS in this university is only about 25% (L.L. Fothergill, personal communication, July 7, 2014). In fact, about 80% of the faculty in the college of nursing and health sciences have not utilized ARS units purchased by the university (K. Boone, personal communication, July 7, 2014).

This local university is a nonprofit, private institution located in southeastern United States. It has a Catholic heritage and emphasizes undergraduate study in the liberal arts and sciences, with some offerings of graduate programs that lead to a master's degree or doctoral degree in subjects such as theology, education, business administration, nursing, anesthesiology, occupational therapy, podiatric medicine, and law. According to the data available at the time of this writing, there are more than 600 full and part-time faculty employed. This university does not offer tenure-track positions; therefore, the faculty hold nontenured positions regardless of their rank. According to the university's division of mission and institutional effectiveness, the student-faculty ratio is approximately 14:1, and more than 80% of faculty members hold a Ph.D. or terminal degree in their fields of expertise.

The limited or slow adoption of instructional technologies is not an isolated problem. In fact, it is well-documented that educators do not make effective use of instructional technologies (Bauer & Kenton, 2005; Bingimals, 2009; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, Sendurur, 2012; Gautreau, 2011; Hixon & Buckemeyer, 2009; Keengwe & Kang, 2012; Levin & Wadmany, 2008; Nichols, 2008; Schneckenberg, 2009). Bingimals (2009) conducted a meta-analysis of the literature on the perceived barriers to technology adoption, particularly in science education. The findings revealed various inter-related factors, from the teachers' lack of competencies in problem-solving technical issues to their failure of leveraging the strengths of instruction technologies (Bingimals, 2009). However, Bingimals (2009) was unable to sort out the complex relationships among the identified barriers because of their interdependent nature.

Davidson and Goldberg (2010) asserted that higher education institutions have a tendency to embrace the traditional patterns of operation and hence perpetuated an educational environment that is resistant to change. Murray (2008) also shared the same view and concluded that a variety of other factors, such as the academic tradition of collegial decision-making and layers of bureaucracy impede more rapid adoption of technology innovations in higher education compared to other industries (Murray, 2008).

Tamim et al. (2011) conducted a second-order meta-analysis that revealed significant positive effects with small to moderate effect size on students' achievement favoring the utilization of instructional technologies. These included, but were not limited to, computer assisted instruction, computer-based instruction, and digital media over instructions that were more traditional. Based on the positive evidence in the literature and encouraged through national accreditation standard on technology use (Southern Association of Colleges and Schools [SACS], 2012), universities have begun to invest in various instructional technologies. However, the decision to adopt any technology into coursework usually rests with the faculty who are teaching the courses (Ertmer et al., 2012; L. L. Fothergill & K. Boone, personal communication, July 7, 2014). This approach to the integration of instructional technologies may have contributed to the inconsistencies in adoption. Therefore, while some instructors take advantage of the available instructional technologies and use them regularly, many tend to rely on the more familiar and traditional methods of delivering course contents (L. L. Fothergill & K. Boone, personal communication, July 7, 2014). Researchers have suggested that the problem also exists elsewhere in educational settings throughout the United States (Bauer & Kenton, 2005; Keengwe, Onchwari, & Wachira, 2008; Schneckenberg, 2009).

This present study applied Rogers's (1995) innovation diffusion model to a specific instructional technology, the ARS. The model for diffusion of innovation developed by Rogers in 1962 is a well-studied framework, which has since formed the basis of many studies in the field of instructional technology (Rogers, 2003). Concisely, the diffusion of innovations is a theory that explains how, why, and at what rate new ideas and technology spread through societies. The perception of innovations by potential adopters forms the cornerstone of Rogers's (1995) diffusion theory. He describes the characteristics of innovation in terms of its perceived attributes, which are *relative advantage*, *compatibility*, *complexity*, *trialability*, and *observability*. According to Rogers (2003), the differences in the perception of these attributes by the individuals contribute to the different rates of adoption among individuals. Therefore, it is important to understand the effects of attributes on any innovations as they influence the adoption decisions of the potential adopters (Rogers, 2003). Relative advantage represents the degree to which an adopter perceives an innovation as being better than its precursor (Rogers, 2003). Compatibility represents the degree to which an adopter perceives an innovation as being consistent with the existing values, needs, and experiences of potential adopters (Rogers, 2003). Complexity represents the degree to which an adopter perceives an innovation as being difficult to use. Observability represents the degree to which the effects of using an innovation are visible to others. Finally, trialability is the attribute that represents the degree to which an innovation might be experimented with before adoption (Rogers, 2003).

According to Rogers (1995), "the perceived attributes of an innovation are one important explanation of the rate of adoption of an innovation" (p. 206). He theorizes that individuals or a social unit will adopt an innovation if they perceive it to have particular attributes. Specifically, innovations that potential adopters perceive to have more relative advantage, compatibility, trialability, observability, and less complexity are likely to be adopted more rapidly (Rogers, 1995). Among these five attributes, relative advantage, compatibility, and complexity seem to be the most influential in affecting decision making by adopting individuals (Huang, 2012; Rogers, 1995, Rogers, 2003; Sultan & Chang, 2000).

Rationale

Evidence of the Problem at the Local Level

Adult students from different backgrounds bring to the classroom a variety of educational attainments, occupational backgrounds, attitudes, and life experiences. These adult students have special learning needs and preferences that require educators' attention (Knowles, 1980). Brookfield (2010) further elaborated on the concept of adult learning and asserted that adult learners learned best when they were actively engaged in their learning experiences. Although techniques of education in clinical sciences traditionally include hands-on laboratories and case study discussions, teacher-centered didactic lectures, which are usually delivered by projecting linear slide shows on the screen, continue to take the center stage of education in health sciences (Schaefer, & Zygmont, 2003). In the meantime, there is a growing consensus among some scholars that using ARSs could turn a teacher-centered linear slide show into a dynamic, interactive, and student-centered learning experience (Heaship, Donovan, & Cullen, 2014; Hinde & Hunt, 2006; Martyn, 2007). Al-Faris et al. (2014) highlighted the importance and relevance of a student-centered learning experience to student achievement, satisfaction, and success in their mixed-method study. In the literature, students reported that they were more interested, engaged, and attentive when the instructors incorporated the use of ARS in their lectures (Fies & Marshall, 2006; Oigara & Keengwe, 2013; Preszler, Dawe, Shuster, & Shuster, 2007; Simpson & Oliver, 2007). Fies and Marshall (2006) conducted a systematic review on ARSs and concluded that there was great agreement in the literature that the use of ARS promotes learning when coupled with pedagogical methodologies that foster class interactions and timely feedback.

Observations of different programs at the local university and conversations with technology trainer and manager of the WITS revealed a pattern of underuse of the ARS units purchased by the university (L. L. Fothergill & K. Boone, personal communication, July 7, 2014). Based on the available usage data, although the WITS has promoted the use of ARS and has offered training opportunities, the adoption of the ARS has been inconsistent among faculty members (L. L. Fothergill & K. Boone, personal communication, July 7, 2014). Unfortunately, at present time, there is no formal data on the current adoption of ARS, and there are limited insights into factors influencing faculty adoption of ARS (L.L. Fothergill, personal communication, July 7, 2014).

Evidence of the Problem from the Professional Literature

Technology in its various forms has pervaded all sectors of modern society, and higher education is no exception (Hilbert & Lopez, 2011). Prensky (2001) stated that students who have grown up with digital technology have different needs than the education system was originally designed to provide. These new generations of students are digital natives who anticipate emerging instructional technology to help create a new learning environment that will engage them in contextually based contexts (Frand, 2006; Project Tomorrow, 2014). In addition, these digital natives also expect to leverage emerging instructional technology to enable greater flexibility and personalization in their learning process (Frand, 2006; Prensky, 2001; Project Tomorrow, 2014).

Current evidence supports the idea that technology can be an efficient way to foster student engagement (Grabe & Grabe, 2007; Keengwe et al., 2008; Tamim et al., 2011). However, it will not be effective if educators are not taking advantage of the available technology to facilitate teaching and learning (Bauer & Kenton, 2005; Bingimals, 2009; Ertmer et al., 2012; Gautreau, 2011; Hixon & Buckemeyer, 2009; Keengwe & Kang, 2012; Levin & Wadmany, 2008; Nichols, 2008; Schneckenberg, 2009). In fact, there are well-documented concerns indicating that instructional use of technology has been lagging behind other uses, such as in communication, gaming, and word processing (Murray, 2008). Davidson and Goldberg (2010) asserted that higher education institutions have a tendency to embrace the traditional patterns of operation and hence perpetuate an educational environment that had largely remained unchanged or antiquated. Murray (2008) concluded that higher education institutions are protected from many competitive pressures that impede more rapid adoption of technology innovations in higher education as compared to other industries.

Universities have invested money and resources on instructional technology innovations to equip and modernize the classrooms, based on the positive evidence in the literature (Tamim et al., 2011) and the reinforcement through national accreditation standards. In fact, the Southern Association of Colleges and Schools commission on Colleges (SACS) accrediting standard 3.4.12 mandates the appropriate use and accessibility of technology to enhance student learning (SACS, 2012). However, the decision to integrate any technology into coursework usually rests with the faculty who are teaching the courses (Ertmer et al., 2012). According to the informants from the WITS of the local university, this approach to the integration of instructional technology may have contributed to the phenomenon of inconsistent and slow adoption of instructional technology (L. L. Fothergill & K. Boone, personal communication, July 7, 2014). A number of researchers explored the factors that might have influenced this underuse or inconsistent use of technology for instructional purposes (Bauer & Kenton, 2005; Levin & Wadmany, 2008; Keengwe, Kidd, & Kyei-Blankson, 2009). The consensus among these researchers is that the presence of instructional technology in the classrooms would not automatically guarantee their adoption in teaching and learning (Bauer & Kenton, 2005; Levin & Wadmany, 2008; Keengwe et al., 2009). Bauer and Kenton (2005) discovered that successful adoption is reliant on the supports and resources available to the faculty and students. The faculty informants of their study expressed the need to have extra planning time to integrate technology in their curriculums after they made the decision to adopt the technology (Bauer & Kenton, 2005). Levin and Wadmany (2008) conducted a longitudinal study, which spanned three years, in order to capture the changes in six teachers' views on the factors that affected technology use in the classrooms. The authors concluded that the factors influencing adoption were multidimensional and changed as the individuals developed their skills and influence in practice. Keengwe et al. (2009) conducted a qualitative research study to explore the factors affecting the adoption process of instruction technology and the implications for faculty training and technology leadership. They concluded that following the initial decision of adoption, training, and development are crucial to the success of technology integration in classrooms (Keengwe et al., 2009).

This study responds to the need of establishing the current level of adoption and the relevant factors that may be influencing the faculty adoption of ARS for teaching and learning at the local level. In order to plan the supports, training, and resources necessary for successful integration of instructional technology, it is paramount to first identify the factors that are influencing the faculty's adoption of instructional technology in the teaching and learning process. The purpose of the study was to determine what attributes of innovation (relative advantage, compatibility, complexity, trialability, and observability) predict the probability of faculty adopting the ARS into instruction. The results of this study may illuminate the path to more effective technology adoption to meet the students' learning needs, and may provide valuable insight for future implementation studies to target the supports, training, and resources necessary for successful integration of ARS.

Definitions

Adoption: This term denotes the decision to make use of a particular innovation as the best course of action available (Rogers, 2003). For the purpose of this study, an adopter is defined as a faculty member who has made the decision to make use of ARS in his or her teaching when the use of it is deemed appropriate. The current study does not investigate the actual implementation of ARS; therefore, an adopter is not necessarily a current user of the technology.

Audience response system (ARS): Audience response system appears in the literature under different names, some examples of which are classroom response system (CRS), student response system (SRS) clicker, and classroom polling system. These commercially available systems are remarkably similar in function. They typically consist of transmitters that students use to send responses, receivers that collect these inputs, and computer software designed to aggregate and present these responses in real time (Kay & LeSage, 2009a).

Compatibility: Compatibility is the degree to which adopters perceive an innovation as being consistent with their existing values, needs, and past experiences (Rogers, 2003).

Complexity: Complexity is the degree to which adopters perceive an innovation as being difficult or cumbersome to use (Rogers, 2003).

Diffusion: Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers, 1995).

Innovation: Innovation is an idea, practice, or object perceived as new, whether it is objectively new as measured by the lapse of time since its first use or discovery (Rogers, 1995).

Integration: Integration in the context of instructional technology is the use of such technology to facilitate teaching and learning (Ertmer, 1999). Williams (2003) provided a clear definition of the integration of instructional technology as the means of using it to assist teaching and learning. In other words, the study of integration of technology is to study its implementation.

Observability: Observability is the extent that an innovation and the effects of its usage are visible to others (Rogers, 2003). It other words, observability is how easy it is for others to notice an innovation is being used.

Trialability: Trialability is the degree to which an innovation may be experimented with before adoption (Rogers, 2003).

Relative Advantage: Relative advantage is the degree to which an adopter perceives an innovation as being better than its precursor (Rogers, 2003).

Significance

By applying a specific model to a specific instructional technology, the outcomes of this study may shed light on the local problem of the adoption of ARS. The results of this study may illuminate the path to more effective technology adoption strategies to meet students' learning needs and to provide the faculty with more targeted supports based on the innovation attributes that are the most influential in predicting faculty adoption of ARS. It may also provide relevant information to administrators of the university to help make informed decisions regarding resource allocation, technology access, and training for the faculty.

Over the past decade, the percentage of increase in the average tuition for four-year public and private institutions has skyrocketed well above inflation (Snyder & Dillow, 2012). Students nationwide are becoming more deeply in debt (The Institute for College Access and Success, 2012). In the state of global economic uncertainty, instead of raising the tuition to offset the impacts of the economic upheavals, the higher education community is challenged to "do more with less and deliver better value for students and their families" (Obama, 2013). The effective use of instructional technology can be a key to meet this challenge, especially when the university has already invested in the technology. Taking advantage of available resources and using them effectively is one way to meet this challenge. Unfortunately, many faculty members are reluctant to incorporate instructional technology into their curricula (Ertmer et al., 2012). This study focuses on a relevant set of variables that may influence the university faculty's decision process for the diffusion of innovation. Its significance lies in its ability to provide additional information as to what variables and factors are most influential in the process of innovation adoption. In addition, this research may not only contribute to an understanding of the local problem, but may also be instrumental in promoting positive social change by fostering evidence-based teaching strategies and innovations that maximize student learning (Schwartz, 2013).

Guiding/Research Question

Because the significance of this study lies in its ability to examine what variables predict the probability of adoption, the following research question is formulated.

RQ: What attributes of innovation (relative advantage, compatibility, complexity, trialability, and observability) predict the probability of faculty adopting ARS into instruction?

H_0: The attributes of innovation **(**relative advantage, compatibility, complexity, trialability, and observability) do not significantly predict the probability of faculty adopting ARS into instruction.

H_a: The attributes of innovation (relative advantage, compatibility, complexity, trialability, and observability) significantly predict the probability of faculty adopting ARS into instruction.

Review of the Literature

This review consists of two parts. The first part describes the theoretical framework that has contributed to the understanding of the problem and informed the study. The second part of this review provides a context for this study by addressing the broader problem associated with the local problem and the fact that technology has influenced every part of human life including education. Also examined in this section is the current literature on the factors affecting adoption of technology, the benefits of ARS, the positive effects of technology in the classroom, and the problems encountered in the adoption of instructional technology. The literature from diverse perspectives and cultures was examined by accessing the Education Resources Information Center (ERIC) database (2008-2013). The following search terms were used with Boolean search strategies to gather relevant information about this topic: *audience response system*, *clickers*, *student response system*, *higher education*, *innovation diffusion*, *integration*, *adoption*, *technology*, *classroom*, *learning*, *education*, and *instructional technology*.

Theoretical Framework

Information system researchers have long been investigating the underlying reasons and processes that influence the propensity for individuals to adopt new information technologies. Most of the existing studies on technology adoption were based on a variety of theoretical models, such as technology acceptance model (Davis, 1989), motivational model (Davis, Bagozzi, & Warshaw, 1992), adapted theory of planned behavior (Mathieson, 1991), and innovation diffusion model (Rogers, 2003) to explain technology adoption in different contexts from business settings to academic environments (Sun & Zhang, 2006). Overall, these theoretical models have contributed to the general understanding of user adoption behaviors and accounted for about 40 percent of the variances in individual intention to adopt technology (Davis, 1989; Venikatesh, Morris, Davis, & Davis, 2003; Viswanath & Davis, 2000). For example, the technology acceptance model (TAM) predicts acceptance of information technologies based on the potential adopter's perceptions of the usefulness and the ease of use of a specific technology (Davis, 1989). From a different perspective, the motivational model explains adoption behavior in terms of the potential adopter's perceived intrinsic and extrinsic motivators (Davis et al., 1992). Unlike the aforementioned models, the theory of planned behavior (TPB) places emphases on the potential adopter's attitude and perceived control towards the technology adoption process (Mathieson, 1991). However, the inconsistent conceptualization of the constructs and the diverse contextual differences among the different types of technology adoption limited the "generalizability of these models across differing contexts" (Sun & Zhang, 2006, p. 53). Therefore, in order to shed light on the local problem of ARS adoption, the first order of business is to select a theoretical model that possesses relevant constructs for the context of this study.

Rogers (2003) developed a theoretical approach to diffusion of innovation, which is instrumental in providing a framework for studying diffusion and adoption of instructional technology. Concisely, the diffusion of innovations is a theory that seeks to explain how, why, and at what rate new ideas and technology spread through cultures. Rogers (2003) theorized the process of diffusion to be the communication of innovation among the members of a social system, through certain channels over time; therefore, his theory, in turn, is composed of four separate but inter-related elements: innovation, communication channels, time, and social system.

Innovation. Rogers (2003) defined innovation as “an idea, practice, or object that is perceived as new by an individual” (p.12). Therefore, innovations are not novelties; they are simply something unfamiliar or new to an individual. According to Rogers (1995), “the perceived attributes of an innovation are one important explanation of the rate of adoption of an innovation” (p. 206). He defined five perceived attributes of innovations related to the adoption and diffusion of innovations and theorized that individuals or social unit would adopt an innovation if they perceived it to have particular attributes (Rogers, 1995). Specifically, innovations that potential adopters perceive to have more relative advantage, compatibility, trialability, observability, and less complexity are likely to be adopted more rapidly (Roger, 1995). Among these five characteristics, relative advantage, compatibility, and complexity seem to be the most influential in affecting decision making by adopting individuals (Huang, 2012; Rogers, 1995, Rogers, 2003; Sultan & Chang, 2000).

Communication channels. Rogers (2003) asserted that “given that an innovation exists, communication must take place if the innovation is to spread” (p. 18). A communication channel is simply the way by which individuals correspond regarding the information of innovation. Rogers (2003) emphasized the importance of using a “two-way” convergent rather than the more traditional one-way linear approach in communicating innovation (p. 6). In general, there are two types of communication channels: mass media channels and interpersonal channels. As the names implies, the mass channels transmit information through mass media; therefore, the information can reach a large number of recipients relatively fast. On the contrary, interpersonal communication channels use a more intimate approach that are created by the exchange of information between two individuals to reach a mutual understanding of the matters (Rogers, 2003). This communication process allows individuals to discuss, problem solve, and explore potential mutually beneficial solutions. Rogers (2003) found that two *homophilous* individuals are prone to have greater effects on the transmission of knowledge, on attitude formation, and on behavioral changes related to innovation because they share similar values, beliefs, education, and socioeconomic status. On the contrary, *heterophilous* individuals are more likely to create problems in the diffusion of innovations because of their differences in technical competence, social status, and beliefs that potentially lead to mistaken meanings, misunderstood intentions, thereby causing messages to be misunderstood or overlooked (Rogers, 2003).

Time. Rogers (2003) expressed “time is an important element in the diffusion process” (p. 21). Three of the constructs that form Rogers’s (2003) innovation diffusion theory involve the element of time. The first construct is the innovation-decision process, which outlines the process from an individual’s first encounter of an innovation to making a decision on its adoption or rejection. According to Rogers (2003), innovation-decision process can be divided into five distinctive stages: knowledge stage, persuasion stage, the decision stage, the implementation stage, and confirmation stage.

Specifically, it is during the persuasion stage that an individual or social unit actively seeks and develops a “favorable or unfavorable attitude towards the innovation” (Rogers, 2003,

p. 38). According to Rogers (2003), this is a crucial stage in the innovation-decision process, where an individual would seek advantages and disadvantages for the innovation concerning his or her experience, circumstance, and the situation. Therefore, at this stage, peer interaction and supportive network can be pivotal in influencing attitude formation towards the innovation and subsequent decision on adoption (Roger 2003). The innovation-decision process involves an element of time in the sense that the stages usually progress according to the time-ordered sequence, where stage I precedes stage II and so forth. The innovative-discussion process can result in either adoption or rejection. According to Rogers (2003), adoption is a decision to make use of the innovation as the best course of action available while rejection is a decision not to adopt an innovation. The adopter can reverse the decision to adopt or reject an innovation at a later point in time. For example, an individual may decide to reject a previously adopted innovation if he or she becomes dissatisfied with it, or a better alternative is available. On the contrary, it is also possible for an individual to adopt an innovation after a previous decision to reject it (Rogers, 2003).

The second construct is the continuum of innovativeness, which categorizes the relative "earliness or lateness" of an individual's adoption (Rogers, 2003). Rogers (2003) proposed that the population can be broken down into five different categories, based on its innovativeness or propensity to adopt an innovation, which can be influenced by the aforementioned attributes. Rogers (2003) reported that due to the interplay of the innovation factors, people adopt innovations at different rates. By grouping people according to how quickly they adopt an idea, he comes up with five different adopter categories: innovators, early adopters, early majority, late majority, and laggards.. The distributions of these adopter categories tend to follow a normally distributed bell-shape curve. Each category of adopters possessed specific characteristics.

Processes specific characteristics. The dominant attribute of innovators is venturesome; they are fascinated with trying new ideas and are often the first to introduce innovations to others. The dominant attribute of early adopters is respect. These early adopters tend to have a high social status and be well respected for their opinions. The dominant attribute of early majority adopters is deliberate; they are willing to try different innovations but are not willing to take the lead. The dominant attribute of late majority adopters is skeptical; they are extremely cautious and uncomfortable with changes. According to Roger's (1995) model, the early majority and late majority adopter categories account for approximately two-third of the population. These individuals would benefit from some external pressure and support in order for them to take the proverbial plunge. At the other end of the bell-shaped curve are the laggards. The dominant attribute of laggards is tradition. Laggards tend to be steadfast and trust previous experiences and traditions to guide their decisions. They are the last group of individuals to adopt an innovation and would not do so without resistance. They would benefit from maximum peer support and implementation strategies that would ensure smooth and successful adoption (Rogers, 2003). The third construct is an innovation’s rate of adoption in a social system, which, in other words, is the number of adopters of an innovation in the system within a specific period.

Social system. Rogers (2003) found that the type of decision involved in the adoption process, the nature of the social system, the communication channels, and the extent of change agent's promotion efforts affect the diffusion of innovation. He further described the term diffusion as a process by which an innovation is communicated through certain channels over time and among members of a social system. Thus, diffusion of innovation within Rogers's (1995) theory is both an individual and social activity. In other words, the physical environments as well as social, cultural, and temporal factors all potentially influence diffusion. Rogers (2003) asserted that both formal and informal social structures including hierarchical positions and individual relationships could be used to predict innovation adoption. He identified individuals with influence and power as opinion leaders or change agents, who would be instrumental to diagnose a problem or create an intent to change. These individuals are likely innovators and early adopters. Surry and Farquhar (1997) applied the theories of innovation diffusion into the practice of instructional technology to help technologists understand the factors that influence adoption of innovations and to apply that knowledge to recommend strategies that would culminate in innovations that are effective and pedagogically appropriate. Similarly, the current study applied the theory of diffusion of innovations as a theoretical framework to explore and account for factors that may influence the propensity of ARS adoption at a local university.

Studies Using the Diffusion of Innovation Theory

Numerous studies in different social science disciplines and contexts have been conducted based on Rogers's (2003) diffusion of innovations theory (Kapoor, Dwivedi, and Williams, 2014). For example, Greenhalgh, Robert, Macfarlane, Bate, and Kyriakidou (2004) addressed the issue of spreading and sustaining innovations in the health service industry through an extensive meta-narrative systematic review based on Rogers's (1995) original five attributes of innovations. The authors investigated and explained the five attributes in detail based on the service innovations that were specific to healthcare. The review supported many recurrent themes in the literature, such as the attributes of innovations that predict successful adoption and the importance of social influence and the complex nature of the adoption process. Al-Jabri and Sohail (2012) investigated the factors that might help the bankers design mobile services that were suitable for and adoptable by bank customers in Saudi Arabia. Using Rogers's (2003) diffusion of innovations theory, Al-Jabri and Sohail (2012) found that relative advantage, compatibility, and observability had a positive impact on the adoption of mobile banking. Among the three attributes, compatibility was found to be the most significant determinant predicting mobile banking adoption (Al-Jabri & Sohail, 2012). Therefore, Al-Jabri and Sohail (2012) suggested that banks, in Saudi Arabia, should offer mobile banking services that are compatible with current user requirements, past experiences, lifestyle, and beliefs in order to fulfill customer expectations.

The innovation diffusion model discussed by Rogers is applicable to the study of innovations in general, and it can be applied in any field of studies (Surry & Farquhar, 1997). A number of researchers have used innovation diffusion model to study the adoption and diffusion of instructional technology innovations. For example, Burkman (1987) realized that instructional design products had been suffering from little utilization and turned to the innovation diffusion theory for a possible solution. He used perceived attributes from the diffusion model to propose a method for developing instructional design products that would be more appealing to potential adopters. Zhang, Wen, Li, Fu, and Cui (2010) used diffusion concepts to investigate the factors influencing e-learning adoption in China. Seechaliao (2014) incorporated innovation diffusion concepts as the basis of a survey study, which intended to examine faculty perceptions of integrating social media into instructional design in higher education. Therefore, the innovation diffusion model is selected as a theoretical framework to guide the development of the research questions in the current study, in order to shed light on the local problem of ARS adoption.

Factors Affecting Adoption of Technology

According to Nichols (2008), simply providing technologically advanced tools would neither result in guaranteed use nor assure integration in any form of pedagogy. Although the use of technology is widespread in education and education administration, it had not been integrated effectively in the activities of teaching and learning (Eteokleous, 2008; Grabe & Grabe, 2007; Keengwe et al., 2008). This phenomenon indicates that factors other than the availability of technology influence the likelihood of technology adoption (Nichols, 2008). Potter and Rockinson-Szapkiw (2012) claimed that mentor-supported professional development approach and sustained administrative supports were crucial factors for successful technology integration. These results resonated with Rogers's (1995) assertion regarding the effects of the nature of the social system on the adoption of innovations. Elsaadani (2013) conducted survey research on 500 full-time faculty in one higher education institution and found a positive relationship between age and the attitude towards technology, where older teaching faculty had a higher propensity to adopt instructional technology than younger faculty. On the contrary, Gautreatu (2011) discovered in her research that the factors of age and gender did not influence the faculty's decision to adopt instructional technology. She found that tenure status and level of experience with the technology significantly influenced the decision to adopt, where untenured faculty had a higher propensity to adopt emerging instructional technology.

Audience Response System (ARS)

Audience Response System is a combination of computer software and hardware designed to present questions, record responses, and to provide feedback to the audiences. The hardware aspect of the system consists of a radio receiver that plugs into the presenter's computer and the audience's remote clickers. The software aspect of the system consists of the driver for the receiver and the software add-in that enhances functions to the PowerPoint software on the presenter's computer. The add-in allows the presenter to create questions and receive data from the audience's clickers using Microsoft PowerPoint, which is widely used and technically supported in academic settings. The question types used with the ARS may include multiple choice, true or false, numeric, ordering, and even short answer depending on the capabilities of specific ARSs. The instructor displays the questions on the projection screen using the PowerPoint software, and the audiences respond by entering their answers using the remote clickers. The audience response system appears in the literature under different names, some examples of which are classroom response system (CRS), student response system (SRS), clicker, and classroom polling system. These commercially available systems are remarkably similar in function (Kay & LeSage, 2009a). The technology behind ARS is easy to navigate and requires only an intermediate level of computer skills, which allows the educator to focus on pedagogy, rather than on the technology itself (Efstathiou & Bailey, 2012).

Effects of ARS in Classrooms

Tamim et al. (2011) conducted a second-order meta-analysis, which brought together more than 40 years of research evidence on the effects of technology in classrooms on student achievement. The results of the studies revealed significant affirmative effects on student's achievement favoring the utilization of instructional technology over instruction methods that were more traditional. The appeal and inspiration to incorporate emerging instructional technology as part of instructional practice had been brought about by evidence supporting their ability to motivate students, encourage participation, and personalize the learning environment (Gee, 2009; Looi et al., 2009; Schneckenberg, 2009). Concomitant with the evidence about the potential benefits of incorporating technology is a paradigm shift from viewing learners as passive recipients of information to understanding them as self-regulated active participants in the construction of knowledge (Knowles, Holton, Swanson, 2011; Lai et al., 2013; Schunk, 2012). When used appropriately, instructional technology proved to have the potential to support this paradigm shift by allowing learners to construct pedagogical experience that was meaningful and relevant to them, to make independent choices, and to master their learning (Renes & Strange, 2011). With the overwhelmingly supportive evidence, many universities are investing in technology for the classroom; however, the decision to integrate any technology into coursework continues to rest with the faculty who teach the courses (Ertmer et al., 2012). Many instructors took advantage of different instructional technology, took the time to learn about them, and used them regularly while others tended to rely on the relatively more traditional methods of delivering course content (L. L. Fothergill & K. Boone, personal communication, July 7, 2014).

Research has demonstrated that ARSs can be a promising pedagogical tool in the classrooms. There is substantial evidence to suggest that higher education students are very positive toward the use of ARSs (Fies & Marshall, 2006; Guse & Zobitz, 2011; Kay & LeSage, 2009a; Oigara & Keengwe, 2013; Simpson & Oliver, 2007; Vaterlans, Beckert, Fauth, & Teemant, 2012). Students report that they are more interested, engaged, and attentive when an ARS is used during lectures (Preszler et al., 2007; Simpson & Oliver, 2007). Students also report that the use of ARSs encourages class engagement and student–faculty exchange, reinforces key concepts, challenges metacognition, and validates student comprehension, as the discussion of answer choices is beneficial to support learning (Lee & Dapremont, 2012; Revell & McCurry, 2010; Russell et al., 2011). According to current studies, one of the key benefits of using an ARS is the ability to obtain accurate real-time assessment of class understanding, and instruction could be modified contingent upon student assessment gathered at strategic points within a lecture (Caldwell, 2007; Hinde & Hunt, 2006). If the majority of students fail to grasp the concept, an experienced instructor could offer alternative explanations of the concept in question (Caldwell, 2007; Draper & Brown, 2004).

In addition to the aforementioned benefits, a number of researchers discovered that when instructors employed ARS to facilitate the pedagogical strategy of peer instruction, the quantity and quality of class discussions improved (Brewer, 2004; Draper & Brown, 2004). Peer instruction could be used in conjunction with ARS when an instructor presents a question using the ARS, and then collects and shares student responses with the class without providing the correct answer. Subsequently, the class would be instructed to discuss possible solutions based on the student responses provided by the ARS. After the initial class discussion, the instructor could present the refined solutions to the class to stimulate further discussions (Brewer, 2004; Draper & Brown, 2004). In essence, using an ARS could potentially change a static, one-way transmission of information into a dynamic and student-centered learning experience (Martyn, 2007). The literature emphasized that the implementation of appropriate pedagogical strategies in combination with the use of ARS could ultimately influence student success by encouraging active participation and improving attentiveness and retention (Kay & LeSage, 2009a; Simpson & Oliver, 2007; Vaterlans et al., 2012).

Despite the supportive findings for the use of ARSs in the classroom, there were challenges highlighted in the ARS literature (Kay & LeSage, 2009b). A few studies evaluated the effectiveness of ARSs in improving students' examination scores and found no statistical significance in the scores in regard to the use the ARSs in the classrooms (Filer, 2010; Paterson, Kilpatrick, & Woebkenberg, 2010; Vana, Silva, Muzyka, & Hirani, 2011). The results of the aforementioned studies did not discredit the effectiveness of ARSs as an instructional tool. They highlighted that although there was no significant improvement in posttest scores, students in ARS-enhanced lectures reported significantly higher satisfaction scores. The use of ARS promoted a sense of comfort, encouraged participation, and motivated students to answer questions and interact with the subject matter (Filer, 2010; Paterson, Kilpatrick, & Woebkenberg, 2010; Vana, Silva, Muzyka, & Hirani, 2011). In addition, Kay and LeSage (2009b) conducted a systematic review of 67 peer-reviewed articles to examine the benefits and challenges of using ARSs and pointed out that data collection instruments used in ARS studies were noticeably lacking in reliability and reliability analysis. They reported that only four out of the 67 reviewed articles reported estimates of variability and reliability (Kay & LeSage, 2009b).

Conclusion

With the proliferation of globalization and the knowledge economy, it has become a priority for developed nations to capitalize their innovative capacities in order to gain a competitive edge in the global market (Feinstein, Vorhaus, & Sabates, 2008). As the nation morphs into a knowledge society, there is a high demand to develop a citizen's competency to work creatively and innovatively with information, knowledge, and technology. Higher education institutions are facing great challenges to prepare their faculty and students to meet the demands of the ever-evolving knowledge society (Lai et al., 2013). Technology is considered a catalyst for growth in the information and knowledge economy; therefore, the propensity to adopt it and the ability to master it are critical factors to the success in the global market (Economist Intelligence Unit, 2012; Warschauer & Matuchniak, 2010).

The continuous growth and development in instructional technology have stimulated many novel pedagogical practices and have changed the teaching and learning environment (Davidson & Goldberg, 2010). Some educators and learners embraced novel pedagogical practices with enthusiasm while others were reluctant to do so (Bingimlas, 2009; Hixon & Buckemeyer, 2009). Bingimals (2009) conducted a meta-analysis of the literature on the perceived barriers to technology integration, which shed light on the complexity of interrelated barriers to integration of instructional technology. Identifying the factors that hinder or facilitate instructional technology adoption may assist faculty and administrators to overcome barriers and become successful instructional technology adopters (Bingimals, 2009).

Despite the growing number of studies on diverse areas surrounding the topic of instructional technology, there continues to be a gap in current knowledge and insight as to the factors that influence the likelihood of technology adoption by university faculty (Buckenmeyer, 2008; Oncu, Delialioglu & Brown, 2008). Most of the existing studies used different models and theories in an attempt to explain the diffusion of technology in general. However, the inconsistent relationships among the constructs and the diverse contextual difference among different types of technology limit the generalizability of these models across differing contexts and disciplines (Sun & Zhang, 2006). This present study applied Rogers's innovation diffusion model to a specific technology, the ARS. By applying a specific model to a specific technology, this study helped shed light on the local problem of the adoption of ARS.

Implications

Because of the aforementioned reasons, it is important to identify the factors that influence the faculty's adoption of instructional technology in the teaching and learning process. The factors that predict the adoption of the ARS technology may provide insight into effective strategies to promote technology utilization among faculty. This information may enable the administration and staff to target the supports, trainings, and resources necessary for successful adoption of instructional technology. Specifically, the findings of this study may inform faculty development and incentive program to address those most influential factors. For example, if relative advantage is the most influential factor in affecting adoption, a faculty development program that focuses on exploring the benefits of integrating ARS may be the most effective approach to facilitate adoption. In addition, this research may also be instrumental in promoting positive social change by fostering evidence-based teaching strategies and innovations that maximize student learning, which include the best practices in leveraging the strengths of instructional technology to expand access and reduce cost.

Summary

Instructional technology can be effective adjuncts to widen educational opportunities and to foster student engagement, but they cannot be effective if educators are not taking advantage of them. Based on Rogers's diffusion of innovation theory, this quantitative survey study determines what attributes of innovation (relative advantage, compatibility, complexity, trialability, and observability) predict faculty adopting and integrating the ARS into instruction. The results of the study may shed light to target support, training, and resources necessary for successful adoption of instructional technology.

In the following section, I will describe the research methodology of this study. It will include a detail description and justification of the research design and approach, sampling method, the survey instrument, and the statistical procedures to analyze the data. In addition, I will discuss the measures to protect the participants' rights.

Section 2: The Methodology

Introduction

This quantitative study surveyed faculty who have current teaching appointments at the university. The purpose of this section is to: (a) describe the research design and approach of this study, (b) explain the setting and sampling technique, (c) describe the data gathering instrument and the administration of the survey, (d) provide an explanation of the statistical procedures used to analyze the data, and (e) address assumptions, limitations, and delimitations of the study.

Research Design and Approach

This research was a quantitative, nonexperimental, one-shot cross-sectional study in which participants provided survey data at one point in time regarding their present perception of the theoretical technology innovation attributes, and linked these to their propensity of adopting ARS into instruction. Lodico, Spulding, and Voegtle (2010) proposed that survey research could be used to collect “opinions, beliefs, or perceptions about current issue from a large group of people” (p. 157). Due to the ability to involve a large group of people, the data gathered possessed a better description of the relative characteristics of the population involved in the study. Creswell (2012) described two main types of survey design based on the time of data collection. According to Creswell (2012), a longitudinal survey design involves the collection of data over time while a cross-sectional survey involves the collection of data at one point in time. For this study, a cross-sectional design is preferred because the research question concerns the present. Therefore, a quantitative, nonexperimental, one-shot cross-sectional study was best suited to answer the proposed research question: “What attributes of innovation (relative advantage, compatibility, complexity, trialability, and observability) predict the probability of faculty adopting ARS into instruction?”

Setting and Sample

The research site for this study is a nonprofit, private university located in the southeastern United States. According to the data available at this time, there are more than 600 full and part-time faculty members. Internal surveys usually receive a 30% to 40% response rate (Lodico et al., 2010). One of the statistical analysis methods that I employed is highly sensitive to the sample size, specifically the ratio of observations for each predictor or independent variable. In fact, multivariable methods of analyses tend to produce problematic results if too few outcome events are available relative to the number of independent variable being analyzed (Peduzzi, Concato, Kemper, Holford, and Feinstein, 1996). These authors conducted a simulation study of the number of events per variable in logistic regression analysis and suggested a guideline for a minimum number of cases for logistic regression study. In their formula, these authors let p be the smallest of the proportions of negative or positive cases in the population and k the number of independent variables, and then the minimum of cases to include in the study, N can be calculated:

$$N = 10\ k/p$$

In the case of this study, there were five explanatory variables to include in the model, and the proportion of positive cases was 0.25, or 25%. According to the formula above, the minimum number of cases required turned out to be 200. Long (1997) expanded on this formula and asserted that if the *N* were less than 100, it should be increased to 100 to maximize the fidelity of the statistical test. Because I needed at least 200 cases, I used the entire faculty population for this study. As I mentioned before, the university consists of approximately 600 full and part-time faculty. Therefore, 40% response rate yielded about 240 cases. This study included all accessible faculty who met the inclusion criteria. Study participants were full-time, part-time, or adjunct faculty members, who had active teaching appointments at the university. The faculty administrators who did not have active teaching appointments were excluded from the study. In addition, faculty members who were teaching solely online were also excluded from the study. The researcher did not supervise or have authority over any of the faculty. Participation in this project was strictly voluntary. In fact, voluntary participation was solicited and ensured through explicit written declarations. The participants had the right to withdraw from the study at any time.

Instrumentation and Materials

A pre-established instrument, created for a similar inquiry in a different context (See Appendix B), formed the basis of the survey instrument for this study. Moore and Benbasat (1991) designed, piloted, field-tested, and published an instrument to measure the perceptions of office workers adopting an information technology innovation based on the perceived attributes of innovations developed by Rogers (1983). The authors simply called their instrument "Perceptions of Adopting an Information Technology Innovation" (Moore & Benbasat, 1991, p. 192). In the process of fine-tuning the content validity of the instrument, these authors undertook an extensive scale development process and developed an instrument that was tested to deliver a high degree of confidence in content and construct validity, as well as reliability. The average value of the reliability coefficient for the five attributes was 0.83. The Kappa scores were also correspondingly high, with an average 0.82, which was indicative of good inter-rater reliability (Moore & Benbasat, 1991). The original survey was designed to measure the various perceptions that an office worker might have of adopting an information technology innovation, a personal workstation (PWS), based on the aforementioned attributes using Rogers's (2003) innovation of diffusion model. Minor modifications were made to the instrument to reflect the purpose of the current study, which was to test the same attributes in the context of adopting ARS into instruction in higher education. The survey consisted of two parts. The first part consisted of ten demographic questions, which was modified to collect relevant characteristics of the population in the context a higher education setting. All demographic data were collected using nominal scales to decrease the likelihood for the participants to be identified from the data. The second part sought information regarding faculty's perceived attributes of the innovations under study and their adoption of the ARS. Moore and Benbasat (1991) expanded upon Rogers's (1983) original five attributes of innovations to include two additional untested attributes: voluntariness and image. These two attributes were out of the scope of the current study; therefore, the associated questions were removed. In the original survey, the authors did not define the term adoption explicitly (Moore and Benbasat, 1991); therefore, a minor modification was made to the instrument to define the term, adoption, based on Rogers's (2003) diffusion of innovations model. For the purpose of this study, an adopter is a faculty member who has made the decision to make use of ARS in his or her teaching when the use of it is deemed appropriate. Please note that the current study was not designed to investigate the actual implementation of ARS; therefore, an adopter was not necessarily a current user of the technology. I had contacted one of the authors and obtained an email approval to use the aforementioned survey instrument in this study (See Appendix C).

Because minor modifications were made to the original instrument to fit the context of this study, I conducted a pilot test of the survey to verify its face and content validity. Five faculty members from the Department of Mathematics and Computer Science were selected based on their expertise in the context of instructional technology. I asked the participants to note areas of difficulty in the survey as they completed it. The participants returned the completed survey within two weeks. The purpose of the pilot study was to provide information concerning errors, ambiguities, and clarity of the survey questions, and to identify any issue of content validity. Content validity is a subjective measure of how appropriate the items are to the reviewers, who have some knowledge of the subject matter (Lodico et al., 2010).

The survey instrument had two parts. The first part consisted of demographic questions, such as gender, age, years of teaching experience, years taught in the current department, and professional rank. The second part consisted of questions regarding faculty's perceived attributes of the innovations under study and their adoption of the ARS. The independent variables consisted of the faculty's five perceived attributes of innovations: relative advantage, compatibility, complexity, observability, and trialability, based on a seven-point Likert scale ranging from *1-strongly disagree* to *7-strongly agree*, with which the equal numbers of positive and negative responses around a neutral option balanced the scale. These variables represented an interval level of measurement. Interval scales provide "continuous response" options to questions with assumed equal distances between options (Creswell, 2012, p.167). The mean score for each variable represented the respondent's level of agreement with the presented statements concerning each attribute of the ARS. The dependent variable was dichotomous: the adopters and the non-adopters of ARS; therefore, it was considered a binary variable (Long, 1997).

The SurveyMonkey website's secure server, which was password protected and encrypted, housed the raw data collected using an online survey instrument (See Appendix B). The researcher was the only person who had access to the raw data. Once the data collection period ended, the researcher transferred the raw data from the web server to his laptop computer, which had biometric login and data encryption. Upon the completion of the study, the researcher downloaded the data onto a biometric fingerprint secured flash drive and stored it in a locked file cabinet in the researcher's office for five years. After 5 years, the data will be permanently erased from the flash drive.

Data Collection and Analysis

Data Collection

The main purpose of any survey is to provide statistics that are quantitative or numerical descriptions of some aspect of the study population (Creswell, 2009). No data were collected prior to the approval from the Walden University Institutional Review Board (IRB). Because this research involved two different universities (where the researcher studies and works), the research proposal needed to be approved by the IRBs of both institutions prior to data collection. The requirements for submitting an IRB application were slightly different for each institution. For example, the research site's IRB required yearly renewal of the Human Research Protections training certification, whereas the same certification was good for five years according to Walden University's IRB.

After I received the approval letter from the research site's IRB, I submitted it along with the IRB application form and other required documents to the Walden University IRB for final approval. I received approval from the Walden University IRB, number 02-16-15-0297465, before the pilot study and the data collection process for this research project.

The data collection process consisted of two principle steps. The first step in the data collection was to validate the research instrument. This step required the administration of a pilot test of the survey to a small sample of faculty members. The purpose of the pilot study was to provide information concerning errors, ambiguities, and clarity within the instrument, and to identify any issue of content validity. Five faculty members from the Department of

Mathematics and Computer Science were selected based on their expertise in the context of instructional technology. The participants were asked to note areas of difficulty with the survey as they were completing it. The participants did not raise any concerns regarding the content validity of the instrument. The second step of the data collection was the administration of the survey to the target population.

The aforementioned survey was disseminated by email to all faculty in the research site. The faculty's email addresses were readily available on the research site's intranet. The email consisted of the cover letter, instructions, and weblink to the survey instrument (See Appendix D). The participants gave their consent by completing and submitting the web-based survey. The survey instrument was hosted using SurveyMonkey (www.surveymonkey.com) for its flexibility, convenience, and accessibility. In order to protect participant privacy and confidentiality, the researcher did not ask or record the participants' identifications. The sensitive demographic information, such as age and years taught in the current department, was collected using nominal scales to decrease the likelihood that participants be easily identified by the demographic data. The independent variables consisted of the faculty's five perceived attributes of innovations: relative advantage, compatibility, complexity, observability, and trialability, based on a seven-point Likert scale ranging from *1-strongly disagree to 7-strongly agree*, where the equal numbers of positive and negative responses around a neutral option balanced the scale. These variables represented an interval level of measurement. Interval scales provided "continuous response" options to questions with assumed equal distances between options (Creswell, 2012, p.167). The mean score for each variable represented the respondent's average level of agreement with the presented statements concerning each attribute of innovation of the ARS. The dependent variable was dichotomous: the adopters and the non-adopters of ARS; therefore, it was considered a binary variable (Long, 1997).

Lodico et al. (2010) stated that internal surveys usually receive a 30% to 40% response rate. In order to ensure a response rate of no less than the typical, a follow-up email reminder was sent to all participants after two weeks (See Appendix E). The same procedure was repeated twice before 200 participants completed the survey.

Data Analysis

The raw data were imported into the Statistical Package for the Social Science (SPSS), Version 21, for descriptive and inferential statistics computation. Because the instrument used in this study included a mixture of *positively-keyed* and *negatively-keyed* questions, the negatively-keyed items had to be reverse-coded before computing the composite scores that represent each attribute. Positively-keyed items were phrased so that an agreement with the item represented a relatively high level of the attribute being measured. For example, Question 11 "Using the ARS enables me to accomplish tasks more quickly" addressed relative advantage by asking respondents to rate on a 7-point Likert scale ranging from "1"-strongly disagree" to "7"-strongly agree." This item was positively-keyed because a strong agreement with the statement indicated the respondent's perception of a higher level of relative advantage in terms of using the ARS. On the contrary, negatively-keyed items were phrased so that an agreement with the item represented a relatively low level of the attribute being measured. For example, Question 22 "I believe that it is easy to get the ARS to do what I want it to do" addressed complexity by asking respondents to rate on a 7-point Likert scale ranging from *1-strongly disagree to 7-strongly agree.* This item was negatively-keyed, because a strong agreement with the statement indicated the respondent's perception of the lower level of complexity in terms of using the ARS. Reverse-scored items force the respondent to notice the altered direction of wording and use the opposite end of the rating scale to produce a response that is consistent with the other items on the survey. The reverse-scored items serve a useful function by reducing acquiescent and extreme response bias (Anderson, Basilevsky, & Hum, 1983). For the instrument used in this study, question 22, 23, 24, 28, and 31 were negatively-keyed. Because the instrument included positively-keyed and negatively-keyed items, the negatively-keyed items had to be reverse-coded before computing the composite scores that represented each attribute. Reverse-scoring the negatively-keyed items ensured that all of the items in the survey were consistent with each other in terms of the levels of agreement the scores implied. The concept of reverse coding an item is to re-code the responses so that high scores on the item indicate high levels of the attribute being measured. Similarly, the low scores indicate low levels of the attribute being measured. To reverse score an item, I used the transform function provided in SPSS.

Although the results of the pilot study had confirmed the content validity of the instrument, I believed that it would be beneficial to assess the degree to which the data met the expected structure as discussed by Moore and Benbasat (1991). After all, the instrument was modified to survey a different population in a different context.

Validity and reliability of the instrument. The dimension reduction function in SPSS was used to conduct an exploratory factor analysis on the data. The results of the analysis revealed that the items generally loaded on the correct factors. According to Moore and Benbasat (1991), relative advantage and compatibility did not emerge as separate factors in their original instrument. Although conceptually different, these two attributes might have a causal relationship to each other. For example, it would be unlikely that the respondents perceived the advantages of using certain innovation if its use were perceived as incompatible with their experiences. Therefore, four factors, instead of five, were used in the analysis. The exploratory factor analysis using principal axis component extraction with the Promax rotation revealed that all of the items, except three of the items under observability, loaded on the correct factors. The three problematic items were removed from further analysis. In other words, only five of the original eight questions on observability were used to calculate the mean score of the attribute. After dropping the three items, the factor analysis was recalculated to confirm correct loading of the factors. The Barlett test of sphericity for the attributes was significant ($p < 0.000$) and the Kaiser-Olkin measure of sample adequacy (KMO) for the attributes was adequate (KMO = 0.927). These tests met the standards for the appropriateness of factor analysis (Table 1). The variance explained for the factors was 77.08%. Factor loading of the attributes was well above acceptable value of 0.4 (Steven, 1992). These results of the factor analysis were similar to the research framework shown in the study reported by Moore and Benbasat (1991). Thus, the instrument retained its construct validity despite the minor modifications.

Table 1

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.927
	Approx. Chi-Square	5030.842
Bartlett's Test of Sphericity	*df*	276
	p	.000

Cronbach's alpha values were calculated for each of the attribute, which confirmed that the instrument exhibited good reliability. All alpha values were more than 0.8, which indicated high internal consistency among the items listed under each attribute (Table 2), thereby indicating acceptable levels of reliability.

Table 2

Cronbach Alpha Reliability Analysis

Attributes	Cronbach's alpha
Relative advantage	0.94
Compatibility	0.87
Complexity	0.94
Observability	0.89
Trialability	0.93

Demographics of the sample. The demographic data, which are categorical in nature, were analyzed using descriptive statistics. The data tables present the frequency and proportion of the responses to each demographic question. The results describe similarities, differences, and trends of the faculty who participated in the study. Demographic information was used to confirm participants met the inclusion criteria for the research study and to summarize the participants overall characteristics

Out of the 204 faculty members, who participated in the study, three did not meet the inclusion criteria; therefore, they were excluded from the study. The data provided by the remaining 201 faculty were included in the analysis (Table 3). The response rate was 34%, which was similar to what was expected in internal surveys (Lodico et al., 2010). The minimum number of cases required for conducting binary logistic analysis on the five predictor variables was met.

Table 3

Data Analysis of Case Processing Summary

	N	%
Included in Analysis	201	100.0
Missing Cases	0	0
Total	201	100.0

Description of the respondents. The first part of the survey instrument composed of demographic questions, such as gender, age, employment status, years of teaching experience, years taught in the current department, and professional rank. Of the 201 respondents, 118 (58.7%) were female (Table 4).

Table 4

Gender of Respondents

	Frequency	Percent
Female	118	58.7
Male	83	41.3
Total	201	100.0

The majority of respondents were between 45 and 64 years old. To be precise, 60 (29.9%) of them were between 45 and 54 years old, and 67 (33.3%) of them were between 55 and 64 years old (Table 5). As for employment status, 178 (88.6%) of the respondents were full-time educators. More than three-quarter (79.1%) of the respondents (*n* = 159) held a doctoral degree (Table 6). The proportion of respondents with a doctoral degree was similar to that of the population of the research site. According to the university's division of mission and institutional effectiveness of the research site, more than 80% of the faculty held a Ph.D. or terminal degree in their fields of expertise.

Table 5

Age Range of Respondents

	Frequency	Percent	Cumulative Percent
Age 25-34	7	3.5	3.5
Age 35-44	50	24.9	28.4
Age 45-54	60	29.9	58.2
Age 55-64	67	33.3	91.5

Age 65-74	16	8.0	99.5
Age 75 or older	1	.5	100.0
Total	201	100.0	

Table 6

Highest Degree Earned by the Respondents

	Frequency	Percent	Cumulative Percent
Bachelors	5	2.5	2.5
Masters	37	18.4	20.9
Doctorate	159	79.1	100.0
Total	201	100.0	

Table 7 shows the employment status of the 201 respondents with full-time faculty (*n* = 178) having the highest representation (88.6%). The majority of faculty in the study held either the academic rank of assistant professor (44.8%) or associate professor (28.9%). Twenty-nine (14%) of the 201 respondents held the rank of instructor while twenty-four (11.9%) held the rank of full professor (Table 8). About half (52.2%) of the 201 respondents had more than ten years of experience teaching at the university level (*n* = 105), spanning from 10 to 40 years (Table 9).

Table 7

Employment Status of the Respondents

	Frequency	Percent
Full-time	178	88.6
Part-time/adjunct	23	11.4
Total	201	100.0

Table 8

Academic Ranks of the Respondents

	Frequency	Percent	Cumulative Percent
Instructor	29	14.4	14.4
Full Professor	24	11.9	26.4
Associate Professor	58	28.9	55.2
Assistant Professor	90	44.8	100.0
Total	201	100.0	

Table 9

Years Taught at University Level

	Frequency	Percent	Cumulative Percent
40 years or more	1	.5	.5
35-39 years	2	1.0	1.5
30-34 years	3	1.5	3.0
25-29 years	4	2.0	5.0
20-24 years	23	11.4	16.4
15-19 years	36	17.9	34.3
10-14 years	36	17.9	52.2
5-9 years	53	26.4	78.6
0-4 years	43	21.4	100.0
Total	201	100.0	

In the demographic profile section of the survey, two questions concerning the adoption of instructional technology were asked: (a) At this time, do you consider yourself an adopter of the ARS? (b) Which of the following statements best describes your disposition toward the adoption of change? The data showed that 37 (18.4%) of the 201 respondents considered themselves an adopter of the ARS (Table 10).

Table 10

Percentages of Respondents Considered Themselves as Adopters and Non-adopters of ARS

	Frequency	Percent
Adopter	37	18.4
Non-adopter	164	81.6
Total	201	100.0

Table 11 shows that out of the 37 respondents, who considered themselves adopters of the ARS, 24 of them were female (64.9%) and 13 of them were male (35.1%). Similarly, out of the 164 respondents who considered themselves non-adopter of the ARS, 94 of them were female (57.3%), and 70 of them were male (42.7%). In order to satisfy my curiosity and pave a path for future study, I conducted a Chi-square test of independence using the crosstab function in the SPSS to examine the relation between gender and the adoption of ARS. The result was insignificant, (X^2 (1) = 0.79, $p > .05$).

Table 11

Frequency Distribution and Relative Frequencies of Adopter and Non-adopter in Relation to Gender

	Adopter		Non-adopter		Total	
	N	*%*	*N*	*%*	*N*	*%*
Female	24	64.9	94	57.3	118	58.7
Male	13	35.1	70	42.7	83	41.3
Total	37	100.0	164	100.0	201	100.0

Table 12 summarizes the distributions of the respondents' disposition toward the adoption of change. It is interesting to see that the frequency plot of the data revealed a normally distributed bell-shaped curve (Figure 1), similar to the one illustrated by Roger (2003).

Table 12

Respondents' Disposition Toward the Adoption of Change

	Frequency	Percent	Cumulative Percent
Laggards	5	2.5	2.5
Late majority adopters	51	25.4	27.9
Early majority adopters	73	36.3	64.2
Early adopter adopters	53	26.4	90.5
Innovators	19	9.5	100.0
Total	201	100.0	

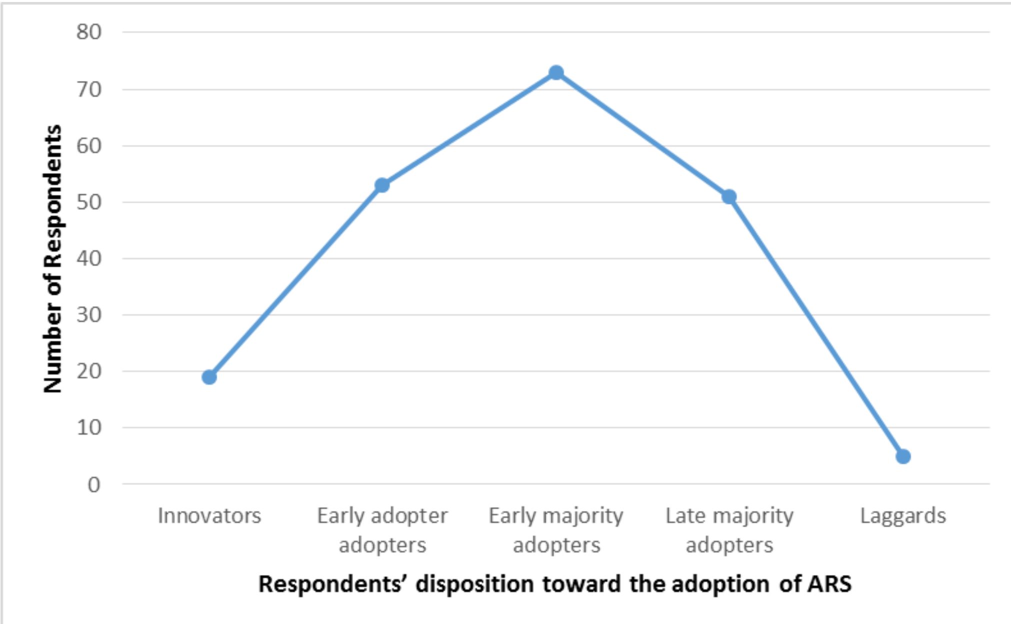

Figure 1. Frequency plot of the respondents' disposition toward the adoption of ARS.

Table 13 presents the mean scores for each of the attributes of innovations derived from the data provided by the 201 respondents. In the study conducted by Moore and Benbasat (1991), the mean scores of attributes were compared between the adopters and the non-adopters groups as a measure of the validity of the instrument. The Mann-Whitney U test was used to exam whether the mean scores of the five attributes were different between adopters and non-adopters. The results fit the theory that the perceptions of the five attributes are different between adopters and non-adopters ($p < 0.05$). The diffusion theory specifies that adopters should have more positive perceptions of the innovation than non-adopters should; therefore, adopters should score higher on the scales.

Table 13

Descriptive and Mann-Whitney U Test of Innovation Diffusion Model Attributes Based on the Respondents' Adoption Decisions

	Adopters			Non-adopters				
Attributes	*M*	*SD*	*n*	*M*	*SD*	*n*	*U*	*p*
Relative Advantage	5.26	1.10	37	3.75	1.09	164	-6.44	.000*
Compatibility	5.44	1.06	37	3.78	1.10	164	-6.85	.000*
Complexity	3.36	1.24	37	4.78	1.07	164	-5.86	.000*
Observability	5.96	1.38	37	4.62	1.23	164	-5.70	.000*
Trialability	4.88	1.96	37	2.43	1.37	164	-6.36	.000*

Note. Asymptotic significances are displayed. *$p < .05$

Measurement of attributes of innovation. The mean scores of the predictor variables of relative advantage, compatibility, complexity, trialability, and observability were analyzed using logistic regression in an attempt to answer the research question: What attributes of innovation (relative advantage, compatibility, complexity, trialability, and observability) predict the probability of faculty adopting ARS into instruction? The basic purpose of binary logistic regression is to explore the influence of multiple independent variables on a binary outcome of interest. Similar to other inferential statistics, binary logistic regression has a few assumptions that must be met to produce reliable results (Long, 1997). In a Logistic Regression model, there is an assumption on the degree of collinearity among predictor variables. The term collinearity implies that two variables are near perfect linear combinations of one another. When more than two variables are involved, it is often called multicollinearity, although the two terms are often used interchangeably (Dormann et al., 2013). Multicollinearity is the undesirable situation when the correlations among the independent variables are strong. In other words, when predictor variables are too highly related, multicollinearity exists. The primary concern is that as the degree of multicollinearity increases, the regression model estimates of the coefficients become unstable, and the standard errors for the coefficients can get very inflated (Dormann et al., 2013). The predictor variables tested for multicollinearity were relative advantage, compatibility, complexity, trialability, and observability. Computing the bivariate correlation for all measured variables is one of the practices to screen for multicollinearity. According to Katz (2011), the threshold of correlation coefficient between predictor variables, $r > 0.85$ is an appropriate predictor for collinearity, when it begins to distort severely model estimation and subsequent prediction (p. 90). As shown in Table 14, the predictor variables each represented an independent measure of the model showing no major concern of multicollinearity. Unfortunately, even if all correlations in the matrix are less than the threshold, this is no guarantee of not having a problem with multicollinearity. A major reason that the correlation matrix is inadequate for assessing collinearity is that a correlation matrix only provides information on the relationship between two variables. Katz (2011) suggested using the collinearity diagnostic routine in the linear regression program for calculating tolerance and variance inflation factor. SPSS version 21 was used to calculate the variable tolerance and variance inflation factor (VIF) values for each predictor variable as a check for multicollinearity. If the variable tolerance is less than 0.1, or the VIF value is greater than 10, then there is a concern of multicollinearity. I conducted a SPSS collinearity diagnostic (Table 15), and the results corroborated with the findings in the correlation matrix, which indicated that multicollinearity was not a concern (complexity, tolerance = .53, VIF = 1.91; observability, tolerance = .50, VIF = 2.01; trialability, tolerance = .56, VIF = 1.78; relative advantage, tolerance = 0.29, VIF = 3.4; compatibility, tolerance = .26, VIF = 3.80).

Table 14

Correlation Coefficients for the Predictor Variables

	Relative Advantage	Compatibility	Complexity	Observability	Trialability
Relative Advantage	1	.829**	.605**	.569**	.483**
Compatibility		1	-.588**	.643**	.539**
Complexity			1	-.541**	.560**
Observability				1	.584**
Trialability					1

Note. Correlation is significant at the 0.01 level (2-tailed) ***p* < .01.

Table 15

Collinearity Diagnostic for the Predictor Variables

	Collinearity Statistics	
	Tolerance	VIF
Complexity	.525	1.906
Observability	.496	2.017
Trialability	.562	1.780
Relative Advantage	.292	3.430
Compatibility	.263	3.803

Hypothesis testing. For this study, it was hypothesized that the attributes of innovation (relative advantage, compatibility, complexity, trialability, and observability) predict the probability of faculty adopting ARS into instruction. The null hypothesis was therefore defined as the following: The attributes of innovation (relative advantage, compatibility, complexity, trialability, and observability) do not significantly predict the probability of faculty adopting ARS into instruction. The null hypothesis was tested using binary logistic regression on the five attributes of innovation to determine what attributes of the innovation diffusion model predict the probability of faculty adopting the ARS into instruction.

The preliminary results of the binary logistic regression analysis revealed that the constant only model suggested that if nothing was known about the predictor variables, one might guess if a faculty member is a non-adopter and be correct 81.6% of the time (Table 16). By adding the predictor variables, the full model was able to predict with an overall 92% accuracy (Table 17). The model appeared to be good; the next steps were to evaluate significance and model fit.

The model coefficient of the omnibus tests of model coefficients provides a measure of how well the model fits. The test of the full model, which includes all five predictor variables (relative advantage, compatibility, complexity, trialability, and observability), against a constant only model, was statistically significant, $X^2(5) = 80.544$, $p < .000$); therefore, the null hypothesis, which states that the model does not make better prediction of the dependent variable, was rejected and the alternative hypothesis, which states that the model makes better prediction of the dependent variable, was accepted. In addition, the Nagelkerke's R^2 of .537 indicated a moderately strong relationship between predictions and grouping, which indicates a well-fitted model (Table 18). These findings were further supported by the results of the Hosmer-Lemeshow goodness-of-fit test, which confirmed the model fit the data. The results, X^2 (8) = 10.26, $p = .25$, revealed the computed chi-square statistics comparing observed frequencies with expected frequencies were non-significant, indicating the model is a good fit and fairly well predictive of the data (Table 19). The case-wise listing of residuals did not reveal any case that did not fit the model well; therefore, the presence of outliers was not a concern. Together, these inferential statistics provided unanimous evidence supporting that the binary regression model, which includes all the predictor variables (relative advantage, compatibility, complexity, trialability, and observability) fits the data and it significantly predicts the probability of faculty adopting ARS into instruction.

Table 16

Binary Logistic Regression Classification Table [a, b] of Constant Only Model

			Predicted		
			Adoption of ARS		
	Observed		Adopter	Non-adopter	Percentage Correct
Step 0	Adoption of ARS	Adopter	0	37	0
		Non-adopter	0	164	100.0
	Overall Percentage				81.6

[a.] Constant is included in this model

[b.] The cut value is .500

Table 17

Binary Logistic Regression Classification Table of the Full Model Including the Five Attributes

			Predicted		
			Adoption of ARS		
	Observed		Adopter	Non-adopter	Percentage Correct
Step 1	Adoption of ARS	Adopter	25	12	67.6
		Non-adopter	4	160	97.6
	Overall Percentage				92.0

[a.] The cut value is .500

Table 18

Binary Logistic Regression Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	111.421[a]	.330	.537

[a.] Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Table 19

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
10.258	8	.247

As shown in Table 20, the inferential binary logistical analysis examined the statistical significance of individual regression coefficients. Each respondent's responses to the items under each attribute were scored by calculating the means for each of the five attribute variables. Using the mean scale scores of the predictor variables, the binary logistic regression computation revealed that compatibility (p = .023) and trialability (p = .005) were statistically significant variables to predict the adoption of ARS into instruction. The odds ratio Exp(B) for compatibility (2.45) and trialability (1.57) predicts that as faculty's perception of compatibility of ARS increases one unit, the odds of adoption increases by 2.5 times. The odds ratio for trialability (1.57) predicts that as faculty's perception of trialability increases one unit, the odds of adoption increases by 1.6 times. In other words, individually, the constructs of compatibility and trialability were significant predictors of faculty's adoption of ARS (p < .05).

Table 20

Binary Logistic Regression Analysis of Innovation Diffusion Model Attributes Based on the Respondents' Adoption Decisions

	B	S.E.	Wald	*df*	*p*	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
Relative Advantage	.356	.384	.859	1	.354	1.427	.673	3.028
Compatibility	.895	.393	5.185	1	.023*	2.447	1.133	5.285
Complexity	-.270	.255	1.119	1	.290	.764	.463	1.259
Observability	-.154	.312	.243	1	.622	0.857	.465	1.580
Trialability	.452	.161	7.859	1	.005*	1.572	1.146	2.156

Note. The binary dependent variable in this analysis is the answer (yes or no) to the survey question: At this time, do you consider yourself an adopter of the ARS? *$p < .05$

Discussion

This study examined factors influencing the adoption of ARS using the concept of perceived attributes described in Rogers's diffusion of innovation theory (Rogers, 1995). Based on data collected, this theory was used to explain the adoption decision of ARS by the faculty in a local university. A binary logistic regression analysis was conducted to predict the probability of faculty adopting the audience response system (ARS) into instruction using the faculty perception of the five attributes (relative advantage, compatibility, complexity, observability, and trialability) as predictors. A test of the full model against a constant only model was statistically significant, confirming that collectively the predictors reliably distinguished between adopters and non-adopters of ARS, X^2 (5) = 80.544, $p < .000$). Prediction success overall was 92%. The Wald criterion demonstrated that, out of the five attributes, only compatibility and trialability made significant contributions to the prediction (Compatibility, $p = .023$; Trialability, $p = 0.005$). The insignificant relationships between genders with adoption were consistent with Gautreatu (2011). In addition, Hsbollah and Idris (2009), in a research on faculty perceptions of innovation attributes towards e-learning also indicated that there was no difference between male and female university faculty. One likely reason is that the advancement of technology and telecommunication continues to shape every aspect of modern lives regardless of gender. Therefore, gender is no longer a factor that influences the ARS adoption.

The significant findings were supported by the literature. For example, the studies by Banerjee, Wei, and Ma (2010); Hasbollah and Idris (2009); and Martins et al. (2004); found trialability was the most significant variable that influenced technology innovation adoption. Similarly, He, Duan, Fu, and Li (2006) found compatibility as the most significant predictor for the adoption of online e-payment in Chinese companies.

Thus, the implication of these findings suggests that faculty need to be given the opportunity to pre-test the ARS prior to implementation. Trialability is the degree to which the faculty can test the technology before deciding whether to adopt it. The greater the opportunity to try a new technology, the easier it is for the faculty to evaluate it and ultimately adopt it (Rogers, 1995). However, trialability can be a challenge because testing with new technology may require the faculty to make substantial investments of time and effort before they can begin to experience the benefits. In addition, the perception of compatibility of ARS with existing instructional materials was considered an important factor affecting adoption as well. Compatibility is the degree to which the faculty perceives an innovation as being consistent with their existing values, needs, and experiences. The faculty needs to know how the technology will assist them in achieving their pedagogical goals. The faculty should be given the opportunity and support to exploit the instructional technology fully.

Assumptions, Limitations, Scope, and Delimitations

Assumptions

First and foremost, this study was interested in the perceived attributes of ARS and its adoption by the faculty; therefore, one of the primary assumptions was that ARS would continue to be relevant and supported at the local university, which was the research site for this study. This assumption was likely to be true given the overwhelming evidence supporting the benefits of ARS and its positive influences on student success by encouraging active participation and improving attentiveness and retention (Kay & LeSage, 2009a; Simpson & Oliver, 2007; Vaterlans et al., 2012). Secondly, because this study hinged on the faculty's responses to a pre-established survey, it was important to validate the assumptions that the contents of the survey instrument were valid for the intents of this study, and the participants would answer truthfully.

Since minor modifications were made to the original instrument to fit the context of this study, a pilot study was conducted to validate the survey instrument's face and content validity. In order to encourage participants to answer the questions truthfully, the participants were informed about the purpose of the study and the procedures designed to ensure their anonymity and confidentiality.

Limitations

Limitations are potential weaknesses in the study and are largely out of the researcher's control. The perspective of this study was limited by surveying only the faculty at a local university. In order to have a more holistic view of the problem, future studies are recommended to explore different perspectives from other stakeholders who contribute to the process that may lead to the adoption of instructional technology. It would be interesting to see if the students' perceived attributes of ARS are different from those of the faculty's perceived attributes. For pragmatic reasons, such as time and resources, it was justifiable for this study to focus on the faculty because they were the ones making the decision to adopt the ARS in their classrooms. In this study, I recruited all 600 full and part-time faculty members; therefore, the results were representative of the local university. The response rate was 34%, which was similar to what was expected in internal surveys (Lodico et al., 2010). The minimum number of cases required for conducting binary logistic analysis on the five predictor variables was met.

Because this study only involved one specific university, the inferences from this study may not be generalizable to other colleges and universities. In order to maximize the usability and relevance of the inferences from this study, I painted a detailed picture of the local context; therefore, readers can make their discussions on the generalizability and applicability of the results to their specific practice settings. Another major limitation of this study is the fact that it was a one-shot survey, which only provided a snapshot of the conditions at one point in time that may or may not be representative of the average condition throughout an academic year. I dealt with this limitation by refraining from collecting data during holidays or final exam periods, which were not representative of an average condition.

This study was subjected to several limitations. One limitation of this study was that only one type of technology innovation was investigated. Future research could be undertaken to investigate whether the predictive properties of the five attributes of innovation vary with different types of innovation. Another limitation may be perceived in terms of the generalizability of the findings. Because only the population of teaching faculty at one local university was studied, the generalizability of the results is somewhat restricted. Further studies are essential to examine the proposed framework in a broader range of educational institutions. Because relative advantage and compatibility did not emerge as separate factors in Moore and Benbasat’s original instrument (Moore & Benbasat, 1991), the validity of relative advantage as an insignificant predictor was questionable. In addition, it is also evident from this study that complexity and observability were not significant predictors. Therefore, future qualitative studies are needed to examine the extent to which the insignificant attributes in this study actually influence the adoption decision.

Scope and Delimitations

The delimitations are those characteristics that limit the scope and define the boundaries of the study. The primary intent of this study was to determine what attributes of innovation (relative advantage, compatibility, complexity, trialability, and observability) shed light on the local problem of limited and slow adoption of ARS. The research site of this study was a non-profit, private university located in southeastern United States. Study participants were full-time, part-time, or adjunct faculty members, who had active teaching appointments at the university. The faculty administrators who did not have active teaching appointments were excluded from the study. In addition, the faculty members who were teaching solely online were also excluded from the study. The results of this study were applicable to full-time, part-time, or adjunct faculty members, who were not teaching solely online.

Protection of Participants

Risk to the Subjects

Human subjects involvement and characteristics. Participants in this study were full-time, part-time, or adjunct faculty members, who had active teaching appointments at a local university located in the southeastern United States. They were adults aged between 18-75 years old. The faculty administrators who did not have active teaching appointments were excluded from the study. In addition, the faculty members who were teaching solely online were also excluded from the study. The researcher did not supervise or have authority over any of the faculty. Participation in this project was strictly voluntary. In fact, voluntary participation was ensured through explicit written declarations in the body of the invitation email, as well as on the survey instrument. The participants had the right to withdraw from the study at any time.

Sources of material. The survey instrument was hosted on SurveyMonkey (www.surveymonkey.com) for its flexibility, convenience, and accessibility. In order to protect participant's privacy and confidentiality, the researcher did not ask or record the participants' identifications. The SurveyMonkey website's secure server, which is password protected and encrypted, housed the raw data collected by the aforementioned online survey instrument. The researcher was the only person who had access to the raw data. Once the data collection period ended, the researcher transferred the raw data from the web server to his laptop computer, which had biometric login and data encryption. Upon the completion of the study, the researcher downloaded the data onto a biometric fingerprint secured flash drive and stored it in a locked file cabinet in the researcher's office. After five years, the data will be permanently erased from the flash drive.

Potential risks. Overall, potential risks associated with participation in the study were unlikely and of low risk.

Physical. There was little likelihood of any physical risk as a result of participating in this research project. Survey participants were not asked to perform any physical tasks that could result in physical harm.

Psychological. Participants were asked to provide information about their perceived attributes of the ARS, their current status of adopting ARS, and demographic data (such as gender, age, education, employment status, and rank). These questions had a small likelihood of low psychological risk. The participants may have felt disturbed if they thought that they were the laggards of adopting the technology.

Social. The likelihood of other social risks was minimum. Perhaps, there may have been a perceived risk among faculty who were reluctant to adopt ARS in the classroom because participation in this project may affect their employment status in a negative way.

Protection against risk.

Minimizing physical, psychological, and social risks. Participants were free to refuse to respond to any question that may result in psychological disturbance. They were free to withdraw from the study at any time. The survey was anonymous. The participants were asked not to include any personal identification information in the survey questionnaire. Individual responses to the survey questionnaire were not linked to identifying information. These precautions were expected to be effective in minimizing any risks associated with participation.

Minimizing risks to confidentiality. The survey was anonymous. The invitation to participate in the study and a link to the online survey were sent directly to the faculty's email. The participants were asked not to include any personal identification information in the survey questionnaire. Individual responses to the survey questionnaire were not linked to identifying information. The SurveyMonkey website's secure server, which was password protected and encrypted, housed the raw data. The researcher was the only person who had access to the raw data. Once the data collection period ended, the researcher transferred the raw data from the web server to his laptop computer, which had biometric login and data encryption. Upon the completion of the study, the researcher downloaded the data onto a biometric fingerprint secured flash drive and stored it in a locked file cabinet in the researcher's office. After five years, the data will be permanently erased from the flash drive. These procedures are expected to be effective in eliminating risks to confidentiality.

Potential benefits of proposed research to subjects and others. Benefits may accrue to the participants simply because of the increased awareness of the instruction technology under study. The participants were not compensated monetarily for taking the time to complete the survey.

Importance of knowledge to be gained. The information gained in the course of this study may be used to improve adoption of ARS within the local university, the research site of this study. Additionally, the information gained in the course of this study may be instrumental to the development of future programs that introduce novel instructional technology to the faculty in order to enhance the adoption rate.

Section 3: The Project

Introduction

The aforementioned quantitative survey study examined factors that influence the adoption of ARS using the concept of perceived attributes of innovation described in Rogers's diffusion of innovation theory (Rogers, 1995). Out of the five attributes studied (relative advantage, compatibility, complexity, trialability, and observability), compatibility and trialability made most significant contributions to the prediction of faculty's adoption of ARS into instruction. The implication of these findings suggests that the faculty needs to be given the opportunity to pre-test the ARS prior to implementation. In addition, the findings also suggest that the faculty's perception of compatibility of ARS with existing instructional materials and pedagogical strategies was an important factor affecting adoption. The faculty needs to know how the technology will assist them in achieving their pedagogical goals. Therefore, the faculty should be given the opportunity and support to exploit the instructional technology fully. These implications support the need to develop a professional development program to help the faculty adopt ARS into instruction with emphasis on the attributes of trialability and compatibility. This section presents a summary of the professional development project, its goals, rationale, a review of relevant literature, project description, evaluation, and project implications.

Description and Goals

Description of the Project

The project is a 3-day experiential professional development workshop. It is designed to provide the faculty opportunities to experience the ARS in different pedagogical contexts, to share pedagogical strategies and experiences, to explore effective and creative ways to overcome student passivity, and to introduce interactivity into the classrooms. Knowles' adult learning theory (1980a) guides the development of learning activities and implementation strategies. Tyler's (1949) linear program planning model helped to structure the 3-day profession development workshop.

Based on the Tyler's (1949) linear program planning model, Daffron and Caffarella (2013) suggested five distinct stages to program planning: needs assessment, program objectives, program structure, transfer of learning, and program evaluation. Because this is a college-wide initiative, a steering committee will be recruited to direct the professional development efforts. The academic program directors will recruit a faculty member from each program to serve on the steering committee; therefore, the committee will consist of members from different disciplines representing the diverse perspectives of the faculty. These diverse perspectives contribute to the development of learning objectives that reflect the desired knowledge, skills, and attitudes required for the achievement of the program outcomes.

Need assessment. As a part of this doctoral capstone project, I identified a local problem of limited faculty adoption of ARS. In an effort to understand the local problem, I conducted a quantitative survey study to examine factors that might influence the adoption of ARS. The study was based on the concept of perceived attributes of innovation described in Rogers's (1995) diffusion of innovation theory. The study results discussed in the previous section indicated that out of the five attributes studied (relative advantage, compatibility, complexity, trialability, and observability), compatibility and trialability made most significant contributions to the prediction of faculty adoption of ARS into instruction. One important implication of these findings is that the faculty needs to be given the opportunity to pre-test the ARS prior to implementation. The greater the opportunity to experience a new technology fully, the easier it is for the faculty to evaluate it and ultimately adopt it (Rogers, 1995). In addition, the faculty's perception of compatibility of ARS with existing instructional materials and pedagogical strategies was found to be an important factor affecting adoption as well. Compatibility is the degree to which the faculty perceives an innovation as being consistent with their existing values, needs, and experiences. Therefore, another implication is that the faculty needs to know how the technology will assist them in achieving their pedagogical goals. The faculty should be given the opportunity and support to exploit the instructional technology fully. These implications of the study support the need to develop a professional development program to help faculty adopt ARS into instruction with emphasis on the attributes of trialability and compatibility.

In addition to the results of the study, an additional need assessment is instrumental to assess and support the learning needs of the faculty for adopting the ARS into instruction. According to Caffarella (2010), assessing learner's baseline attitude, knowledge, and skills forms the foundation of the evaluation plan, which I will elaborate in a separate section. The steering committee will meet once a week and complete the additional needs assessment within four months. In the first steering committee meeting, the structure and responsibilities of the members are distributed (Appendix A). Because I am coordinating this professional development effort, I will propose a tentative timeline with target dates and benchmarks.

For the additional needs assessment, the steering committee will gather data from focus groups of opinion leaders recruited from different disciplines. The purpose of the focus group interviews is to identify the top three learning needs, expectations, preferences, and concerns of the faculty related to the use of the ARS in instruction, as well as the faculty's current levels of competency in instructional technology. For consistency, two of the members of the steering committee will conduct all of the focus groups. Each of the focus group interviews will consist of six opinion leaders. One of the members of the steering committee will serve as a recorder who takes field notes on the happenings during the focus group meeting. The other member serves as the moderator who welcomes the group and conducts the interview. The focus group interviews are semi-structured and open-ended, which aim to elicit opinions and qualitative data regarding learning needs, expectations, preferences, and concerns of the faculty related to the use of the ARS in instruction. The main advantage of the focus group methodology is to allow for in-depth discussion and probing on an issue of interest. The interaction between group participants can result in increased elaboration on a topic and broader insight into understanding the issues surrounding the adoption of ARS into instruction. The steering committee will then synthesize the findings to arrive at a consensus on the top four needs and concerns that the profession development programs should first address.

Program objectives. Program objectives are the overarching goals and expected achievements or outcomes of a program. On the other hand, the learning objectives are the benchmarks that are designed to build knowledge, skills, and attitudes in the learners in order to achieve the program and learning outcomes. Together, program and learning objectives set the course of the program (Caffarella, 2010). Why is it important to formulate the outcomes and objectives in such early stage of developing a program? It is because, "to begin with the end in mind means to start with a clear understanding of your destination. It means to know where you're going so that you better understand where you are now and so that the steps you take are always in the right direction" (Covey, 2004, p. 98). This approach to program design is also called the backward design approach, which consists of three stages: Identify desired results, determine acceptable evidence, and plan learning experiences and instruction (Wiggins &

McTighe, 1998, p. 9). In order to identify the program objectives, the steering committee is charged to analyze, synthesize, and prioritize the data from the needs assessment, their expertise, and the organizational mission and vision to help identify the issue, concern, gap, or trend that may influence the subsequent development and overall success of the program. In addition, it is important to employ a consultative client-centered approach to maximize the commitment and engagement of the stakeholders to the program (Daffron & Caffarella, 2013).

For the current project, in addition to the findings related to trialability and compatibility, the desired knowledge, skills, and attitudes identified through the needs assessment may revolve around the functions of ARS and the logistics of incorporating ARS into instruction. Therefore, the program objective is to deliver a 3-day experiential professional development workshop that provides faculty opportunities to experience the ARS in different pedagogical contexts, share pedagogical strategies and experiences, explore effective and creative ways to overcome student passivity, and introduce interactivity into the classrooms. According to Caffarella (2010), the learning objectives should reflect what the participants learn in the program and provide a base for the instructional plan, selecting appropriate learning activities, and assessing learners' progress. The four learning objectives that scaffold learning towards the program goal are as follows:

- Acquire the technical skills to operate the software and hardware of an ARS.
- Recognize the benefit of using clickers and peer instruction to promote student engagement.

- Develop pedagogical strategies for using clickers, including thoughtful question-writing.
- Create pedagogically effective lectures for the use of student response systems.

Program structure. Structuring a program is another important stage of Tyler's (1949) linear program planning models (Caffarella, 2010; Daffron and Caffarella, 2013). According to Caffarella (2010), drafting an instructional plan entails designing the interaction between learners and instructors to facilitate the learning process. In other words, the purpose of an instructional plan is to provide a clearly and concise roadmap to keep instructors in line with the program objectives. Daffron and Caffarella (2013) suggested that the essential elements of an instructional plan should include the following:

- Course or session title
- Date and timeframe
- Learning objectives
- Session activities
- Instructional techniques
- Assessment plan
- Estimated time for each major part of the learning activities
- Instructor and learner materials
- Room arrangements
- Equipment and other resources (Daffron and Caffarella, 2013, p. 202).

Caffarella (2010) emphasized that an instructional plan should allow room for flexibility and change in both the content and the learning process contingent to the dynamics of the learning environment. A tentative instructional plan for the 3-day professional development workshop is presented in Appendix A.

Transfer of learning. Transfer of learning is defined in the literature as the effective and continuing application of knowledge and skills gained in learning activities (Broad, 1997; Merriam & Leahy, 2005; Nelson & Dufour, 2002). In a literature review of empirical research on learning transfer, Merriam and Leahy (2005) summarized that there are a number of strategies adult educators can employ to increase the likelihoods of transferring knowledge and skills to practice. These strategies include the following:

- Include participants in the planning
- Incorporate strategies that link to transfer in the program design
- Ensure for a supportive transfer climate (Merriam and Leahy, 2005, pp. 15-17).

I have incorporated these three strategies into the transfer of learning plan of the 3-day professional development workshop. For example, the participants are engaged in the planning of the workshop through their participation in the need assessments, my survey research study, and focus group interviews. In addition, the workshop is designed to give learners opportunities to learn through hands-on experience and to support each other in a community of practice.

Goals of the Project

The project goal is to develop a 3-day professional development program to help faculty adopt ARS into instruction. The overarching goals of the project are to provide faculty-centered training on the use and implementation of ARS software and hardware in their curricula, as well as provide ongoing support in the form of mentor-support. The project will also share best practices for implementing the technology in classrooms, which include best practices in formulating questions to be used with the ARS, timing for asking questions, facilitating discussions, dealing with technical issues that arise in class, developing objectives for the use of ARS, and designing instruction to meet those objectives.

Rationale

As discussed in previous sections, the quantitative survey study was conducted to examine factors that influence the adoption of ARS using the concept of perceived attributes of innovation described in Rogers's diffusion of innovation theory (Rogers, 1995). The study results indicated that out of the five attributes studied (relative advantage, compatibility, complexity, trialability, and observability), compatibility and trialability made most significant contributions to the prediction of faculty adoption of ARS into instruction. The implications of these findings suggested that the faculty needs to be given the opportunity to experience the ARS prior to implementation, which corroborated Rogers' (1995) assertion that the greater the opportunity to fully experience a new technology, the easier it is for the potential adopters to evaluate it and ultimately adopt it. Furthermore, the perception of compatibility of ARS with existing instructional materials and pedagogical strategies is also found to be an important factor affecting adoption. According to Roger (1995), compatibility is the degree to which the potential adaptors perceive an innovation as being consistent with their existing values, needs, and experiences. Therefore, in the context of instructional technology, the faculty needs to know how the technology will assist them in achieving their pedagogical goals. The faculty should be given the opportunity, support, and guidance to exploit and apply the instructional technology in realistic situations that are consistent with their pedagogy. These implications support the need to develop a professional development program to help the faculty adopt ARS into instruction with emphasis on the attributes of trialability and compatibility. In addition, the demographic data of my study revealed a heterogeneous group of faculty in terms of gender, age, education, employment status, and rank. The faculty composed of adults from different disciplines brings to the classroom a variety of educational attainments, pedagogical philosophies, teaching styles, technical competencies, attitudes, and life experiences. These differences inspired the selection of Knowles' (1980a) adult learning theory, andragogy, as the framework for this project.

Review of the Literature

This review of the literature was conducted to explore the body of educational research on professional development. Because professionals are adults, the adult learning theory (Knowles, 1980a) was also briefly reviewed. The concepts surrounding the adult learning theory guided the development of the learning activities and implementation strategies of the 3-day professional development workshop. The literature from diverse perspectives and cultures was examined by accessing the Education Resources Information Center (ERIC) database (2009-

2015). The following search terms were used with Boolean search strategies to gather relevant information about these topics: *faculty development, professional development, experiential learning, situated learning, adult learning theory, and program planning model.*

Faculty Development

Faculty development is a critical process that enables faculty to keep abreast of new knowledge, skills, and innovations in teaching and learning (Al-Eraky, Donkers, Wajid, & Van Merrienboer, 2015). In a nutshell, faculty development consists of planned activities designed to improve the knowledge, attitudes, and skills essential to the roles of the faculty. In the context of instructional technology, faculty development activities must take into account not only faculty predisposition and readiness to adopt technology innovations, but also their levels of technical skill competency (Reilly, Vandenhouten, Gallagher-Lepak, & Ralston-Berg, 2012).

In a systematic review of the literature dealing with the diffusion of innovative learning and teaching practices in higher education, Smith (2012) concluded that characteristics of successful faculty development programs built on prior knowledge, encouraged faculty to discuss classroom experiences, and offered opportunities to ongoing professional communication for faculties to share similar concerns and success stories. Al-Eraky, Donkers, Wajid, and Van Merrienboer (2015) in a systematic review of faculty development studies designed to enhance medical education, found programs to be most effective when they incorporated experiential learning, provided feedback, included effective peer and colleague relationships, applied effective teaching-learning principles, and used diverse methods.

Situated and Experiential Learning

Learning by doing is not a novel idea for the teaching and learning process. A hands-on approach requires learners to become active participants instead of passive ones who simply listen to lectures behind the desks. Some programs have integrated experiential learning in the curriculum to enhance learning. For example, laboratory and field activities are traditional methods of giving learners hands-on experiences. Some fields of study, such as occupational therapy and other allied health disciplines, use practicum or internship experiences to foster a meaningful connection between theory and clinical practice. The idea behind experiential learning is based on constructivism, which suggests that learners construct their understanding and knowledge of the world through experiencing things and reflecting on those experiences (Milhem, Abushamsieh, & Pérez Aróstegui, 2014). Helping learners engage in meaningful experiences will connect their prior knowledge or schema and assist in integrating new learning and knowledge (Mezirow, 1997).

Situated learning is a general theory of knowledge acquisition (Lave & Wenger, 1990). It has been applied in the context of technology-based learning activities that focus on problem-solving skills (Dawley & Dede, 2014). Building on the concepts of social constructivism and experimental learning, Lave and Wenger (1990) asserted that learning as it naturally occurs is a function of the activity, context, and culture in which it occurs. This contextual approach contrasts with the traditional classroom learning activities that involve textbook knowledge and tend to be abstract and out of context. Therefore, social interaction and community of practice are critical components of situated learning. Lave and Wenger (1990) theorized that a community of practice is a group of individuals who have a common interest or a common goal of gaining knowledge related to their field. Tam (2015) conducted a longitudinal qualitative study to examine the role of a professional learning community in changing educators' beliefs and practices and concluded that cultivating an effective professional learning community was paramount to faculty development. In order to facilitate the development of a professional development community, small group discussions and collaborative activities have been integrated into the workshop to promote sharing of experiences, successes, and concerns among the faculty.

Adult Learning

Knowles (1980b) introduced the term *andragogy* and theorized it as "the art and science of helping adults learn" (p. 43). Based on his experiences and observations, Knowles (1977, 1980a) developed six assumptions of how adults learn and their attitude toward and motivation for learning. Consequently, these assumptions laid the foundations of andragogy that have been inspiring the field of adult and higher education since then. These six assumptions of andragogy are: adults are self-directed learners, adult learners bring a wealth of experience to the educational setting, adults enter educational settings ready to learn, adults are problem-centered in their learning, adults are best motivated by internal factors, and adults need to know why they need to learn something (Knowles, Holton, & Swanson, 2011, p. 3).

Based on these assumptions, Knowles (1980b) derived seven principles of effective adult teaching and learning. He emphasized the importance of establishing a learner-centered physical and social climate where learners feel safe and comfortable expressing, exploring, evaluating, and diagnosing their own learning experiences. In other words, these principles provided a vehicle to organize the teaching and learning tasks and environment to allow the learners to have control over their learning experiences. Therefore, Knowles' principles could be viewed as providing the pathways that might lead to an ultimate goal towards which learners would strive so that they could become empowered to make individual choices, appreciate autonomy, and accept responsibilities for their own learning. Knowles (1984) believed learning experiences should be structured around life situations and challenges instead of around plain subject matters, and that learners would learn more effectively if they were aware of the relevance of what they were learning in relation to their life situations and goals. In the case of innovation adoption, the perception of compatibility is the perception of relevance.

Stephen Brookfield (1986) concurred with Knowles (1980) on his theory that adult learners learn best when they were actively engaged in the learning experience, self-motivated, and empowered. He elaborated on Knowles' (1980) central ideas of learner-centered and self-directed learning by explicitly expressing the educator's role as facilitator who "keeps students focused; involves them actively in peer group activities; and allows each learner to be responsible for his or her own learning" (Williamson & Null, 2008, p. 384). In fact, in his principles of effective teaching and learning for adults, he emphasized, "Praxis is placed at the heart of effective facilitation. Learners and facilitators are involved in a continual process of activity, reflection upon activity, collaborative analysis of activity, new activity, further reflection and collaborative analysis, and so on" (Brookfield, 1986, p. 10). This iterative process is integrated in the 3-day professional development workshop through mentoring and community of practice (Kopcha, 2010). In addition, Brookfield (1986) asserted that reflective practices could provide the added benefit of engaging in an ongoing cycle of self-observation and self-evaluation to allow learners to become aware of the effects of their own actions and worldview on instructional effectiveness (Brookfield, 2010). Long (2002) concurred with Brookfield on his principle that in order to help learners alter their perception and explore alternative ways of thinking and learning, educators should have an "understanding of self and of adult learners" (Galbraith, 2004, p. 10).

Interestingly, the principles of practices proposed by Brookfield (1998) and Long (2002) comprised of the basic elements from Knowles' (1980) theory of andragogy. Similar to Brookfield's (1998) principles, Long (2002) concurred with Knowles (1980) on his theory that adult learners learn best when they are actively engaged in the learning experience, self-motivated, and empowered. Long (2002) organized his ten principles of practice into two categories. The first category, composed of five principles, related to the nature of the adult learners, which were largely similar to those addressed in Knowles and Brookfield's principles. In the second category, Long (2002) expressed his philosophical positions related to teaching adults, which were based heavily on the theory of experiential learning (Galbraith, 2004).

According to Kolb (1984), experiential learning is the process of making meaning from experience and prior knowledge, which is a constructivist's approach to learning. The constructivist approach to learning is based on an information-processing model that emphasizes learners' integration of new materials within the context of their existing knowledge base (Kolb, 1984). Needless to say, the hallmark of Long's principles is his emphasis on the learner's personal worth and prior knowledge (Long, 2002). Adult learners from different walks of life brought to the classroom a variety of educational attainments, occupational backgrounds, attitudes, values, and life experiences; therefore, an effective learning environment should take into consideration of what learners might have brought to the educational encounter from their prior knowledge and experience (Arseneau & Rodenburg, 1998; Knowles, 1980; Merriam, Caffarella, & Baumgartner, 2007).

The essence of Brookfield's (1998) and Long's (2002) principles reminded me of the theory of transformative learning. Mezirow (1997), in his transformative learning theory, emphasized that through the combination of discourse and reflection, adult learners were capable of modifying their meaning perspectives and producing a more comprehensive and inclusive world-view. Concisely, transformative learning encourages learners to reflect on and integrate their "… prior learning to determine whether what [they] have learned is justified under present circumstances" (Mezirow & Associates, 2000, p. 5).

Adult Learners and Prior Knowledge

Mancuso (2001) functionally defined adults as individuals who “have assumed major life responsibilities and commitments…. As a result, their [educational] needs are very different...” (p.165-166). The demographic data of my study revealed a heterogeneous group of faculty in terms of gender, age, education, employment status, and rank. Faculty from different disciplines bring to the classroom a variety of educational attainments, pedagogical philosophies, teaching styles, technical competencies, attitudes, and life experiences. Therefore, the professional development program should assess and benchmark each faculty member’s existing knowledge and competence in ARS and related instructional technology to tailor a learning environment that is meaningful and intrinsically motivating to them (Arseneau & Rodenburg, 1998; Merriam & Caffarella, 1999). Another important benefit of knowing the adult learners’ existing knowledge is to allow the instructor to activate it and “to make it available in the working memory for learning” (Reiser & Dempsey, 2007, p. 315).

Best Practices for ARS in the Classroom

As I surveyed the literature, I discovered serval books specifically written to help novice ARS users get started with the technology (Banks, 2006; Bruff, 2009; Duncan, 2005). The following themes for effective use of ARS are synthesized from these texts and a few other relevant articles in the literature. These themes were incorporated into the design and structure of the 3-day professional development workshop.

Setup and preparation. Mareno, Bremner, and Emerson (2010) conducted a systematic literature review on the use of ARS in higher education and suggested that faculty should be trained and offered the opportunities to practice using the technology before it in the classroom. Furthermore, the faculty should determine clear objectives that will be met with the use ARS (Caldwell, 2007; Draper, 2002). In order to do that, faculty must be familiar with the potential benefits and basic operations of the technology. Draper (2002) suggested that in addition to the formal training, novice ARS users should have the opportunities to observe experienced ARS users in action. Duncan (2005) emphasized that the ARS, like any other technology, could have noted technical glitches. To lower frustration dealing with potential hiccups, users should prepare contingency plans for dealing with common issues. Knowing possible issues and planning ahead seemed to relieve many of the frustrating factors included in using digital/wireless technology. A user network may provide valuable insights into possible issues. Klein and Kientz (2013) suggested that mastery of the ARS is best accomplished when it is used for familiar pedagogic tasks such as obtaining class feedback during lectures and conducting a formative assessment of challenging concepts. The use of familiar tasks ensures that educators become competent with the basic demands of the technology before advancing to the more creative ways of using the ARS.

Student-centeredness. Another emergent theme from the literature is the importance of explaining the purpose of using ARS to the students. Duncan (2007) emphasized the importance for instructors to be explicit in terms of any expectations and responsibilities regarding student participation in ARS related activities. In order to get the students to support the idea of using the ARS, they need to understand the benefits of using the technology. Student support is important especially when non-traditional pedagogical activities, such as peer instruction and active learning are to be successful (Atlantis & Cheema, 2015; Good, 2013; Heaslip, Donovan, & Cullen, 2014). One of the staples of the ARS is the promotion of student-centered teaching strategies (Klein & Kientz, 2013); therefore, faculty should factor in ample time in their lesson plan for student discussions. In addition, the students' responses to questions may be used as a formative assessment, which provides vital information for successful contingent teaching (Good, 2013). For example, the instructor may decide, based on the student responses, to spend more or less time teaching or reviewing specific material. Furthermore, the instructors may determine, based on the student responses, the need to clarify conceptual misunderstandings. If concept misunderstandings are noted in the formative assessment, the instructor can alter the delivery of class materials to clarify information (Blasco-Arcas, Buil, Hernández-Ortega, & Sese, 2013; Lantz & Stawiski, 2014).

Developing effective questions. There is a consensus in the literature that developing good questions to use with the ARS can be challenging for most novice users (Klein & Kientz, 2013). Caldlwell (2007) emphasized that instructors should spend time to practice developing good questions to be sued with the ARS. Beatty, Gerace, Leonar, and Dufresne (2006) suggested that a good question to use with the ARS is different from a good question to use in an exam. According to these authors, qualitative questions challenge students to examine their conceptual understanding rather than distract them with the unnecessary details and aimless factual recalls (Beatty, Gerace, Leonar, & Dufresne, 2006; Caldwell, 2007). In a systematic review of the literature on ARS, Mareno, Bremner, and Emerson (2010) recommended to incorporate two to five ARS questions in a 60-minute class to highlight the most important contents. These authors also shared a common best practice tip from the literature, which is to give no more than four responses for a multiple choice type question.

Peer instruction. Pioneered by Mazur (1991), peer instruction is an active learning approach facilitated by peer discussions. In peer instruction, the traditional lecture is replaced by the before-class homework assignments and readings, mini-lectures, conceptual questions, and peer discussions. Following a brief review of the assigned readings, students are asked to answer a conceptual question individually using the ARS. If the majority of students respond incorrectly, the instructor then asks students to engage in peer discussion to persuade their neighboring classmates that they have the correct answer. Following the peer discussion, students are asked to submit their answers again. Based on the students' responses, the instructor explains the correct and incorrect answers (Crouch and Mazur, 2001; Mazur, 1997). Although peer instruction can be used without the ARS, it is commonly associated with best practices for the ARS in the classroom (Caldwell, 2007; Good, 2013; MacArthur, Jones, & Suits, 2011; Mareno, Bremner, & Emerson, 2010).

Program Planning Model

Several program-planning models can serve as frameworks for planning programs for adult learners (Kistler, 2011). Daffron and Caffarella (2013) defined program planning models as the program designers' ideas of what elements should be included to ensure successful program outcomes. Although these models share one common goal of providing structures to program planning and evaluation, they present a huge variation in their conceptual foundation, philosophy, and methods of implementation. Fundamentally speaking, these program-planning models can be separated into two major categories according to their structures and sequence of their applications.

Linear program planning model follow a stepwise sequence in their applications (Daffron & Caffarella, 2013). In other words, the linear model is rigid about the sequence of its applications, and all the steps within the model are hieratical. It is analogous to the instructions to build a do-it-yourself bookshelf. The instructions are stepwise, and it is not advised to skip or reverse a step. An alternative to the linear model is to conceptualize program planning as a dynamic process that consists of a set of interactive steps, similar to an idea map. The interactive program planning model is non-sequential model, which allows program planners to address a number of the happenings simultaneously and to reorder steps to meet the demands of rising situations (Caffarella, 2002). The interactive program-planning model is similar to an idea map, which consists of no predefined beginnings or endings. This approach of program planning provides a general structure to allow flexibility for unforeseen situations.

A simple linear model, like Tyler's (1949) linear program planning model, can be very effective by providing a stepwise sequential framework for program planning and evaluation. Inexperienced program planners may find Tyler's (1949) linear program planning model especially helpful for its concreteness and stepwise structure. It can serve as a checklist to ensure all of the steps are completed accordingly. On the contrary, experienced program planners may not appreciate the rigid structure of a linear model, and find the interactive program-planning model more inspiring to use. In fact, the most compelling assumption of the interactive program planning model is that it recognizes the learning needs of the program planners and values "learning through practice" to be a more effective program planners (Caffarella, 2002, p. 29).

Tyler's (1949) linear program planning model lays out a basic plan that is suitable for the short training programs, similar to this 3-day professional development program. In addition, it serves my needs as a novice program planner because the process is sequential and relatively straightforward. In summary, using the linear program-planning model as a guide, this professional development project follows a series of discrete and sequential steps of development. After the learning needs are identified, the objectives are specified. These objectives are used to refine the selection and organization of contents. At the end of each workshop, there will be an evaluation process to determine whether the objectives have been met.

Implementation

The project is a 3-day experiential professional development workshop that provides the faculty opportunities to learn and experience the ARS in different pedagogical contexts, share pedagogical strategies and experiences, explore effective and creative ways to overcome student passivity, and introduce interactivity into the classrooms. The first day of the workshop will address the technical skills of operating the software and hardware of the ARS; therefore, it will be held in the university's computer lab. Unlike the first day, the second and the third days of the workshop will be held in a typical classroom according to availability. A typical classroom setting will allow faculty to visualize and practice how the ARS can be used in everyday teaching. In addition, the contextual relevance of a typical classroom will maximize the faculty's perception on the trialability and compatibility attributes of the ARS. The 3-day workshop will be conducted every third Wednesday, Thursday, and Friday of the month during the spring and fall semesters. The academic program directors will be contacted to schedule their subordinating faculty to attend the workshop. The targeted audience will be comprised of all full and part-time faculty members. The instructional plan for the 3-day workshop is outlined in Appendix A Because the workshop is a part of faculty development and the university has catering agreement with the cafeteria, the cost for food and beverages will be absorbed by the division of institutional advancement. There would be no additional cost involved in the workshop because the university has already purchased the ARS and the vendor consultation and support are free of charge. Day one of the workshop is titled "The Benefit of using ARS and Peer Instruction." The participants will be engaged in an interactive demonstration and instruction on the mechanics of using ARS and peer instruction. The objective of this session is for the participants to be familiar with the technology and recognize the benefit of using ARS and peer instruction to promote student engagement. Day two of the workshop is titled "Writing Great ARS Questions". In this interactive session, the participants will explore research-based tips and ideas for achieving the full benefit of questioning as a pedagogical strategy. Effective use of ARS for questioning will be discussed as a means to achieve student engagement and deep learning. Participants will have the opportunity to practice question-writing and give each other feedback on questions they write. The objective of this session is for the participants to develop pedagogical strategies for using ARS, including thoughtful question-writing. Day three of the workshop is titled "Making ARS Work for You". In this interactive session, the participants will explore research-based best practice tips for incorporating ARS in lectures. Participants will be divided into small groups in order to create pedagogically effective mini-lectures for the use of ARS based on the best practices suggested in the literature. During the training, the participants are given time to ask questions and engage in discussions and active learning activities. The participants will also have the opportunity to reflect on what they have learned in each session using the session evaluation form. The overarching goal of the workshop is to provide faculty-centered training on the use and implementation of ARS software and hardware in their curricula. Faculty members are encouraged to incorporate ARS in their lectures and curricula. The steering committee members will act as mentors helping their colleagues integrate ARS into their curricula. In addition, the steering committee will conduct data analysis on the session and workshop evaluation to determine if any changes are implicated for subsequent workshops.

Potential Resources and Existing Supports

Potential resources and existing supports include assistance from facility management staff in order to reserve the computer lab and classrooms for the 3-day workshops throughout the academic year. The academic program directors play an important role in facilitating faculty attitude and motivation towards the workshop and eventually the integration of ARS in their curricula. They are also responsible for the recruitment of the steering committee members. The steering committee members from each academic program will provide most needed peer support to their colleagues. In addition, the support from the Workplace Instructional Technology Services (WITS) team is crucial for the success of the workshop and the distribution of the ARS to the faculty. The instructors for this 3-day professional development workshop are recruited by the WITS based on their expertise and experience with the technology. The current vendor of the ARS will also provide consultation and technical support when needed. At this point, the university purchases and supplies the ARS for students to use in class. However, with the university-wide adoption of the technology, an executive discussion has to be made if the university will continue to supply the ARS, or if the students will need to purchase their own remotes. Nonetheless, with the advancement of technology and the growing competition in the ARS market, the cost of ARS remote has dropped significantly in the past few years. Students can purchase their own remotes for under 20 dollars.

Potential Barriers

Potential barriers include getting the support from the academic directors to schedule their subordinating faculty to attend the workshop. It is no easy task to schedule time and budget professional development hours for 600 faculty members to attend a sequent of 3-day professional development workshops. Another potential barrier is the availability of part-time and adjunct faculty. The academic directors have to come to a decision if part-time and adjunct faculty would be required and paid to attend the workshop.

Proposal of Implementation and Timetable

The steering committee proposed to start the 3-day workshop in 2016 spring semester. The 3-day workshop will be held every third Wednesday, Thursday, and Friday of the month throughout the spring and fall semester. The workshop will begin at 8:00 a.m. and end at 4:00 p.m. each day over a 3-day period. A tentative workshop schedule has be developed and presented in Appendix A. along with an instructional plan, which outlines the purpose, goals, learning objectives, learning activities, assessments, and overall structure of the 3-day workshop.

Roles and Responsibilities of Key Stakeholders

The academic program directors, the WITS team, the steering committee, and the faculty are crucial stakeholders of the project. Because this is a college-wide initiative, a steering committee will be recruited to direct the professional development efforts. The instructors for this 3-day professional development workshop are recruited by the WITS based on their expertise and experience with the technology and related pedagogy. These instructors will also serve on the steering committee. In addition, the academic program directors are responsible for the recruitment of other steering committee members from each academic program. Therefore, the committee will consist of members from different disciplines representing the diverse perspectives of the faculty. These diverse perspectives contribute to the development of learning objectives that reflect the desired knowledge, skills, and attitudes required for the achievement of the program outcomes. The steering committee is also responsible for reviewing evaluations and feedbacks. Because the committee members are in the forefront of this initiative, they will also serve as mentors helping their colleagues integrate the ARS into their curricula. My role will be the chair of the steering committee. I have proposed a tentative outline of the workshop and setup timeline with target dates and benchmarks for the steering committee.

Project Evaluation

Caffarella (2010) synthesized from the literature and asserted that the overarching purpose of program evaluation is to appraise the value of a program. Project evaluation is an integral part of the project planning process, which begins in the initial planning phase and continues throughout the program. The additional need assessment, which gathers qualitative data from the focus groups regarding their attitude, knowledge, skills, and learning needs, is the initial stage of the evaluation plan for this project. Additional evaluation data will be collected during and after the workshop. The overall goals of the evaluation are to identify if any changes are implicated for subsequent workshops and to determine if the program goal is met.

Evaluation Plan

As an integral part of program planning, evaluation data will be collected before, during and after the program is completed. The key stakeholders of the evaluation plan are the faculty, the instructors, and the steering committee. Before the implementation of the 3-day workshop, the steering committee, which composes of liaisons from each of academic programs in the university, gathers qualitative data from the opinion leaders in the faculty. The focus group methodology is used to obtain in-depth qualitative data on the participants' attitude, knowledge, skills, and learning needs regarding ARS use in the classroom. A focus group interview guide is designed to serve as a guide for facilitators (Appendix A). The qualitative data is used to complement the quantitative data from the earlier study to inform program planning. In addition, the qualitative data collected at this stage will serve as a baseline for program evaluation.

An objectives-based evaluation method is used in the next stage of the evaluation plan (Caffarella, 2010). A session evaluation instrument is developed to gather feedback from participants (Appendix A). The participants are asked if the learning objective was met and what recommendations they may have to improve the session. In addition to objectives-based learning indicators, the session evaluation instrument also includes a question to encourage participants to reflect on the knowledge and skills they have gained from the session. The opportunity to reflect on learning is beneficial for the transfer of learning (Merriam and Leahy, 2005). At the end of each workshop session, the instructor will collect the completed section evaluation. The steering committee is responsible for reviewing evaluations and feedbacks.

In addition to the session evaluation, a workshop evaluation instrument is also developed to gather feedback from the participant immediately after the 3-day workshop is completed (Appendix A). The participants are asked if they will be able to apply what they have learned in the workshop in the classroom. In addition, the participants are also asked to comment on the strengths and provide suggestions for improving the workshop. At the end of third workshop session, the instructor will collect the completed section and workshop evaluations. The steering committee is responsible for reviewing evaluations and feedbacks.

As the final stage of the evaluation plan, the steering committee will conduct focus group interviews with the opinion leaders twelve months after the completion of the 3-day workshop (Appendix A). The focus group interviews will provide qualitative data on participants' attitude, knowledge, skills, and learning needs regarding ARS use in the classroom. In addition, the participant will be asked to provide information regarding ARS usage since the completion of the 3-day workshop. The analysis of qualitative and quantitative evaluation data will shed light on the value of the 3-day workshop. In addition, the results will inform future development of the workshop to better serve the university community.

Implications Including Social Change

Local Community

The implication for social change at the local level is to bring an understanding of the factors that influence the faculty's adoption of ARS in the teaching and learning process. Providing evidence-based training and supporting the transfer of learning are the first steps to the successful adoption of ARS in instruction. In addition, this project is also instrumental in promoting positive social change by fostering evidence-based teaching strategies and innovations that maximize student learning, which include the best practices in leveraging the strengths of ARS. In addition, the workshop is designed to give learners opportunities to learn through hands-on experience and to support each other in a community of practice that cultivate faculty cohesiveness and development (Tam, 2015).

Far-Reaching

Over the past decade, the average tuition for four-year public and private higher education institutions has skyrocketed (Snyder & Dillow, 2012, p. 502). In the state of global economic uncertainty, the higher education community is challenged to “do more with less and deliver better value for students and their families” (Obama, 2013). The effective use of instructional technology can be one way to meet this challenge, especially when the university has already invested in the technology. The current project not only provides faculty with experiences for teaching and learning with a technology tool, but it also promotes positive social change by fostering evidence-based teaching strategies and best practices that maximize student learning. The success of the current project will provide a framework for future professional development workshops for other evidence-based instructional technology. Because the process of program planning is rather generic, it can be easily adapted for cross-disciplinary applications.

Conclusion

This section provided the rationale for the project genre selected for this project study based on the results of a literature review of best practices. A 3-day professional development workshop was developed based on the findings of the research study conducted as part of my doctoral capstone. The program goals of the professional development workshop were informed by the findings from the study. An instructional plan and workshop schedule were used to outline the implementation of the workshop. The workshop proposal also provided detail on potential resources, supports, potential barriers, and responsibilities of key stakeholders. A program evaluation plan was developed to seek feedback before, during, and after the 3-day workshop.

This section concluded with social change at a local and far-reaching level, which highlighted the potential social implications the 3-day workshop may have in the community. The following section composes of a collection of my reflections and an overall conclusion of the capstone project.

Section 4: Reflections and Conclusions

Introduction

A quantitative, non-experimental, one-shot cross-sectional survey was conducted to determine what attributes of innovation (relative advantage, compatibility, complexity, trialability, and observability) predict the probability of faculty adopting the ARS into instruction. The implications of the findings supported the need to develop a 3-day professional development workshop to help faculty adopt ARS into instruction with emphasis on the attributes of trialability and compatibility. During the workshop, the faculty will be given the opportunity and support to exploit the instructional technology fully. In addition, they will learn how ARS can assist them in achieving their pedagogical goals. The faculty is involved in developing the program objectives. Through the implementation of this program, ARS adoption is expected to improve, allowing faculty to incorporate the ARS into their teaching based on practices from the literature.

In this section, the strengths, limitations, and suggestions for improvement of the professional development project are discussed. In addition, I will address my personal reflections about the research process and doctoral study experiences with the emphasis on scholarship, leadership, social change, implications, applications, and directions for future research.

Project Strengths

Evidence-Informed Planning

I identified several strengths of the project. The biggest strength of the project came from its systematic development process. The project study was developed based on the evidence-based research findings and best practices available in the literature. For example, Smith (2012) conducted a systematic literature review and concluded that characteristics of successful faculty development programs built on prior knowledge, encouraged faculty to discuss classroom experiences, and offered opportunities to ongoing professional communication for faculties to share similar concerns and success stories.

Participant-Centeredness

Another strength of the project is that the steering committee consists of members from different disciplines representing the diverse perspectives of the faculty. In addition, the faculty is actively involved in the development of learning objectives. These diverse perspectives contribute to the development of learning objectives that reflect the desired knowledge, skills, and attitudes required for the achievement of the program outcomes.

Hands-on Learning Experience

Using a hands-on approach to facilitate active learning, contributes to the strength of the project. A hands-on approach requires the learners to become active participants in the learning process. The workshop consists of experiential learning in the instructional plan to enhance learning and acquisitions of skills. Helping learners engage in meaningful experiences will connect their prior knowledge or schema and assist in integrating new learning and knowledge (Mezirow, 1997).

Integrated Program Evaluations

Another noted strength of the project is the strategic integration of the evaluation process throughout the program cycle. As an integral part of program planning, evaluation data are collected before, during and after the program is completed. The qualitative data are used to complement the quantitative data from the earlier study to inform program planning. An objectives-based evaluation method provides a guide towards the achievement of the program goal.

Recommendations for Addressing the Problem Differently

Companion Website and Distance Learning

A major project limitation is time. It will require precision coordination and administrative support to schedule time and budget professional development hours for 600 faculty members in order for them to attend a 3-day workshop throughout an academic year. In addition, the availability of part-time and adjunct faculty can be an issue, because they may not be scheduled or available to work during the workshop days. The academic directors have to come to a decision if part-time and adjunct faculty would be required and paid to attend the workshop. I recommend a future project to feature a blended learning approach that includes a companion website to provide an alternative way to access the workshop modules.

Blended learning is the thoughtful integration of traditional face-to-face learning experiences with online learning experiences (Garrison & Kanuka, 2004). In other words, blended learning is a practical approach that takes advantage of the strengths of synchronous and asynchronous learning. It encourages the use of contemporary technologies to enhance learning, and the development of flexible approaches to course design to enhance student engagement (Queensland University of Technology, 2011). The emergent tools of information technology provide great potential for designing learning materials that are nonlinear, interactive, and can accommodate various learning levels and styles. There is a considerable intuitive appeal to the concept of integrating the strengths of synchronous and asynchronous learning activities. The blended approach not only allows learners to spend more time processing the information, but also provides students the flexibility to structure and direct their own learning. In addition, learners can take the opportunity to reflect and re-examine their worldview. This type of self-directed reflective learning is supported by the theory of andragogy (Knowles, 1980) and the theory of transformative learning, which defined learning "…as the process of using a prior interpretation to construe a new or revised interpretation of the meaning of one's experience in order to guide future action" (Mezirow, 1996, p. 162).

The Workplace Instructional Technology Services (WITS) can help design and maintain the website. The website may consist of tutorials, examples by discipline, future workshops, current articles, discussions, and additional resources. It may also include areas to showcase faculty's success stories and to share their experiences. The added benefit of a companion website is that the training materials, contacts, and resources are available on the Internet 24/7; therefore, the learners can review the materials, ask questions, and form a learning community in an environment that is non-threatening and flexible (Lim, Morris, & Kupritz, 2014). To maximize flexibility and sustainability of the training, some of the workshop sessions can be developed into stand-alone interactive distance-learning modules.

Train-The-Trainer

Another potential limitation is the basic assumption that a well-intended professional development will result in the faculty using ARS in their classrooms. Learning how to use the technology is by no means guaranteeing technology integration into practice (Tamim, Bernard, Borokhovski, Abrami, & Schmid, 2011). Support will be needed to facilitate the implementation of knowledge and skills learned in the workshop. In a literature review article, Potter and Rockinson-Szapkiw (2012) emphasized that mentor-supported professional development approach and sustained administrative supports were crucial factors for successful technology integration. In the current project, because the steering committee members were recruited from each academic program to direct the professional development efforts, it is a logical solution for the steering committee members to provide mentor-support to help their colleagues integrate ARS into their curricula. An altherative way to implement training and mentor support is to use the train-the-trainer model (Lane & Mitchell, 2013). The train-the-trainer model focuses on initially training a small group of individuals, who will eventually be training their colleuges. According to Suhrheinricj (2011). the train-the-trainer model is both efficient and cost-effective in addressing issues of skills training and providing ongoing mentor-support to the less experienced parctitioners.

Scholarship

According to Boyer's (1990) classic definition, scholarship can be described by four fundamental activities: (a) discovery, (b) integration, (c) application, and (d) teaching. The process of completing this project study involves all four activities.

Discovery

After identifying a local problem and formulating the problem statement, I had to conduct a preliminary literature review to discover what relevant information regarding the local problem has been studied and presented in the literature. This process of discovery helps identify gaps in the literature, relevant research question to ask, and eventually the methodology to help answer the research question.

Integration

Conducting an in-depth and comprehensive literature review involved reading, understanding, analyzing, appraising, and synthesizing the literature to provide insight and to develop a perspective on the research problem. To synthesize from the literature is to integrate and make connections of ideas from the literature. When I began this project study, I found myself reading articles multiple times trying to conceptualize the results and identify common themes from them. It became overwhelming at times. With the progression of the project study, I was able to interpret and summarize important information more effectively. In addition, the data analysis phase of the project study further challenged my abilities to analyze and conceptualize from the findings.

Application

Creating a 3-day professional development workshop based on the findings of my research project was the next phase of the study. This process required me to make the connection between research and practice. I had to apply what I have learned from the research and from the literature to plan a 3-day experiential professional development workshop that provides faculty opportunities to experience the ARS in different pedagogical contexts, share pedagogical strategies and experiences, explore effective and creative ways to overcome student passivity, and introduce interactivity in the classrooms.

Teaching

In order to deliver an effective professional development workshop, I needed to go through the process of discovery, integration, and application again. This time the focus was on program planning models and best practices. In addition, the development of an instructional plan required me to review the different teaching activities and techniques. Every step involved in the project study has exemplified the systematic process of scholarship.

Project Development and Evaluation

The project development and evaluation were guided by the findings of the literature review and findings from my research study. The literature search yielded many relevant articles that offered many different alternative approaches to professional development. Tyler's (1949) linear program planning model lays out a basic plan that is suitable for the short training programs, similar to this 3-day professional development program. In addition, it serves my needs as a novice program planner because the process is sequential and relatively straightforward, Therefore, Tyler's (1949) linear program planning model is used to structure the development of the 3-day profession development program. Because the target learners are adults, it is a logical choice to use the adult learning theory (Knowles, 1980a) to guide the development of the learning activities and implementation strategies.

Evaluation tools were guided by the literature and determined according to the stakeholder needs and learning objectives. Through the process of project development and evaluation, I realized that the administrative and leadership skills I have developed as an occupational therapy practitioner were largely transferrable.

Leadership and Change

Kouzes and Posner (2007) identified five practices of exemplary leadership: Model the way, inspire a shared vision, challenge the process, enable others to act, and encourage the heart. The entire process of this project study models leadership capabilities by mirroring these five practices. The acts of conducting evidence-based research, sharing newfound knowledge, and advocating the application of theories to everyday practice are to model the way of best practices in teaching. A well-designed professional development program not only challenges the learners' critical thinking process and fosters rational discourse but also enables learners to keep current and apply evidence-based theories and research in their practices.

Analysis of self as a Scholar

At one point in my life, I could not wait to graduate from college and start to earn a living in the real world. In my mind, education was merely a means to an end, not an end in itself. What motivated me was the yearning for financial independence and the skepticism of how well my education had prepared me to be a contributing member of the society. During the first few years of my career as an occupational therapy practitioner, I spent the majority of my time, energy, and monetary resources on learning the tricks of the trade and getting accustomed to the demands of productivities and work related regulations. I was too busy to have goals, and my view of professional development was relatively shortsighted and ineffective. Fortunately, I was one of the few lucky individuals who found passion on the career path. My curiosity, thirst for knowledge, passion for didactic pursuits, and supportive family and friends had led me to embark on a journey of lifelong learning. With a blink of an eye, I am now completing my second doctoral degree.

Steward of the Discipline

Golde and Walker (2006) envisioned that the development of students as "stewards of the discipline" (p.5) was the purpose of doctoral education. A steward was defined as a visionary scholar who would "generate new knowledge, critically conserve valuable and useful ideas, and responsibly transform those understandings through writing, teaching, and application" (Golde & Walker, 2006, p.5). The process of completing this doctoral study paves the path for my journey of lifelong learning and to becoming a steward of my discipline.

The doctoral curriculum was designed to correspond to the "phases of critical thinking" (Brookfield, 2010, p. 25) in order to facilitate the development of higher-order cognitive abilities. Unlike doctoral level of education, the critical thinking skills demanded at the masters and undergraduate levels generally focus on the acquisition, comprehension, and application of learned skills and knowledge to practical situations. These levels of critical thinking skills set the foundations for higher order cognitive abilities that are crucial at the doctoral level. For instance, the process of the doctoral study not only focuses on the acquisition and application of knowledge, but it also focuses on fostering higher-order cognitive abilities, such as the capacities to identify creditable sources and to analyze, synthesize, and evaluate the ideas and claims for their validity and relevance in practice. This way of thinking is called “reflective skepticism” (Bookfield, 2010, p. 22), and it has certainly changed the way I interact with the world, inside and outside of the academic arena. As an apprentice of the “stewards of the discipline” (Golde & Walker, 2006, p.5), I am ready to “test the validity of claims made by others for any presumed givens, final solutions, and ultimate truths against [my] own experience of the world” (Bookfield, 2010, pp. 22-23).

Analysis of Self as Practitioner

It is important to note that becoming a steward of the discipline goes beyond generating new knowledge or critically validating other scholars’ ideas (Golde & Walker, 2006). An important aspect of the doctoral curriculum is to learn and apply a systematic process to bring research and theories into everyday practice. The concept of active learning is firmly embedded in the process of the doctoral curriculum. The steps involved in the project study have exemplified the systematic process of identifying a need in everyday practice, exploring related contexts and perspectives, and proposing a solution to address the need based on best available evidence. In order to become one of the “stewards of the discipline”, I must also be able to communicate clearly and intellectually my ideas to other scholars and stakeholders (Golde & Walker, 2006, p.5). As a busy practitioner, time management is particularly challenging in terms of bringing research and theories into everyday practice.

Self-Discipline

Effective adult learners are independent, self-motivated, and self-directed; therefore, to promote effective adult learning, learners need to be actively involved in setting achievable goals (Goldman, 2009). From the process and structure of the doctoral curriculum, I have learned that goal setting and benchmarking are essential to my success. In fact, goal setting is the first step toward successful goal achievement; it marks my path with metaphorical milestones that point toward my destination. Goals provide busy practitioners with structure, accountability, and conscious control over time management which keep them focused and motivated to improve their attitudes, skills, and knowledge towards best practices (Arseneau & Rodenburg, 1998).

According to a Chinese proverb, “The man who moves a mountain begins by carrying away small stones.” This proverb signifies the embarking of my journey of lifelong learning and my role as an agent of change. As a practitioner of my discipline, I believe that it is my responsibility and my role to facilitate positive social changes in practice and to contribute to the body of knowledge in my discipline, one project at a time. With hard work and tenacity, I believe I can move a mountain.

At the beginning of my journey, I believed that education was merely a means to an end, not an end in itself. Today, I believe that education is not merely a means to an end. It is an end in itself. Education is important to me not only because it will help me to achieve some tangible goals, but also because I embrace the philosophy of lifelong learning. I look forward to continuing my journey along this rewarding path of becoming one of the “stewards of my discipline” (Golde & Walker, 2006, p.5).

Analysis of Self as Project Developer

Several program-planning models can serve as frameworks for planning programs for adult learners (Kistler, 2011). Fundamentally speaking, these program-planning models can be separated into two major categories according to their structures and sequence of their applications. Linear program planning models follow a step-wise sequence of their applications; on the other hand, non-linear program planning models use a more pragmatic approach (Daffron & Caffarella, 2013). Tyler's linear program planning model lays out a basic plan that is suitable for the short training programs, similar to this 3-day professional development program. In addition, it serves my needs as a novice program planner because the process is sequential, relatively straightforward, and very similar to what I have been doing when I plan clinical education programs in the hospital setting where I used to work. I have always worked with a team when planning educational programs for the clinicians. It is my first time completing a program development plan by myself. To be honest, I find the details overwhelming at times. I find the step-wise sequence of the linear program-planning model helpful.

The Overall Importance of the Work and Lessons Learned

In reflecting on my capstone experience, I have identified that the most important aspect of the capstone project is the hands-on experience of applying a systematic process to bring research and theories into everyday practice. The systematic process not only helped me develop new knowledge directly related to pedagogy, but it also provided me with a framework for a critical, investigative process of improving pedagogical practices in general. I also feel empowered that I was able to use research data to inform the development of a 3-day professional development program to help my colleagues adopt ARS into instruction. I hope that the current project not only provides faculty with experiences for teaching and learning with a technology tool, but it also promotes positive social change by fostering evidence-based teaching strategies and best practices that maximize student learning.

In the course of my study, I learned to read extensively and critically across disciplines. I also realized that evidence and knowledge extracted from the literature can be synthesized across disciplines. For example, the concepts from evidence-based medicine can be applied seamlessly to the field of education. I also learned to explore and take advantage of the resources around me. For example, during the data analysis phase of the project study, I was encouraged by my committee chair to consult with the statisticians at my college. This action may lead to future scholarly collaboration. I realized the importance of networking and developing "critical friendships" (Swaffield, 2007, p. 205) with colleagues across disciplines who possess varying degrees of knowledge and expertise in different fields. The cross-disciplinary collaboration is crucial to the development of critical thinking because it foster new ways of thinking that involved various frameworks of interpretation.

The Project's Potential Impact on Social Change

The project's potential impact on social change is to bring an understanding of the factors that influence the faculty's adoption of the ARS in the teaching and learning process. Teaching with the ARS is an evidence-based pedagogy, which involves a paradigm shift in how teaching and learning occur in the classroom. This project is instrumental in promoting positive social change by fostering evidence-based teaching strategies and innovations that maximize student learning, which include the best practices in leveraging the strengths of the ARS. In addition, the workshop is designed to give learners opportunities to learn through hands-on experience and to support each other in a community of practice that cultivate faculty cohesiveness. The faculty who utilizes evidence-based pedagogy effectively in the classroom models the knowledge, skills, and attitude of a life-long learner.

Implications, Applications, and Directions for Future Research

Implications

During the course of this capstone project, a few implications were identified from either the literature review, survey responses, or program planning process. Although the technology behind ARS has been available for several years, it is new to many educators; therefore, simply making an educational tool available does not guarantee it being used. Well-planned training, practical active learning, and supportive peer mentoring are instrumental affecting change in faculty practice.

When used appropriately, ARS can be an effective adjunct to widen educational opportunities and to foster student engagement. Peer instruction is an effective evidence-based pedagogy that works well with the use of ARS. In addition, questioning can be an effective pedagogical technique when using with ARS. Therefore, ARS alone is not a panacea to student passivity and related learning barriers in the classroom. The faculty needs to be mindful in choosing appropriate evidence-based pedagogical techniques according to the learning objectives and student needs.

In addition, because compatibility and trialability made most significant contributions to the prediction of faculty's adoption of the ARS into instruction, program developers of future training on other instructional innovations should take these two attributes into consideration. The implication of these two attributes is that the faculty needs be given the opportunity to experience an innovation, and they need to know how the innovation can assist them in achieving their pedagogical goals.

Applications

Evidence-based pedagogy is essential to the delivery of high-quality education that optimizes student outcome (Hargreaves, 1996; McIntyre, 2005; Vanderlinde & van Braak, 2010). The movement for evidence-based practice had its roots in medicine in the early 1990s (Claridge & Fabian, 2005). Sackett, Rosenberg, Gray, Haynes, and Richardson (1996) eloquently defined evidence-based medicine as "the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients" (p. 71). This definition was later elaborated to emphasize the integration of the clinician's expertise and the patient's value with the best available clinical evidence from systematic research (Guyatt & Rennie, 2004). Since the 1990s, evidence-based practice has grown in influence in medicine and spread across a number of other fields, including education (Davies, Nutley, & Smith, 2000). In fact, the need for a strategic approach to generating, accumulating, and using educational research in the field of education was proposed (Hargreaves, 1996).

The process of evidence-based practice begins with the practitioner's professional inquiry. This process implies curiosity and actions that are directed to finding out about matters of professional practice, and it draws upon strategic, reflective, and analytical thinking (Davis et al., 2013). It comes to my realization that every step involved in the capstone project has exemplified the systematic process of evidence-based practice. For example, the process of creating a 3-day professional development workshop was based on the findings of my research project. I had to synthesize and apply what I learned from the research and from the literature to plan a 3-day experiential professional development workshop to help faculty adopt ARS into instruction. Remarkably, the process of evidence-based practice that I learned in the clinical setting as an occupational therapist was equally applicable and relevant in the field of education.

Directions for Future Research

Although Roger's (1995) diffusion of innovation theory was developed to predict adoption of innovations according to potential adopters' perceptions of an innovation, the predictive power of each innovation attribute may vary with the nature of the innovation being studied and the context of the application. Therefore, the results of the study may only be applicable to ARS. It would be interesting to see if the attributes of compatibility and trialability remain the best predictors for the adoption of other type of instructional technology. The perspective of this study was limited by surveying only the faculty at a local university. In order to have a more holistic view of the problem, future studies are recommended to explore different perspectives from other stakeholders who contribute to the process that may lead to the adoption of instructional technology. For example, it would be interesting to see if the students' perceived attributes of ARS are different from those of the faculty's perceived attributes. It is also interesting to see the effects of ARS on students' academic performance across multiple disciplines.

Conclusion

Audience response systems can be an effective adjunct to widen educational opportunities and to foster student engagement, but they cannot be effective if educators are not taking advantage of them. Based on Rogers's (1995) diffusion of innovation theory, a quantitative survey study was conducted to determined what attributes of innovation (relative advantage, compatibility, complexity, trialability, and observability) predicted faculty adopting and integrating the ARS into instruction. The survey study represented an attempt to fill the gap of knowledge about the adoption of ARS into instruction, as well as, to address the low adoption rate in a local university.

The results of the study informed the development of a 3-day professional development workshop to target support, training, and resources necessary for successful adoption of instructional technology. Through the 3-day professional development workshop, the faculty members have the opportunities to learn through hands-on experience and to support each other in a community of practice that cultivate faculty cohesiveness and development (Tam, 2015).

Because mentor-supported professional development approach and sustained administrative supports were crucial factors for successful technology integration, the steering committee members from each academic program will serve as mentors to their colleagues (Potter & Rockinson-Szapkiw, 2012).

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Appendix A: Proposed Project

Title of the Project: Audience Response System (ARS) Professional Development Workshop

Purpose: The purpose of the project is to develop a 3-day professional development program to help faculty adopt ARS into instruction. The project will also share best practices for implementing the technology in classrooms, which include best practices in formulating questions to be used with the ARS, timing for asking questions, facilitating discussions, dealing with technical issues that arise in class, developing objectives for the use of ARS, and designing instruction to meet those objectives.

Program Goal: The overarching goals of the project are to provide faculty-centered training on the use and implementation of ARS software and hardware in their curricula, as well as provide ongoing support in the form of mentor-support.

Program Outcome: The desired outcome is for the faculty to adopt ARS into instruction.

Learning Objectives: The learning objectives that scaffold learning towards the program goal are identified as follow:

- Acquire the technical skills to operate the software and hardware of an ARS.
- Recognize the benefit of using clickers and peer instruction to promote student engagement.
- Develop pedagogical strategies for using clickers, including thoughtful question-writing.
- Create pedagogically effective lectures for the use of student response systems.

Target Audience: The target audience is all full and part-time faculty members.

Steering Committee: The committee consists of faculty members from each academic program. It represents the diverse perspectives of the faculty.

Steering Committee Responsibilities: Two of the members of the steering committee will conduct the pre-program and follow-up focus groups. One of the two members will serve as a recorder who takes field notes on the happenings during the focus group meetings. The other member serves as the moderator who welcomes the group and conducts the interviews. The other members of the steering committee will be responsible of analyzing and synthesizing from the data. After the 3-day workshop, the steering committee members will act as mentors helping their colleagues integrate ARS into their curricula.

Timeline: A 3-day professional development workshop will repeat every month throughout the spring and fall semesters. Details are listed in the instructional plan and workshop schedule.

Workshop Activities: Specific activities, instructional resources, equipment needs, and assessment plan are included the instructional plan.

Instructional Plan: The following is the instruction plan for the 3-Day Audience Response System (ARS) Workshop:

Instructional Plan

Title: Audience Response System (ARS) 3-day Workshop

Workshop description: This is a 3-day hands-on professional development workshop to help faculty adopt ARS into instruction. The contents of the workshop include best practices for implementing the technology in classrooms, which include best practices in formulating questions to be used with the ARS, timing for asking questions, facilitating discussions, dealing with technical issues that arise in class, developing objectives for the use of ARS, and designing instruction to meet those objectives.

Learning Objectives: At the end of the workshop, faculty will be able to:

- **Operate the software and hardware of an ARS**
- **Recognize the benefit of using clickers and peer instruction to promote student engagement.**
- **Develop pedagogical strategies for using clickers, including thoughtful question-writing.**
- **Create pedagogically effective lectures for the use of student response systems.**

Date and Time: Every third Wednesday, Thursday, and Friday of the month in spring and fall semesters , 8:00 a.m. – 4:00 p.m.

Day one (Wednesdays)

Learning Objectives ***The participants will be able to…***	**Content Heading**	**Key Points to Emphasize**	**Instructional Techniques / Activities**	**Estimate Time**
Operate the software and hardware of an ARS and recognize the benefit of using ARS and peer instruction to promote student engagement.	The Benefit of Using ARS and Peer Instruction.	What is the current evidence of using ARS in higher education classrooms? This session introduces research evidence on effective use of ARS to facilitate peer instruction (the practice of requiring students to discuss their answers to challenging questions with one another).	• Lecture • Class discussion *Warmup discussion:* • Share your experience and discuss pros and cons of using ARS. *Class Discussion:* • What aspect of the ARS technology makes it helpful for student learning? *Cooperative learning:* • Working in groups of two, the learners will create mini-lectures practicing what they have learned in the lecture. *Action plan discussion:* • Take 10 to 15 minutes to write down your action plan to implement ideas you heard about	8 hours

			in this workshop and discuss your plan with your neighbors. Is your plan feasible? What resources you may need to implement your plan? • Question and answer period	
Day two (Thursdays)				
Learning Objectives ***The participants will be able to…***	**Content Heading**	**Key Points to Emphasize**	**Instructional Techniques / Activities**	**Estimate Time**
Develop pedagogical strategies for using ARS, including thoughtful question-writing.	Writing Great ARS Questions	In this interactive session, we'll explore research-based tips and ideas for achieving the full benefit of questioning as a pedagogical strategy. Effective use of ARS for questioning will be discussed as a means to achieve student engagement and deep learning.	• Lecture • Small-group discussion *Warmup discussion:* • Why do we ask question? What might you use ARS questions to accomplish in your classroom? • When should we be asking questions? *Cooperative learning:* • Peer review and appraisal of individually constructed sample questions. *Action plan discussion:* • Take 10 to 15 minutes to write down your action plan to implement ideas you heard about in this workshop and discuss your plan with your	8 hours

			group. Is your plan feasible? What resources you may need to implement your plan? • Round-robin listing of ideas in the group	
Day three (Fridays)				
Learning Objectives ***The participants will be able to…***	**Content Heading**	**Key Points to Emphasize**	**Instructional Techniques / Activities**	**Estimate Time**
Create pedagogically effective lectures for the use of ARS.	Making ARS Work for You	In this interactive session, we'll explore research-based best practice tips of incorporating ARS in lectures.	• Lecture • Small-group discussion *Warmup discussion:* • Case Scenario: A frustrated student *Peer instruction discussion:* • Share experience using peer instruction • Brainstorm and discuss the potential challenges and solutions of using peer instruction. *Action plan discussion:* • Take 10 to 15 minutes to write down your action plan to implement ideas you heard about in this workshop and discuss your plan with your group. Is your plan feasible? What resources you may need to implement your	8 hours

			plan? *Cooperative learning:* • Peer review and appraisal of individually constructed learning goals. • Small-group presentation of group created mini lectures.	

Assessment plan:

Pre-workshop qualitative assessment: Focus group interviews of opinion leaders provide information regarding their attitude, knowledge, skills, and learning needs.

Post-session formative quantitative assessment: At the end of each session, there is an evaluation to determine whether the objectives have been met.

Post-workshop summative quantitative assessments: At the end of the 3-day workshop, there will is an evaluation to determine whether the program outcome has been met. The participants are asked to comment on the strengths and provide suggestions for improving the workshop

Follow-up summative qualitative assessment: Twelve months after the completion of the 3-day workshop, the steering committee will conduct focus group interviews of opinion leaders to gather information regarding their attitude, knowledge, skills, learning needs, and progression in ARS implementation.

Instructional resources and needed:

For Instructor	For Participants
PowerPoint presentation	Handouts of the workshop contents
LCD projector	ARS remotes (one for each participant)
Computer	Session evaluation and feedback form
ARS hardware and software	Workshop evaluation and feedback form
Instructional plan	Workshop Schedule
Workshop schedule	

Room arrangement:

For Day one:

Computer lab

For Day two and three

Chairs arranged around tables for small group discussions and activities (6 chairs per table).

Workshop Schedule: The following is the workshop schedule for the 3-Day Audience Response System (ARS) Workshop:

Workshop Schedule
Day one

Introduction to the ARS

Learning Objective: After completing this session, participants will acquire the technical skills to use ARS and be able to recognize the benefit of using ARS to promote student engagement.

Day one of the workshop will be conducted in the computer lab.

8:00 a.m. – 8:30 a.m.	**Sign-in, coffee and refreshments**
8:30 a.m. – 9:40 a.m.	Brief introduction to the workshop and learning objective
9:40 a.m. – 9:55 a.m.	Warmup discussion
9:55 a.m. – 10:30 a.m.	Introduction to the ARS and research evidence
10:30 a.m. – 10:45 a.m.	Coffee break
10:45 a.m. – 12:00 p.m.	Creating a presentation
12:00 p.m. – 1:00 p.m.	Lunch break
1:00 p.m. – 2:30 p.m.	Practice incorporating ARS into a sample mini-lecture: Working in groups of two, the learners will create mini-lectures (5 slides) practicing what they have learned in the lecture.
2:30 p.m. – 2:45 p.m.	Coffee break
2:45 p.m. – 3:30 p.m.	Action Plan and group discussion on implementation
3:30 p.m. – 3:45 p.m.	Questions and answers
3:45 p.m. – 4:00 p.m.	Session evaluation, sign-out

Day two

Writing Great ARS Questions

Learning Objective: After completing this session, participants will be able to develop pedagogical strategies for using ARS, including thoughtful question-writing.

8:00 a.m. – 8:30 a.m.	**Sign-in, coffee and refreshments**
8:30 a.m. – 9:40 a.m.	Brief introduction to the workshop and learning objective
9:40 a.m. – 9:55 a.m.	Warmup discussion
9:55 a.m. – 10:30 a.m.	Introduction to question-writing and question goals
10:30 a.m. – 10:45 a.m.	Coffee break
10:45 a.m. – 11:00 a.m.	Tips for writing ARS questions
11:00 a.m. – 11:45 a.m.	Bloom’s taxonomy and effective question-writing
11:45 a.m. – 12:00 p.m.	Practice writing ARS questions
12:00 p.m. – 1:00 p.m.	Lunch break
1:00 p.m. – 2:30 p.m.	Cooperative learning: Peer review of practice questions.
2:30 p.m. – 2:45 p.m.	Coffee break
2:45 p.m. – 3:30 p.m.	Action Plan and group discussion on implementation
3:30 p.m. – 3:45 p.m.	Questions and answers
3:45 p.m. – 4:00 p.m.	Session evaluation, sign-out

Day three

Making ARS Work for You

Learning Objective: After completing this session, participants will be able to create pedagogically effective lectures for the use of ARS, including peer instruction.

8:00 a.m. – 8:30 a.m.	**Sign-in, coffee and refreshments**
8:30 a.m. – 9:40 a.m.	Brief introduction to the workshop and learning objective
9:40 a.m. – 9:55 a.m.	Warmup discussion: Case scenario
9:55 a.m. – 10:30 a.m.	Introduction to research-based best practice tips
10:30 a.m. – 10:45 a.m.	Coffee break
10:45 a.m. – 11:00 a.m.	Writing learning goals to drive instruction and assessment
11:00 a.m. – 11:45 a.m.	Practice writing learning goals
11:45 a.m. – 12:00 p.m.	Best practices in peer instruction
12:00 p.m. – 1:00 p.m.	Lunch break
1:00 p.m. – 2:30 p.m.	Best practices tips for ARS
2:30 p.m. – 2:45 p.m.	Coffee break
2:45 p.m. – 3:30 p.m.	Action Plan and group discussion on implementation
3:30 p.m. – 3:45 p.m.	Questions and answers
3:45 p.m. – 4:00 p.m.	Session evaluation, sign-out

Handouts of Workshop Contents: The following is the workshop handouts for the 3-Day Audience Response System (ARS) Workshop.

Focus Group Interview Guide for Facilitators

Welcome

Introduce yourself and the notetaker. Please ask the participants to sign in while you are introducing the focus group. A welcome script is provided as a general guide to introduce the focus group to the participants.

1. Review the following:
   - Who we are and what we're trying to do
   - What will be done with this information
   - Why we asked you to participate
   - If you are a supervisor, we would like to excuse you at this time

2. Explanation of the process:
   - Ask the group if anyone has participated in a focus group before. Explain the purpose of the focus group.
   - We learn from you (positive and negative)
   - Not trying to achieve consensus; we are gathering information surrounding the topic of interest
   - Focus group will last about one hour
   - Feel free to move around
   - Where is the bathroom?

3. Ask the group to suggest some ground rules. After they brainstorm some, make sure the following are on the list:
   - Everyone should participate.
   - Information provided in the focus group must be kept confidential
   - Stay with the group and please refrain from having side conversations
   - Put your cell phones on vibrate if possible

4. Turn on the recorder
   - Ask the group if there are any questions before we get started, and address those questions.

- Discussion begins. Please do not go through the questions too quickly; make sure to give participants time to think. You can use the probes to make sure that all issues are addressed. You should ask a new question when you feel you are starting to hear repetitive information.

Welcome Script

Thank you for agreeing to participate in this focus group. We are interested to hear your valuable opinion on how audience response system can be incorporated into instruction.

- The purpose of the focus group interview is to identify the top three learning needs, expectations, preferences, and concerns of the faculty related to the use of the ARS in instruction, as well as the faculty's current levels of competency in instructional technology. We are not trying to achieve consensus; we are gathering as much information on the topic as possible. We hope to learn information that the steering committee can use to plan a 3-day professional development workshop that provides faculty opportunities to experience the ARS in different pedagogical contexts, share pedagogical strategies and experiences, explore effective and creative ways to overcome student passivity, and introduce interactivity into the classrooms.

- The information you give us is completely confidential, and we will not associate your name with anything you say in the focus group.

- We would like to record the focus groups so that we can make sure to capture the thoughts, opinions, and ideas we hear from the group. No names will be attached to the focus groups and the recordings will be destroyed as soon as they are transcribed.

- We understand how important it is that this information is kept private and confidential. We will ask participants to respect each other's confidentiality.

- The focus group will last about an hour. Please feel free to move around. There are bathrooms close by. They are located half way down the corridor on the left.

- Before we start the discussion, let's brainstorm some ground rules for participation. For example, we are asking you to refrain from having side conversations during the discussion. Can you come up with some other ground rules for the group?

- If you have any questions, please feel free to ask. Otherwise, we will begin the focus group interview.

Semi-structured Interview Sample Questions and Probes

Semi-structured questions	Themes	Repeated Terminology	Frequency	Field Notes
1. How would you describe your experience of using ARS? Probes for discussion: • Setup and preparation • Glitches • Taking attendance • Formative and summative assessment • Difficulty				
2. What are some of your expectations from using ARS in instruction? Probes for discussion: • Student interactions • Student performance • Student attendance				
3. What are some of the barriers of incorporating ARS into instruction?				

Probes for discussion: • Technical problem • Time management • Complexity • Lack support • Lack resource • Glitches • Instructor skill • Opportunity to try • Cost				
4. How would you describe your current levels of competency in instructional technology in general? Probes for discussion: • Instructional technology • Other technology • Home and leisure • Software vs Hardware				
5. What contents would you like to see in the professional development workshop? Probes for discussion: • Discipline specific • Online materials • Evidence • Goals and objectives • Strategies • Facilitation • Question writing • Pedagogical techniques				

• Best practices				
6. *How have you been incorporating ARS into instruction since the completion of the 3-day workshop? Probes for discussion: • Frequency • Curriculum • Peer instruction • Attendance • Assessment • Support				
7. *Would you describe the use of ARS in your department since the completion of the 3-day workshop? Probes for discussion: • Frequency • Availability • Curriculum • Peer instruction • Attendance • Assessment • Complaints • Mentoring • Administrative support • Collaboration				
8. *What are some of your suggestions for future ARS workshops?				

Probes for discussion: • Frequency • Curriculum • Availability • Neuro-sciences and learning • Modes of delivery • Certification • Incentive				
*The questions with an asterisk are the additional questions for the 12-month post workshop focus group interview.				

5. When the focus group adjourns, thank the participants for coming and sharing their thoughts and opinions.

Materials and Supplies for Focus Groups

- Sign-in sheet
- Name tents
- Pads & Pencils for each participant
- Focus Group Interview Guide for Facilitator
- One digital recording device with battery
- Notebook for taking field notes

Session Evaluation and Feedback Forms

Title of the Session:

Date:

For the questions with numerical ratings, please circle the ratings that best represent your reaction to this session:

1 = No 2 = Somewhat 3 = Yes, definitely

1. Were the session objectives clear and achievable?	1	2	3
2. Were the instructional techniques and materials helpful in your learning?	1	2	3
3. Did the instructor focus the presentation on the session objectives and integrate the instructional techniques well?	1	2	3
4. Did the instructor provide adequate opportunities for questions and discussion?	1	2	3
5. The overall session contributed to my knowledge and skill base of using ARS.	1	2	3
6. Please identify any key information and skills you can use from the session.			

7. Please suggest improvement for this session.

Workshop Evaluation and Feedback Forms

Audience Response System (ARS) 3-day Workshop
Date:

Please assist us in evaluating the quality of the workshop by completing this feedback form. Your specific comments and suggestions for improvement are most appreciated. For the questions with numerical ratings, circle the ratings that best represent your reaction to the overall quality of the workshop.

1 = No 2 = Somewhat 3 = Yes, definitely

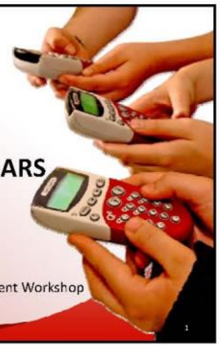
How do you rate the program overall? Comments/suggestions:	1	2	3
Will you be able to apply what you have learned in the workshop? Comments/suggestions:	1	2	3

Where you challenged by the content and the way the material was presented? Comments/suggestions:	1	2	3
Please comment on the major strengths of the program and changes you would recommend. Major strengths: Suggestions for improvement:			

Day one: Introduction to the ARS

Day One

Introduction to the ARS



A 3-day Professional Development Workshop

1

Learning Objective

After completing this session, participants will be able to

- recognize the benefit of using ARS and peer instruction to promote student engagement.
- create and deliver simple presentations using the ARS.

2

Contents

- Provide an introduction to Audience Response Systems (ARS) and peer instruction
- A brief review of literatures and evidence supporting the use of ARS in higher education
- Experience the impact of ARS on engagement

3

Day one: Introduction to the ARS

Raise Your Hands

- May I have a show of hands to see who had positive experiences with ARS before.

4

Raise Your Hands

- May I have a show of hands to see who never used an ARS before.

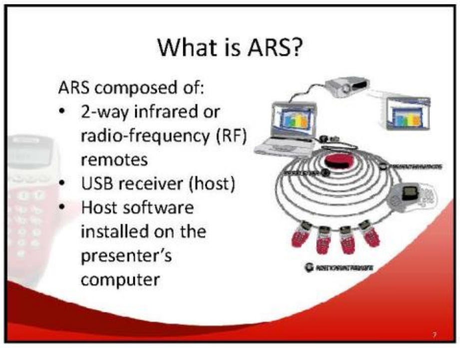
5

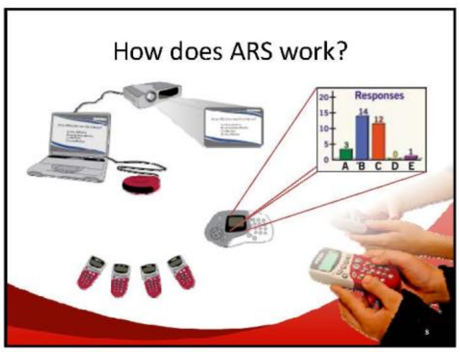
Warmup Discussion

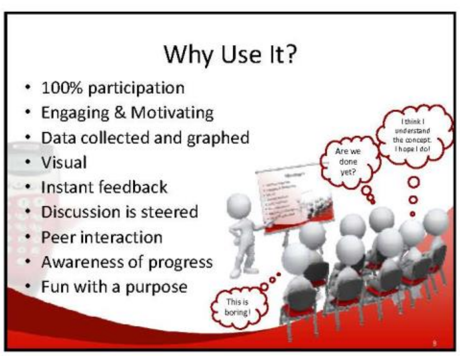
- Please take a few minutes to introduce yourself to your neighbors and share your experience and discuss pros and cons of using ARS.
- This exercise is to activate your prior knowledge and to access your preconceptions regarding ARS.

6

Day one: Introduction to the ARS







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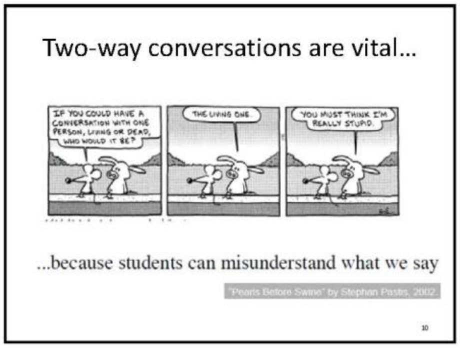
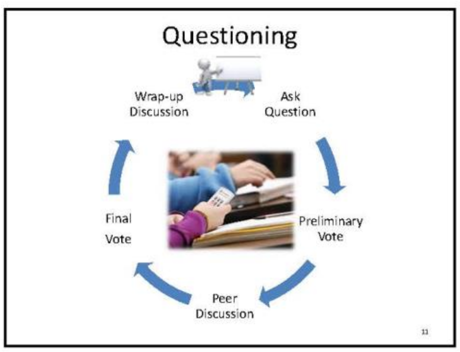
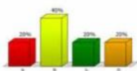




Day one: Introduction to the ARS

Preliminary Vote



- Typically allow 2 to 3 minutes
- Use a time on the slide, or when about 80% of students have voted
- Show histogram

13

Peer Discussion

- Students learn more deeply by teaching each other
- Makes them articulate answer and consider others viewpoints
- Let you know what they are thinking

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Final Vote

- Typically allow 2 to 3 minutes
- Use a time on the slide, or when about 80% of students have voted

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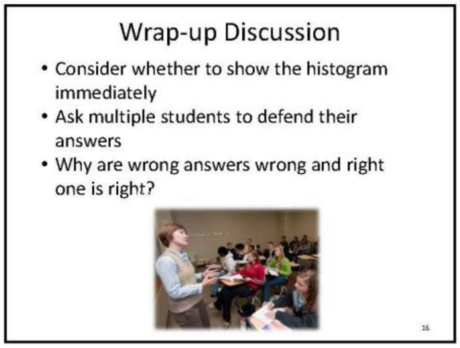
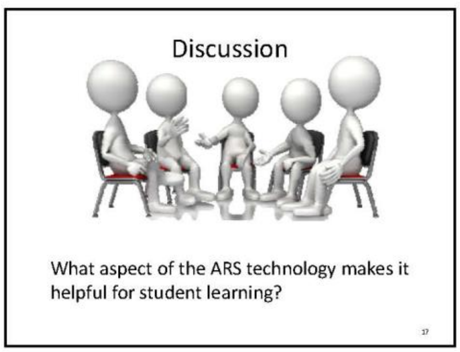
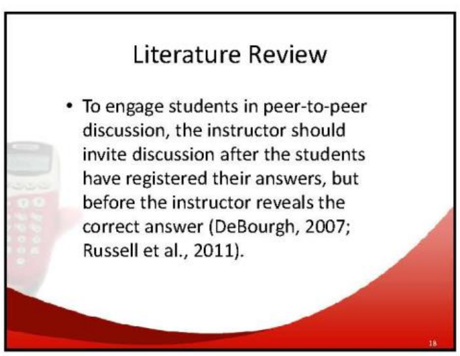
Day one: Introduction to the ARS







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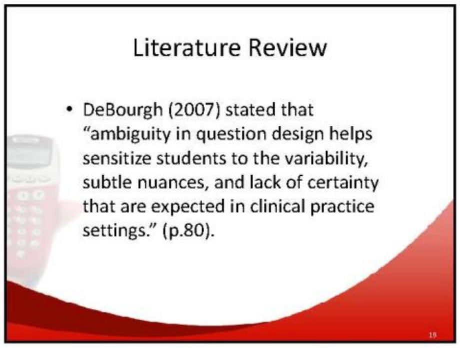

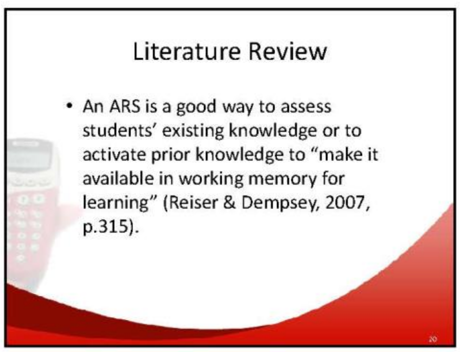

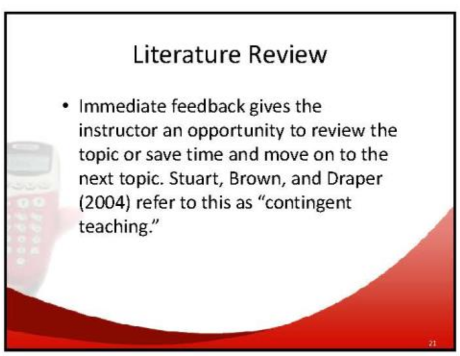

Day one: Introduction to the ARS

12 tips for success (Premkumar & Coupal, 2008)

1. Pedagogy should be the focus – not the technology
2. Check your readiness for use this strategy
3. Practice using the technology – learn to input questions ahead of the time and on the fly
4. Identify purpose of posing questions
5. Less is better than more
6. Write the question and test it

22

12 tips for success (Premkumar & Coupal, 2008)

7. Plan for contingency teaching
8. Build in time for the activity
9. Decide if individuals have to be linked to questions or not
10. Decide on whether you want to use the output or not
11. Evaluate effectiveness
12. Enjoy the process, be creative

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Turning Point Clickers

A "Try it" Technology Opportunity for Faculty
Turning Point Clickers – Student response kits for your classroom
WITs now has a limited number of Turning Technologies student response clicker kits that faculty can reserve.
Each kit contains:
· 20 student clickers
· 1 faculty receiver
· 1 carry case
Learn how to use the Turning Technology response system by attending these workshops:
· Clickers
· Clicker Anywhere
To reserve your kit, contact:
kboone@mail.barry.edu

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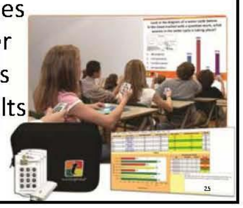
Day one: Introduction to the ARS

TurningPoint Technology

- Create interactive ("question") slides whereby lecturer can poll students and display results instantaneously



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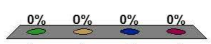
Did you have any experience using ARS in the classroom setting before?

1. I had no idea such technology existed.
2. I heard about it, but I never used it.
3. I had some experience.
4. I used it a lot.



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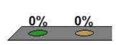
According to DeBourgh (2007), to best engage students in peer-to-peer discussion, the instructor should invite discussion before or after revealing the correct answer (DeBourgh, 2007; Russell et al., 2011).

1. Before
2. After



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Day one: Introduction to the ARS

Software

- TurningTechnologies software (TurningPoint 5) must be utilized for the students' clickers to communicate with the instructor's presentation.
- This product is used to create interactive slides, view response graphs, and configure the session parameters. TurningPoint has been installed in all of the computers in the classrooms supported by WITs.

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Software

Do this only if you don't have the software on your computer!

DOWNLOADING THE SOFTWARE

1 Visit **www.turningtechnologies.com/downloads** to download TurningPoint. Choose the install version or the no install version of the software.

2 Opening the no install version of the software:

a Double-click the downloaded zip file.

b Select the desired folder location and click **Unzip**.

c Open the unzipped folder and double-click **TurningPoint.exe**.

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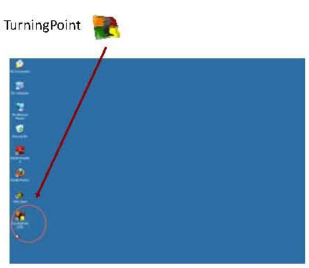
Creating the Presentation Before Class

1. Open TurningPoint



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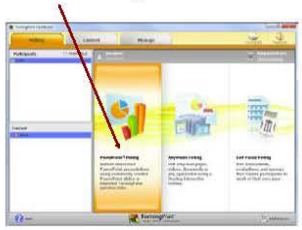
Day one: Introduction to the ARS

Creating the Presentation Before Class

2. Select PowerPoint Polling



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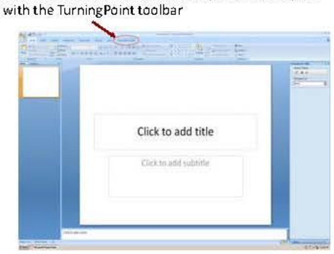
Creating the Presentation Before Class

3. PowerPoint will start automatically, and it will open with the TurningPoint toolbar



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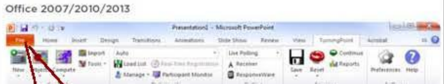
PowerPoint TurningPoint Toolbar

Office 2007/2010/2013



- Open an existing PowerPoint presentation (if applicable)
- When it is your turn to practice, you will open a new presentation.

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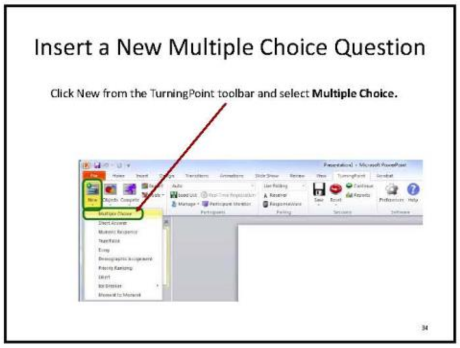
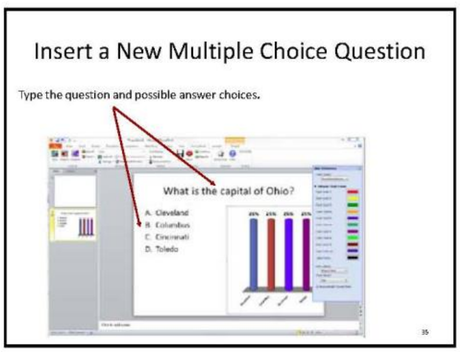
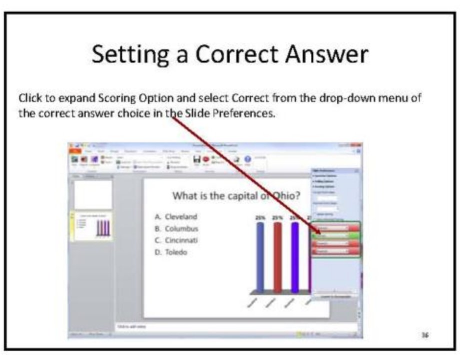
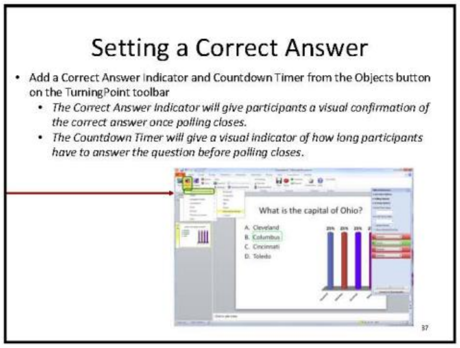
Day one: Introduction to the ARS

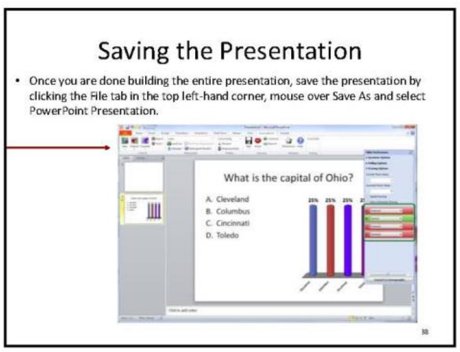


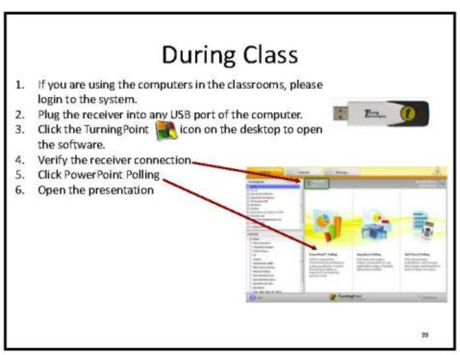




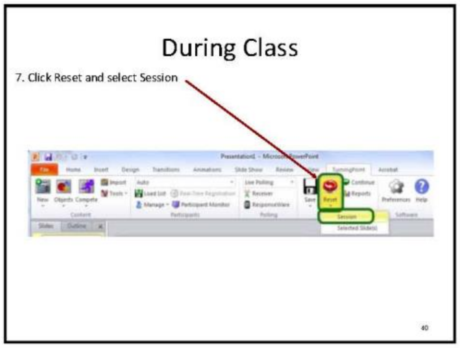
Day one: Introduction to the ARS

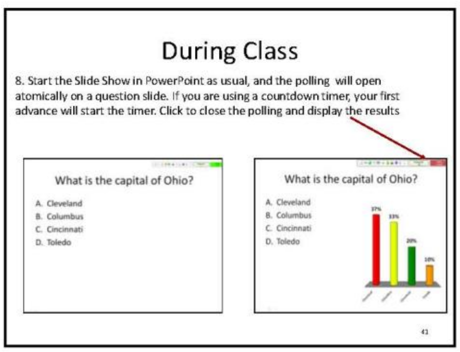


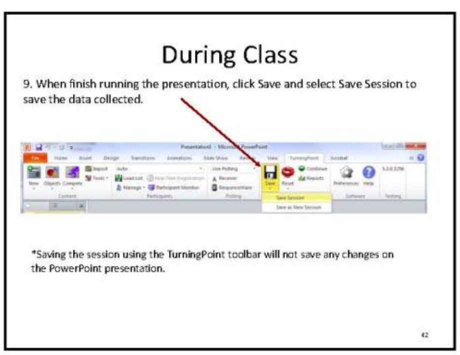




Day one: Introduction to the ARS







Day one: Introduction to the ARS

After Class: Generating Reports

1. Open Turning Point and select the Manage tab.

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After Class: Generating Reports

2. Select the saved session from the left panel.

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After Class: Generating Reports

3. Click Reports in the bottom right corner. Double clicking the session name will also open the report window.

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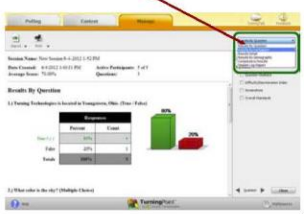
Day one: Introduction to the ARS

After Class: Generating Reports

4. Select the report type from the drop-down menu. Click close when finish.



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Your Turn to Practice

- Working in groups of two, you will create mini-lectures (5 slides including the cover) practicing what you have learned in this lecture.
- You can use any topic (the content is not important), or
- You can use the template provided and modify the question slides to be used with TurningPoint.

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Slide 1

Title Slide

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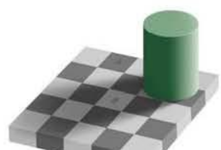
Day one: Introduction to the ARS

Slide 2

Which of the following statements is correct?

A. Square A is in a darker shade of grey
B. Square B is in a darker shade of grey
C. Square A and B are the same shade of grey



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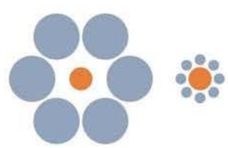
Slide 3

Which of the following statements is correct?

A. The orange dot on the left is smaller than the one on the right
B. The orange dot on the left is bigger than the one on the right
C. The two orange dots are in the same size



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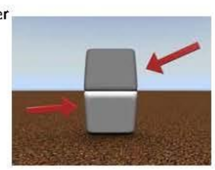
Slide 4

Which of the these two blocks is darker?

A. The block on top is darker
B. The block in bottom darker
C. The two blocks are the same color



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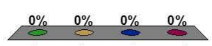
Day one: Introduction to the ARS

Slide 5

Thank You

How likely are you to use this type of technology in your classroom in the future?

A. Not at all likely
B. Slight likely
C. Moderately likely
D. Very likely



Action Plan Discussion

Take 10 to 15 minutes to write down your action plan to implement ideas you heard about in this workshop and discuss your plan with your neighbors.

- What are you planning to do with the technology?
- Is your plan feasible?
- What resources you may need to implement your plan?

Day one: Introduction to the ARS

Turning Point Online Training

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Day one: Introduction to the ARS

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Questions?

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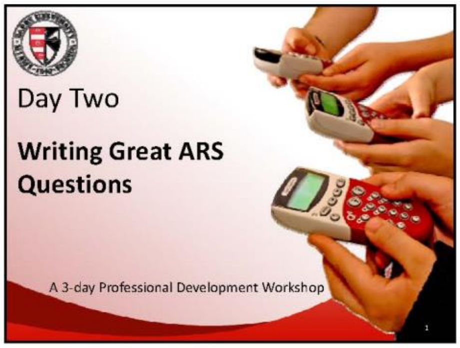
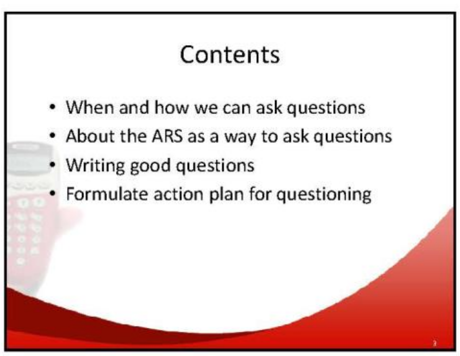
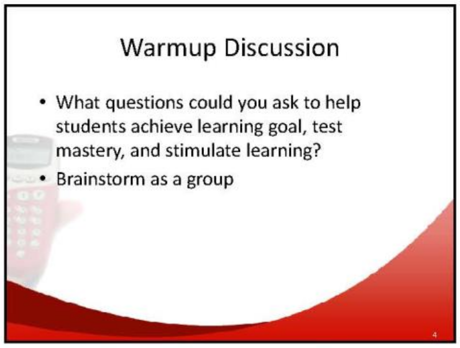
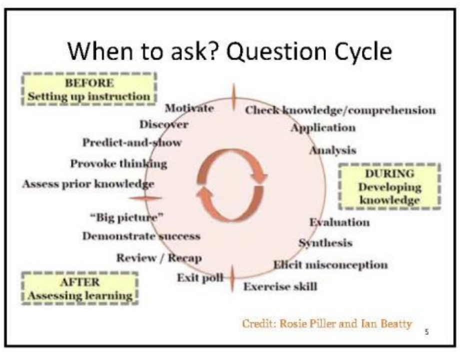
Day two: Writing Great ARS Questions



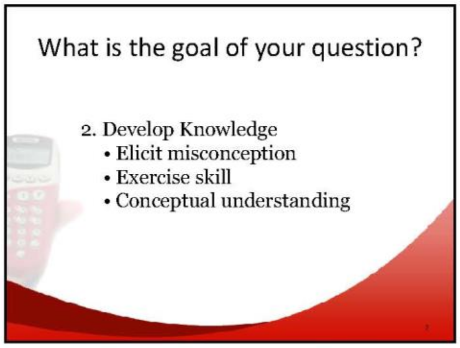


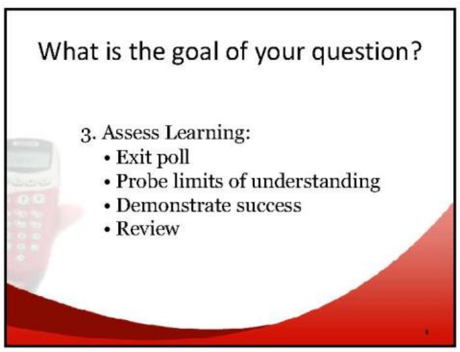
Day two: Writing Great ARS Questions

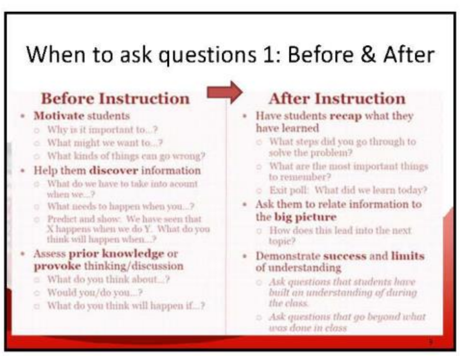




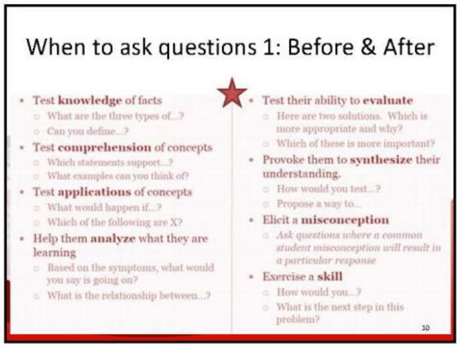
Day two: Writing Great ARS Questions

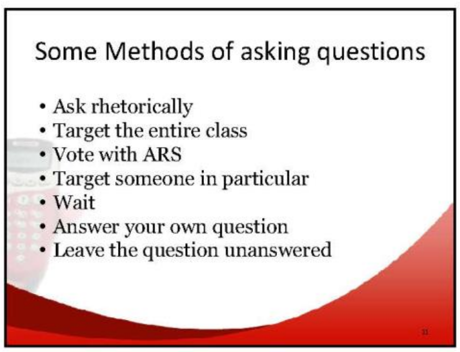


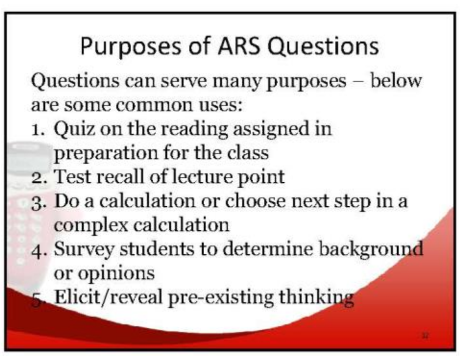




Day two: Writing Great ARS Questions







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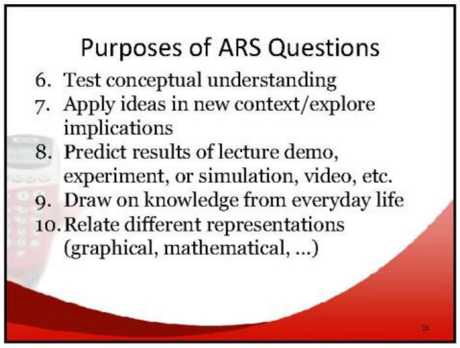

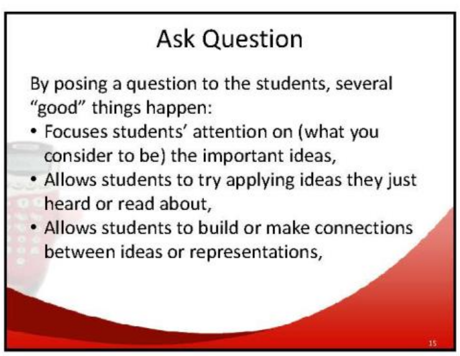

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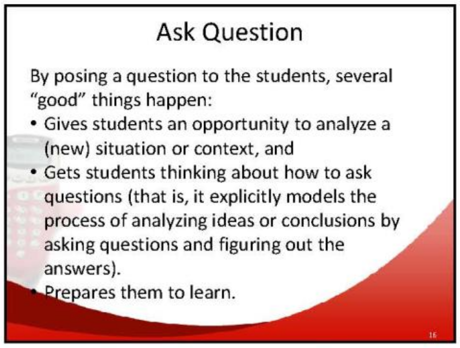

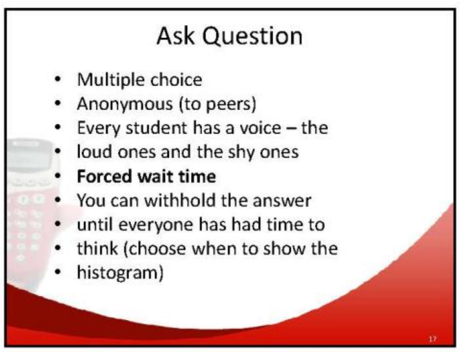

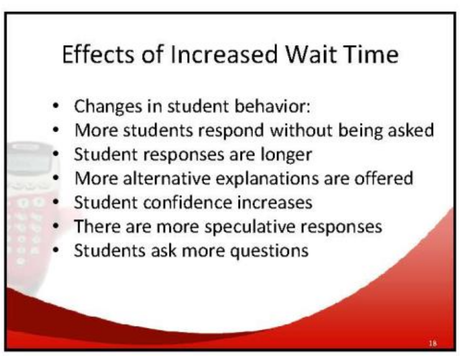

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Giving the answer stops students from thinking!

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Terminology

1. Stem: presents the problem
2. Keyed Response: correct or best answer
3. Distracters: appear to be reasonable answers to the examinee who does not know the content
4. Options: include the distracters and the keyed response.

1 → 1. The capital city of Canada is
3 → a. Vancouver
b. Montreal
c. Toronto ← 4
2 → *d. Ottawa

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Ambiguity

- Extrinsic
  - Desirable quality in multiple choice items
  - Outside the item
  - Allows discrimination between those who know material and those who do not.
- *Intrinsic*
  - *Undesirable*
  - *Should be avoided*
  - *Inside the item*
    - *poor wording*
    - *more than one answer*
  - *Even those who know content have difficulty choosing correct answer*

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Day two: Writing Great ARS Questions

Types of Multiple Choice Items

- Correct Answer*
  - Only one correct response
- Best Answer
  - requires examinee to select alternative closest to being correct
  - fine distinctions
- Multiple Answer
  - More than one correct or best answer

Interpretive Exercise

- Usually begins with verbal, tabular or graphic information which is the basis for 1 or more multiple choice questions.
  - *map, passage from a story, a poem, a cartoon*
- Can challenge students at various levels of understanding
  - *application, analysis, synthesis, evaluation*
- Exercise contains all information needed to answer questions
- Readily adaptive to the more important outcomes of disciplines.

Interpretive Exercise

- Examples
- If student answers incorrectly it is because they have not mastered the thinking or reasoning required by the question, NOT because they failed to memorize background information.
- Math questions: give students the formulas, test ability to apply concepts, rather than ability to memorize formulas.

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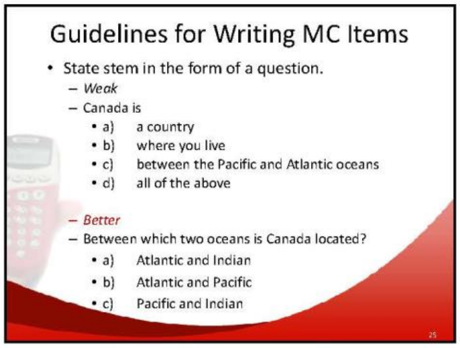

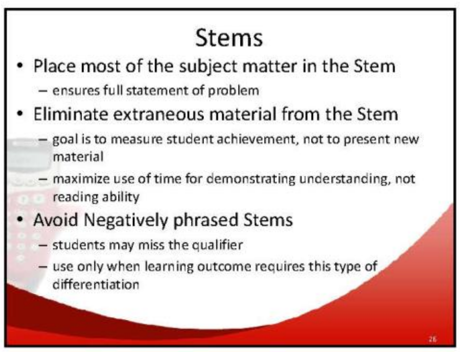

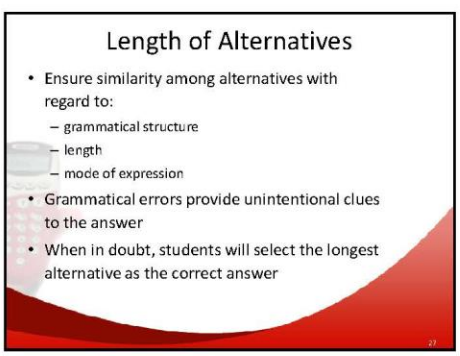

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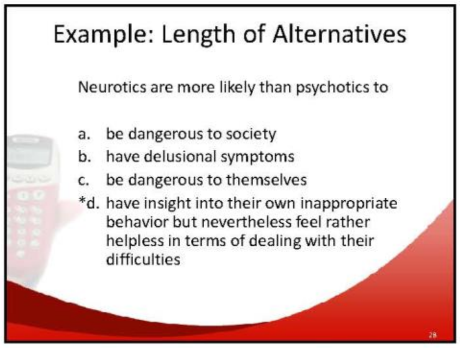

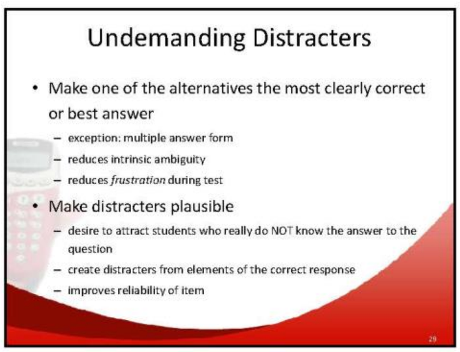

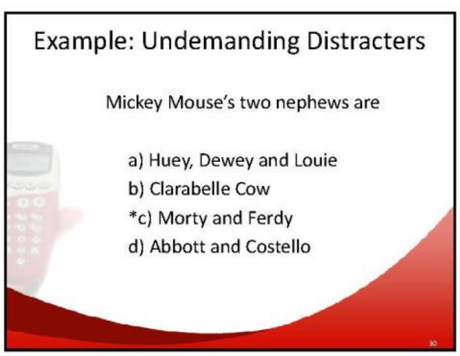

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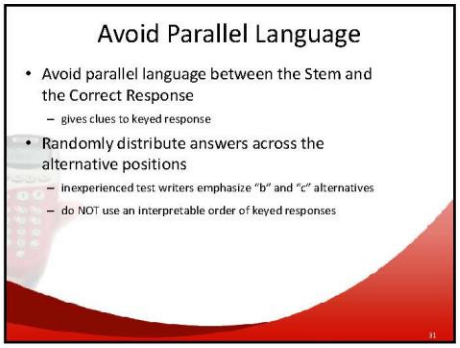

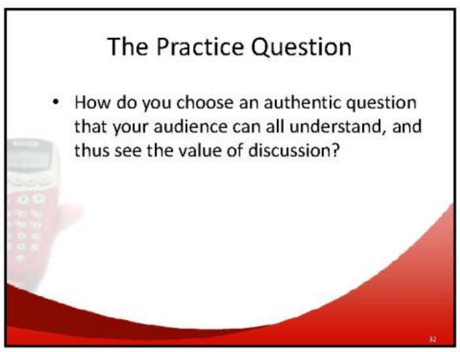

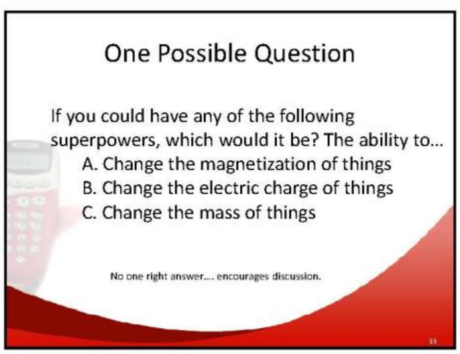

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Another Possible Question

Your sister in law calls to say that she's having a fraternal twin. Which of the following is the most likely?

A) Twin boys
B) Twin girls
C) One girl and one boy
D) All are equally likely

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Another Possible Question

A tennis racket and can of balls together costs \$110. The tennis racket alone costs \$100 more than the can of balls. How much does the can of balls alone cost?

A. \$5
B. \$10
C. \$11
D. \$100
E. None of the above

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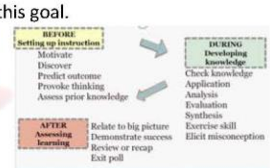
Write a Draft Question

- Choose one of the question goals
- Write a draft question that aims to achieve this goal.



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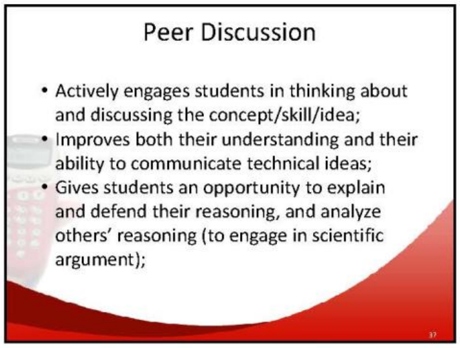

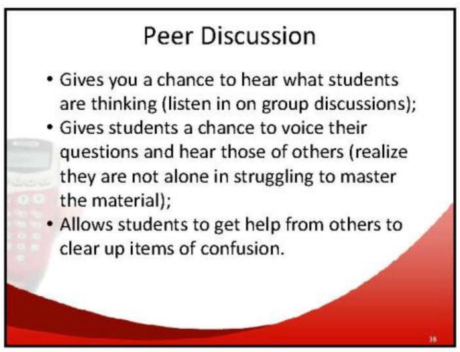

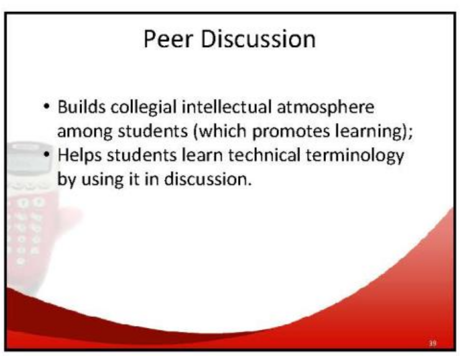

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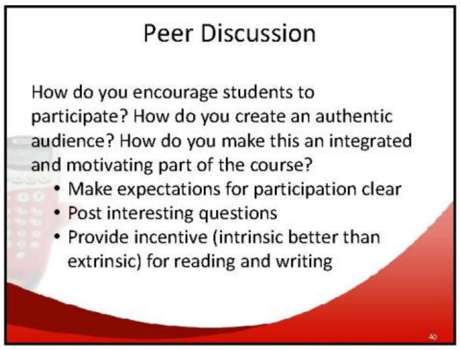

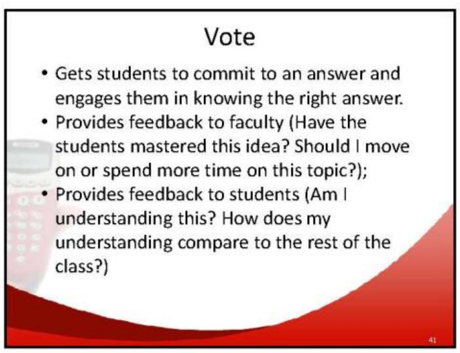

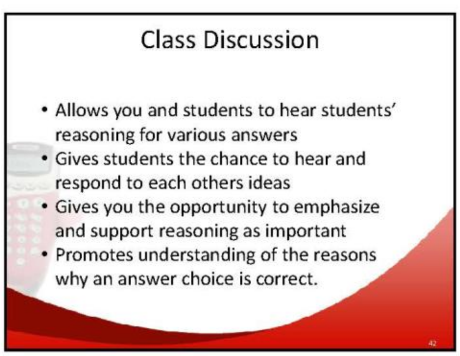

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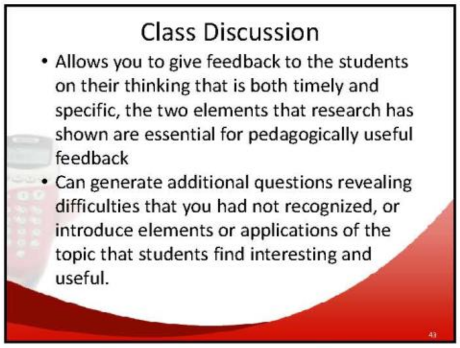

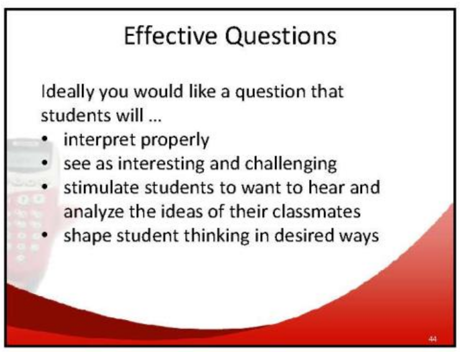

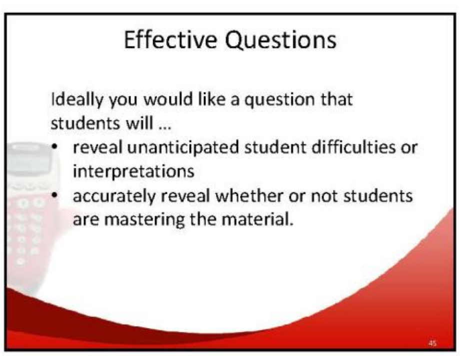

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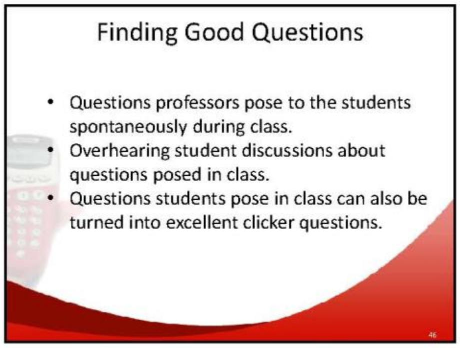

Day two: Writing Great ARS Questions

Question design goals and tactics (Beatty et al., 2006)

Question design goals	Tactics
Promote articulation and discussion	• Qualitative questions • Analysis and reasoning questions • Multiple defensible answers • Require unstated assumptions • Trap unjustified assumptions • Deliberate ambiguity • Trolling for misconceptions

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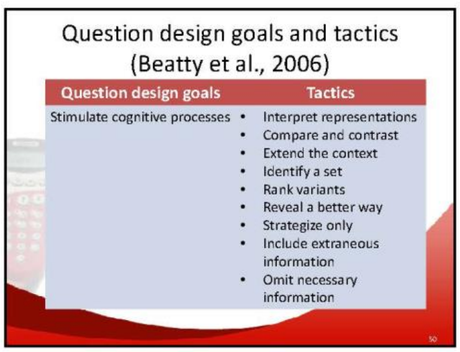

Question design goals and tactics (Beatty et al., 2006)

Question design goals	Tactics
Stimulate cognitive processes	• Interpret representations • Compare and contrast • Extend the context • Identify a set • Rank variants • Reveal a better way • Strategize only • Include extraneous information • Omit necessary information

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Question design goals and tactics (Beatty et al., 2006)

Question design goals	Tactics
Formative use of response data	• Answer choices reveal likely difficulties • Use "none of the above"
Connect to the real world	• Apply to real world setting • Pose in terms of real world problem

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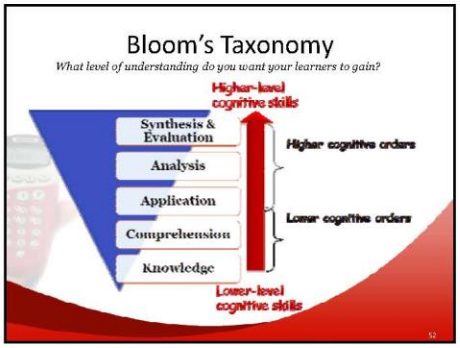

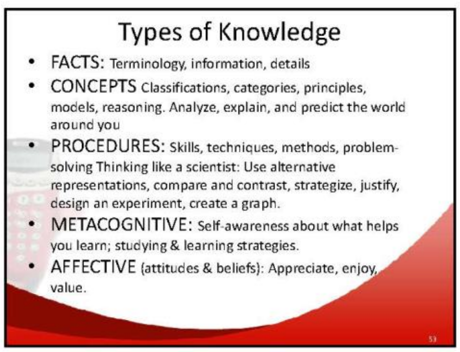

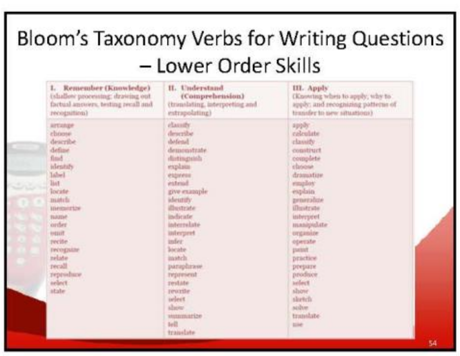

I. Remember (Knowledge) (shallow processing: drawing out factual answers, testing recall and recognition)	II. Understand (Comprehension) (translating, interpreting and extrapolating)	III. Apply (Knowing when to apply; why to apply; and recognizing patterns of transfer to new situations)
arrange choose describe define find identify label list locate match memorize name order omit recite recognize relate recall reproduce select state	classify describe defend demonstrate distinguish explain express extend give example identify illustrate indicate interrelate interpret infer locate match paraphrase represent restate rewrite select show summarize tell translate	apply calculate classify construct complete choose dramatize employ explain generalize illustrate interpret manipulate organize operate paint practice prepare produce select show sketch solve translate use

Day two: Writing Great ARS Questions

Bloom's Taxonomy Verbs for Writing Questions – Higher Order Skills

IV. Analyze (breaking down into parts, forms)	V. Evaluate (according to some set of criteria, and state why)	VI. Create (Synthesis) (combining elements into a pattern not clearly there before)
analyze	appraise	arrange
apprase	argue	assemble
calculate	assess	collect
categorize	choose	choose
classify	compare	combine
compare	criticize	compose
contrast	critique	construct
discriminate	decide	create
differentiate	debate	design
distinguish	defend	develop
examine	determine	do
experiment	discuss	formulate
identify	estimate	hypothesize
infer	evaluate	invent
investigate	judge	make
point out	justify	make up
question	predict	originate
select	prioritize	organize
separate	rate	prepare
subdivide	recommend	plan
survey	select	produce
test	support	propose
	value	role play
	weigh	tell
		write

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Question Dissection

Question #	Type of knowledge (facts, concepts, procedures, metacognitive, beliefs)	(Optional) Bloom's Level?

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We're going to practice writing questions now

- Give a learning goal
- Draft a few questions "on something you'll teach next week"
- Work with a neighbor to revise the question (use the Question Dissection matric to determine the type of knowledge involved in your questions.
- Can you modify your questions to assess higher order skills?

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Action Plan Discussion

Take 10 to 15 minutes to write down your action plan to implement ideas you heard about in this workshop and discuss your plan with your neighbors.

- What are you planning to do with the technology?
- Is your plan feasible?
- What resources you may need to implement your plan?

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Action Plan Discussion

- What additional ideas, questions, or concerns do you have about teaching effective question writing techniques?
- Do you think this will work with your faculty?

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Questions?

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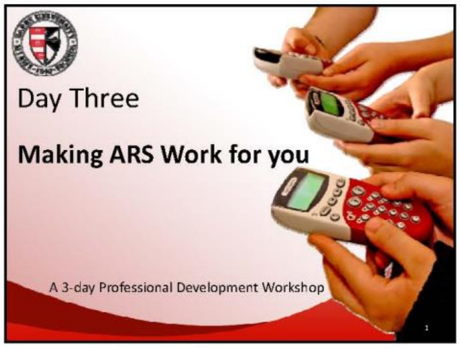

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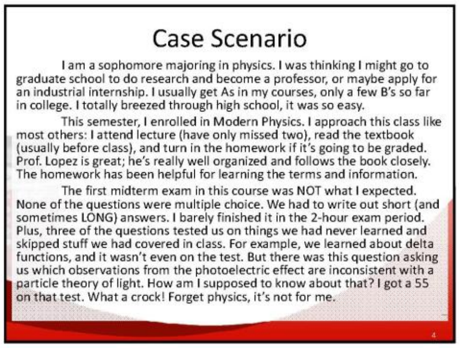

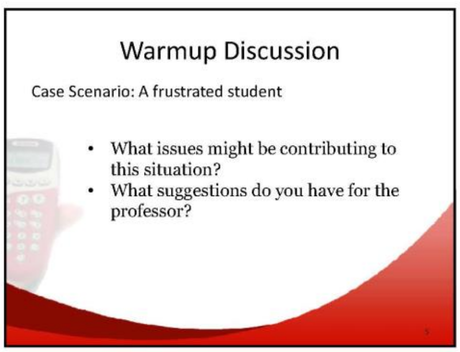

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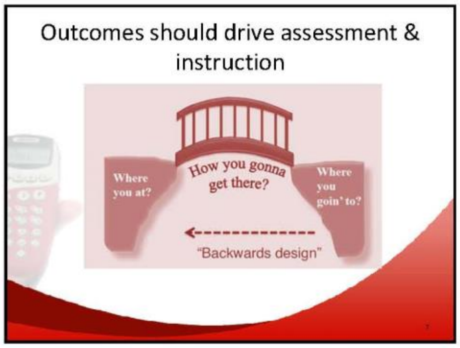

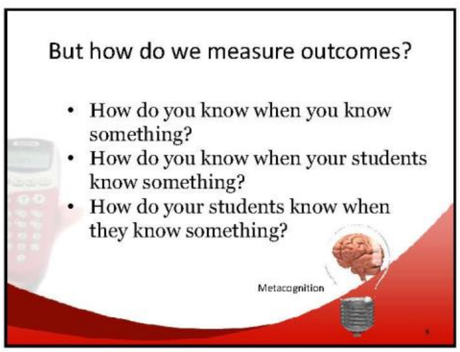

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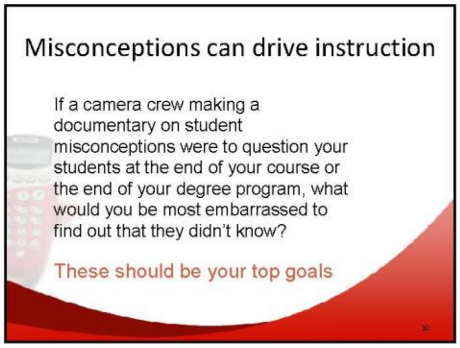

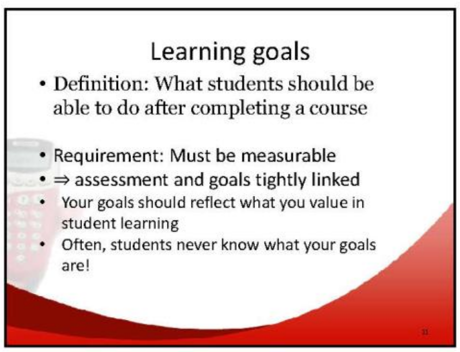

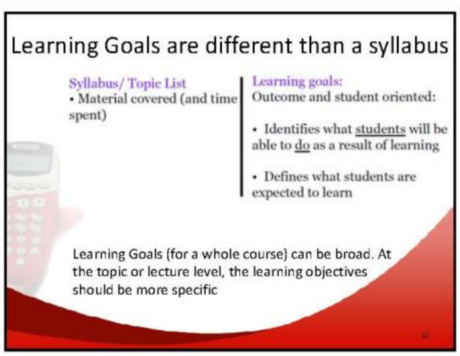

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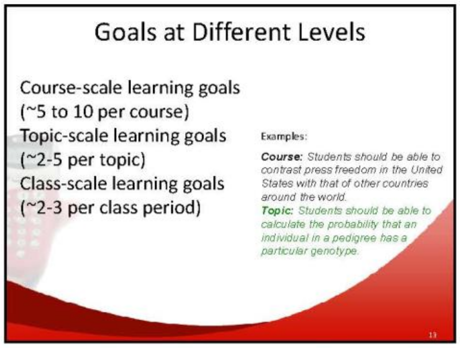

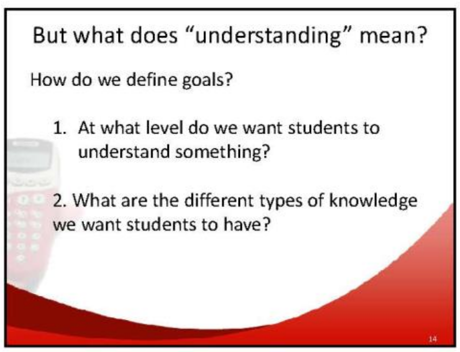

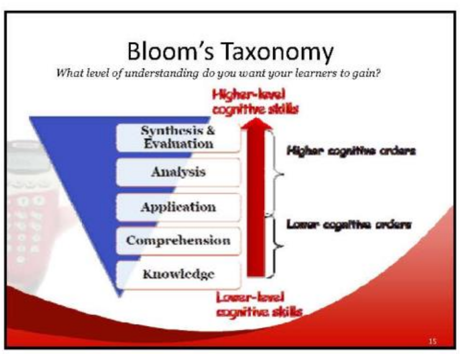

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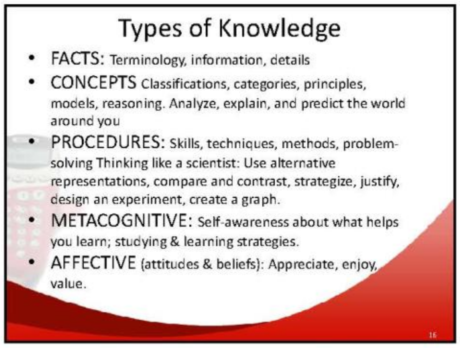

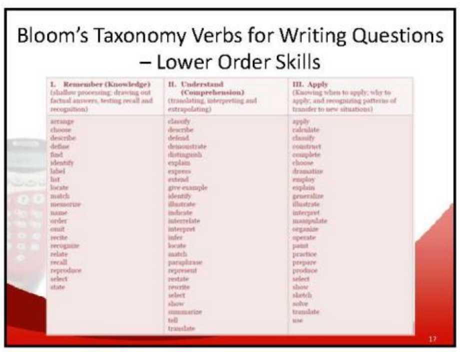

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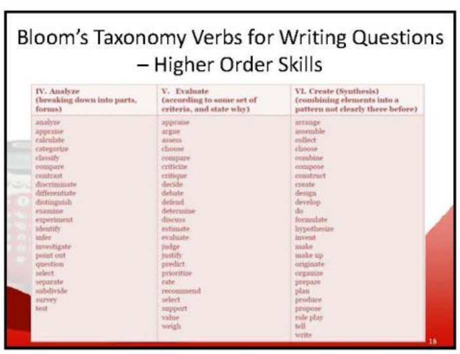
choose	describe	calculate
describe	defend	classify
define	demonstrate	construct
find	distinguish	complete
identify	explain	choose
label	express	dramatize
list	extend	employ
locate	give example	explain
match	identify	generalize
memorize	illustrate	illustrate
name	indicate	interpret
order	interrelate	manipulate
omit	interpret	organize
recite	infer	operate
recognize	locate	paint
relate	match	practice
recall	paraphrase	prepare
reproduce	represent	produce
select	restate	select
state	rewrite	show
	select	sketch
	show	solve
	summarize	translate
	tell	use
	translate	



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compare	criticize	compose
contrast	critique	construct
discriminate	decide	create
differentiate	debate	design
distinguish	defend	develop
examine	determine	do
experiment	discuss	formulate
identify	estimate	hypothesize
infer	evaluate	invent
investigate	judge	make
point out	justify	make up
question	predict	originate
select	prioritize	organize
separate	rate	prepare
subdivide	recommend	plan
survey	select	produce
test	support	propose
	value	role play
	weigh	tell
		write

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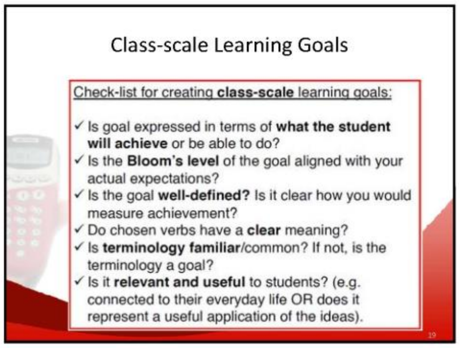

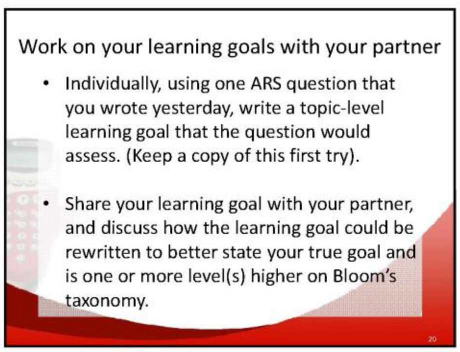

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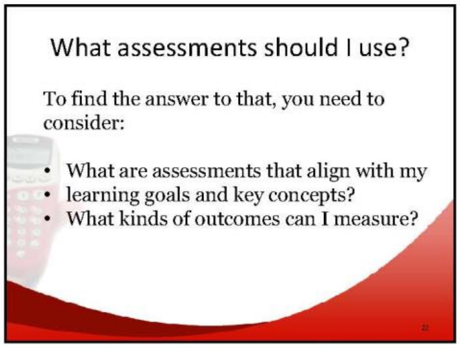
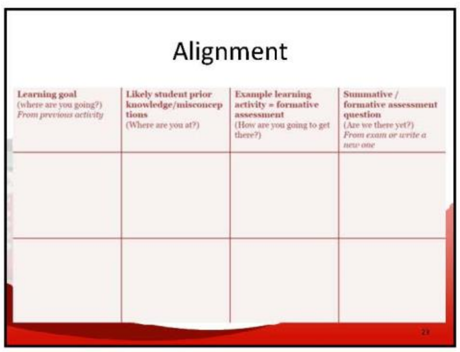
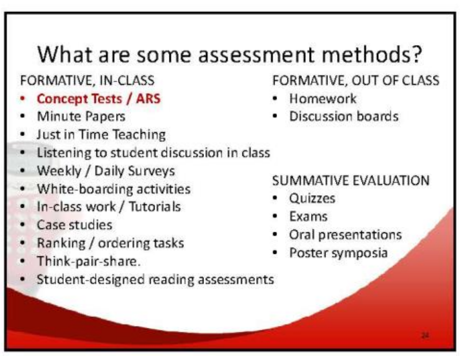
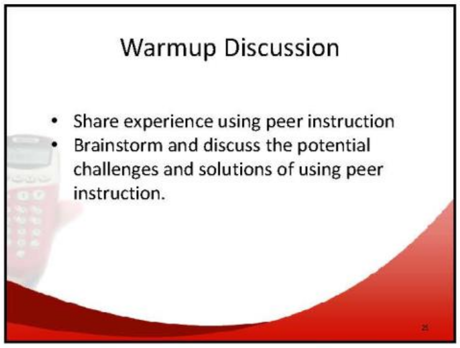
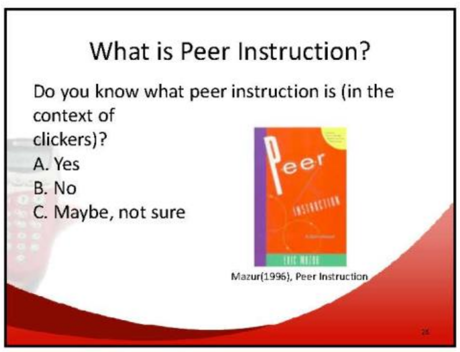


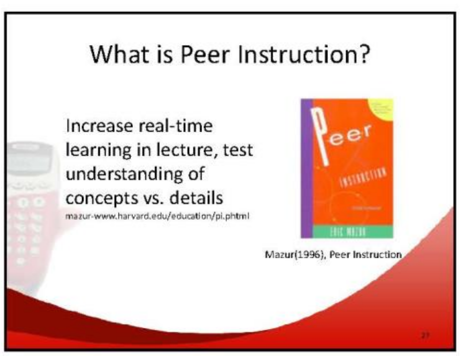




Day three: Making ARS Work for You







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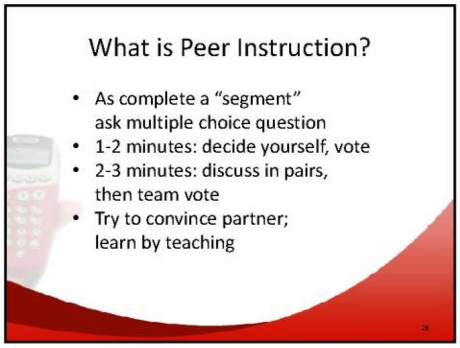

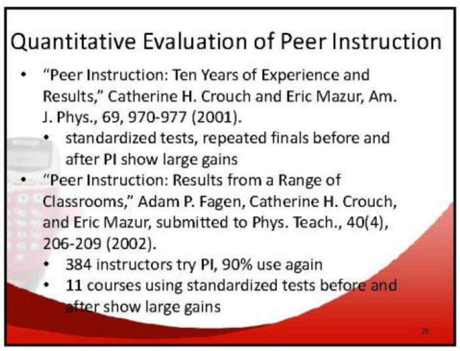

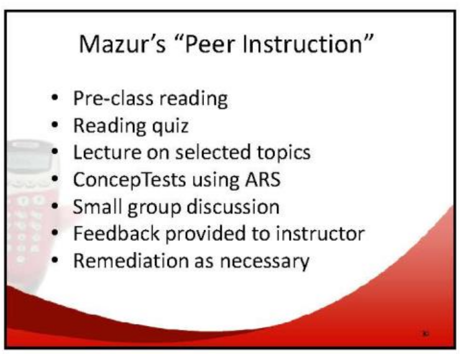

Day three: Making ARS Work for You

Peer Instruction Procedure 1

- Assign reading & write reading quiz.
- Prepare limited lecture outline (3-4 topics) from reading.
- Prepare ConcepTest questions:
  - Single concept per question
  - Qualitative questions
  - Adequate M.C. foils (based on preconceptions)
  - Unambiguous wording
  - Neither too easy nor too hard

Peer Instruction Procedure 2

- Lecture (approx. 15 min. per topic)
  - 7-10 min. for lecturing
  - 5-8 min. for ConcepTest)
- Demonstrations (if applicable)
  - Not part of lecture
  - Related to ConcepTest questions
- Examinations contain:
  - Concept questions

Conducting ConcepTests

- Students view question, reflect on answers.
- Students record individual responses on ARS.
- Students share responses and gather in small groups to work out detail.
- A single group response is given.
- Instructor responds to groups.

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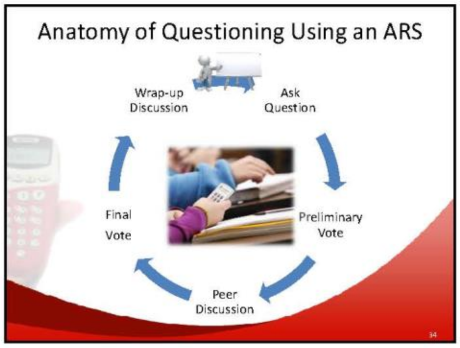

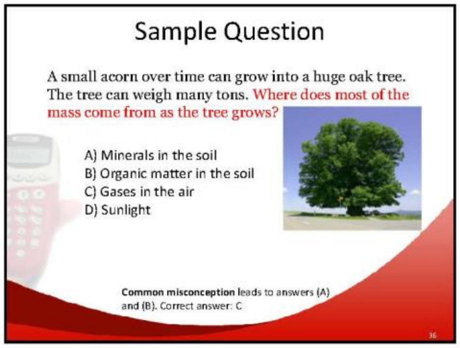

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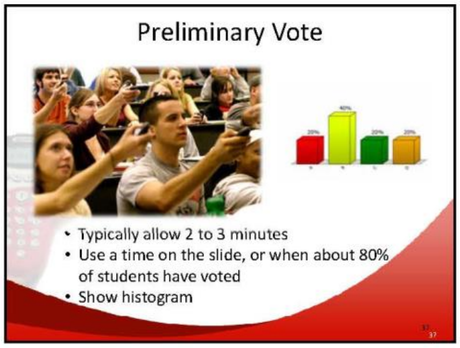

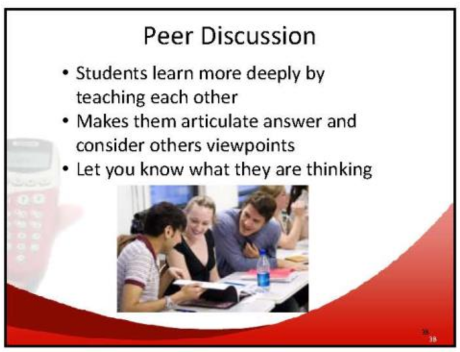

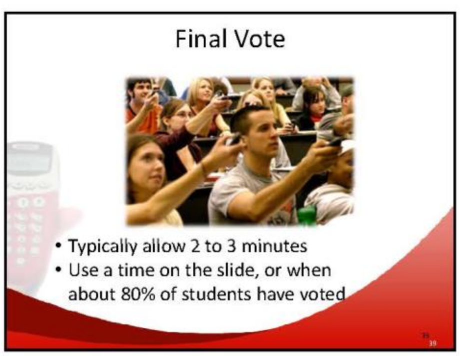

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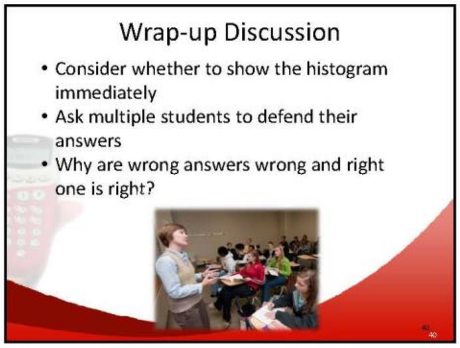

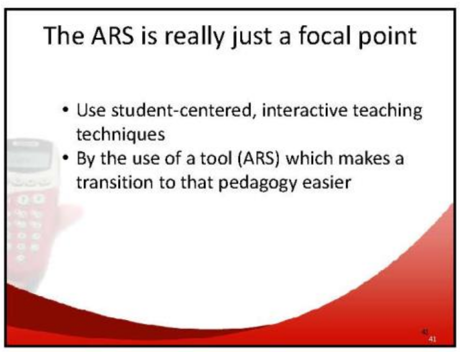

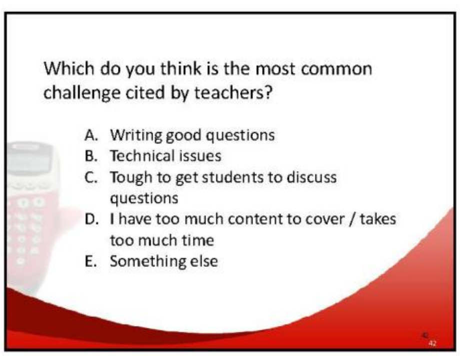

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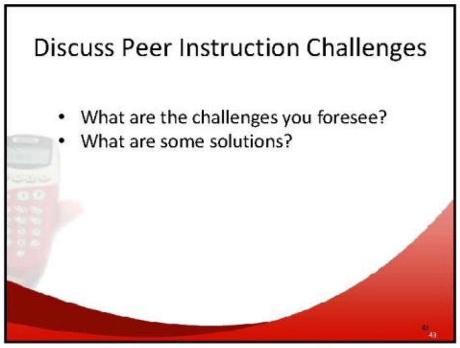

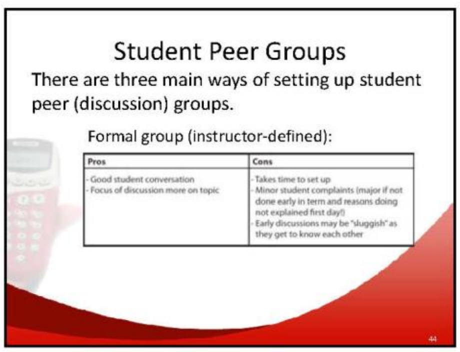

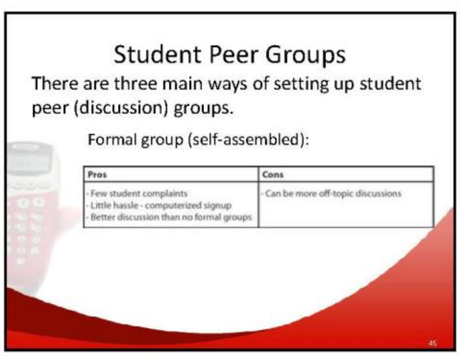

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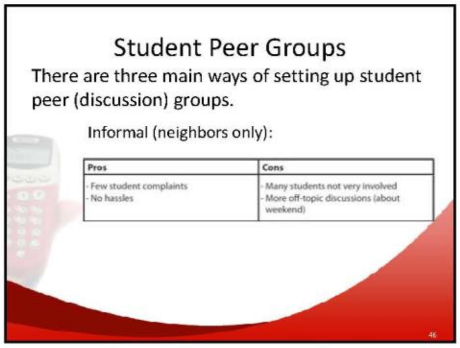

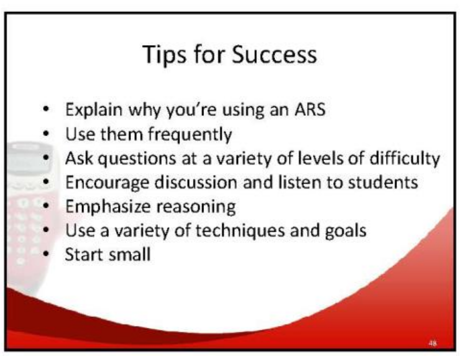

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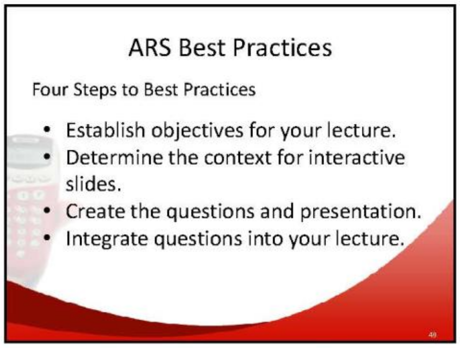

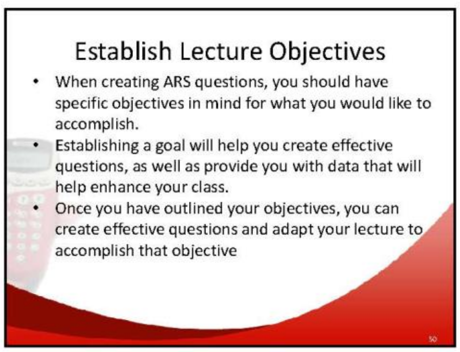

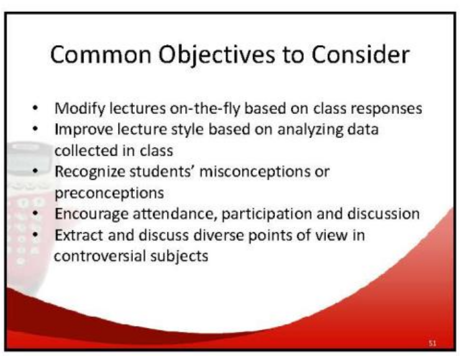

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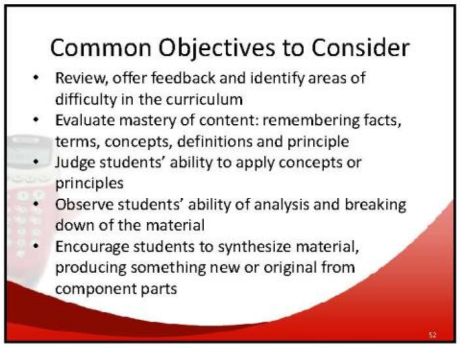

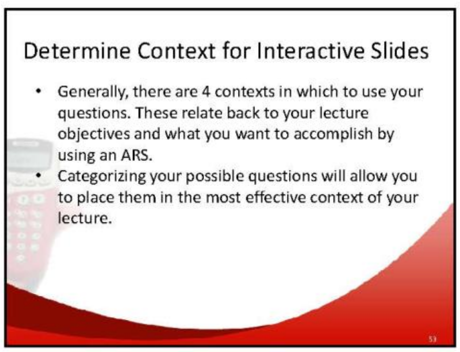

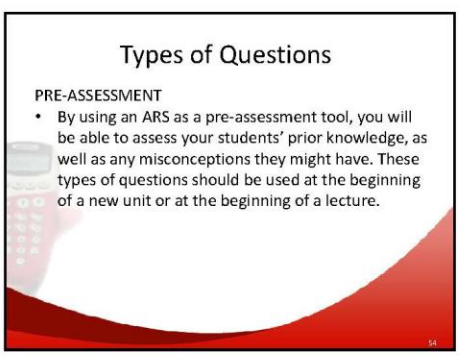

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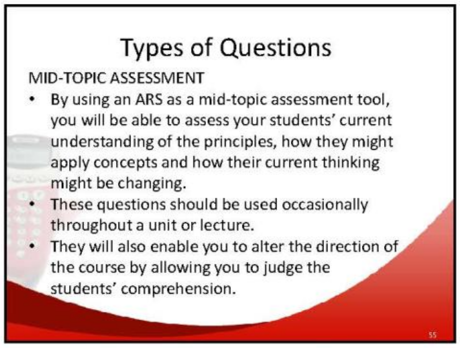

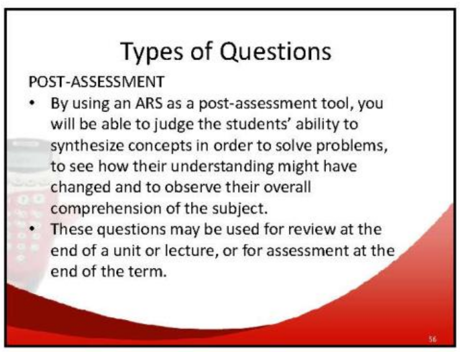

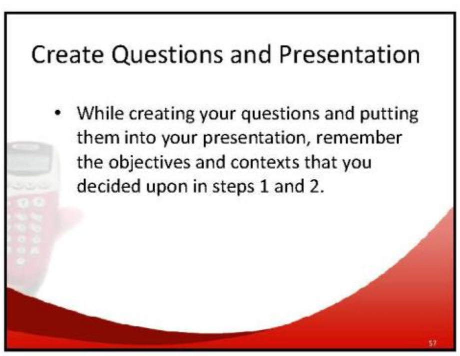

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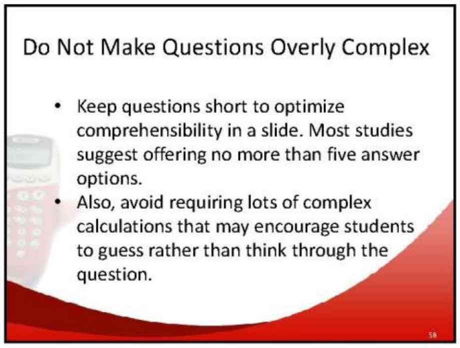

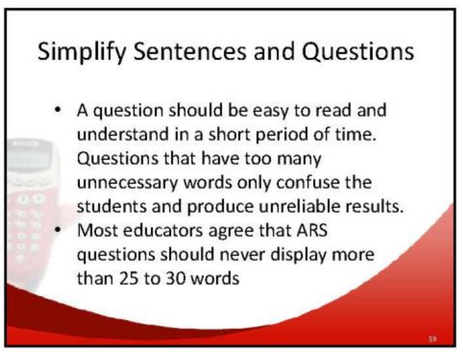

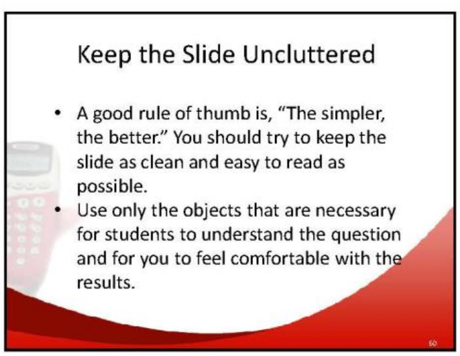

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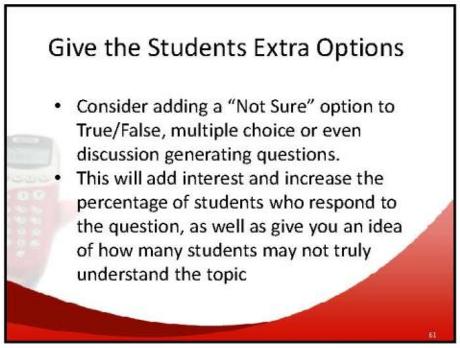

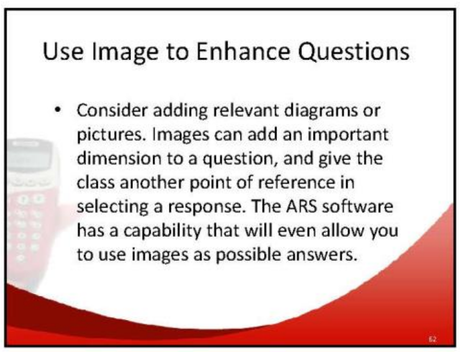

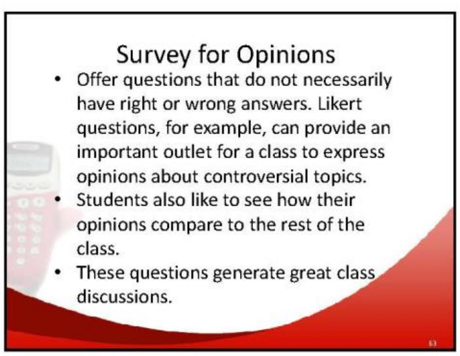

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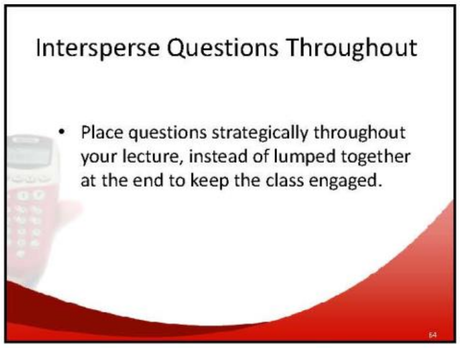

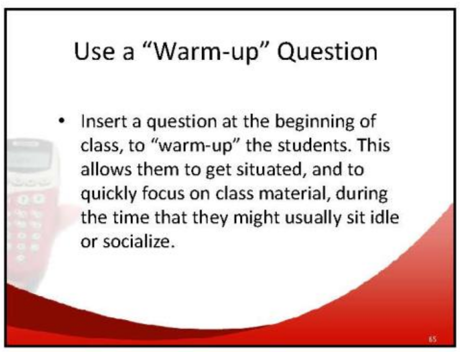

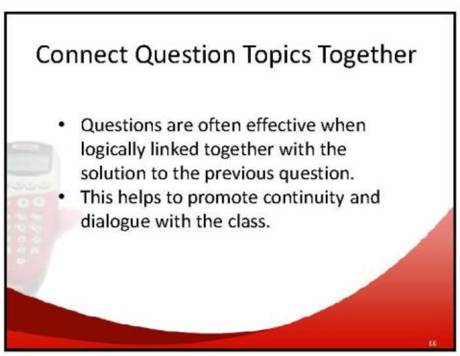

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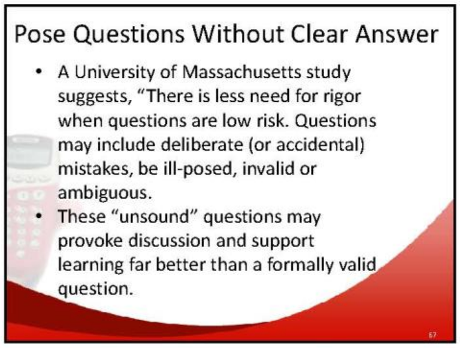

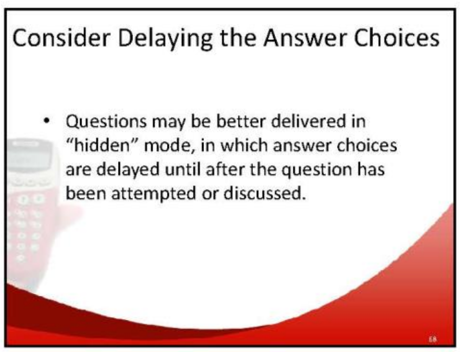

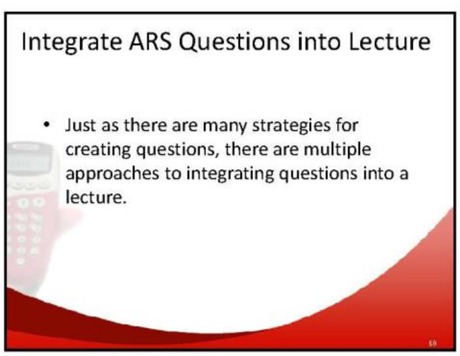

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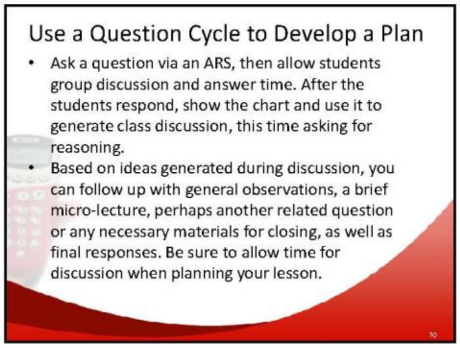

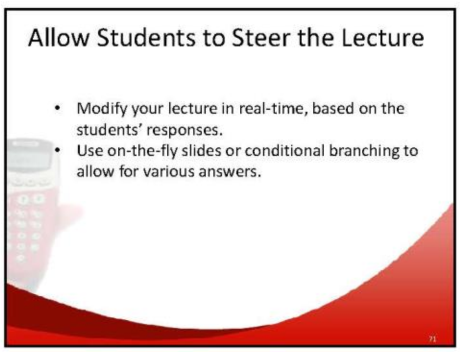

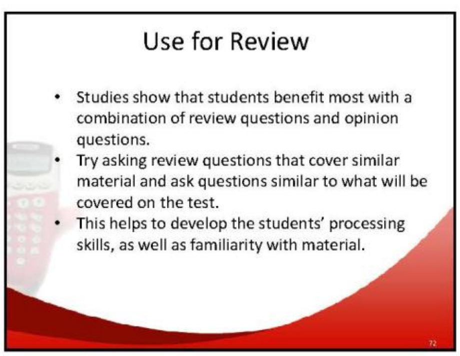

Day three: Making ARS Work for You

Additional Considerations

- Provide clear instruction to the class
- Test everything ahead of time
- Do not over use the system
- Allot extra time for your presentation

Turning Technologies, LLC Best Practices Retrieved on October 23, 2006. http://www.turningtechnologies.com/higher educationinteractivelearning/bestpractices.cfm.

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Action Plan Discussion

Take 10 to 15 minutes to write down your action plan to implement ideas you heard about in this workshop and discuss your plan with your neighbors.

- Which tools, strategies or resources from today's workshop will be most helpful to you in teaching this semester or in the near future?

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Action Plan Discussion

- Think of your last few lectures. What topics have you struggled to teach? With your neighbors, brainstorm ways to address this struggle using learning goals and ARS. Next time you teach, try one of the strategies that you and your colleague identify. How will you know if the strategy is successful? What will you observe or measure?

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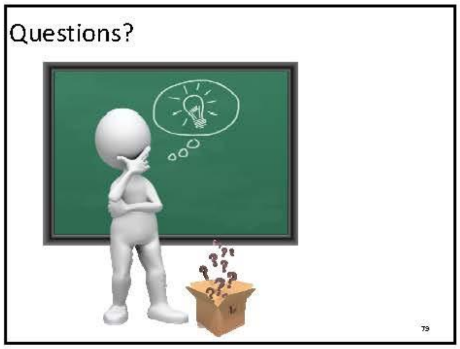
Day three: Making ARS Work for You



Appendix B: Perceptions of Adopting an Information Technology Innovation

Perceptions of Adopting an Information Technology Innovation

Adapted from "Development of an instrument to measure the perceptions of adopting an information technology innovation" by G. C. Moore and I. Benbasat, 1991.
The objective of this survey is to identify factors that influence faculty's use of instructional technology, specifically the audience response system (ARS) in the delivery of instruction.

The audience response system appears in the literature under different names, some examples of which are classroom response system (CRS), student response system (SRS), clicker, and classroom polling system. These commercially available systems are remarkably similar in form and in function. They are generally made up of a combination of software and hardware for the purpose of presenting questions, recording responses, and providing immediate feedback (Kay & LeSage, 2009a).

Your participation in this research is strictly voluntary. Your completion and submission of the questionnaire indicate your consent to participate in the study.

PLEASE DO NOT IDENTIFY YOURSELF ON THIS SURVEY. ALL INDIVIDUAL RESPONSES WILL REMAIN CONFIDENTIAL. ONLY THE AGGREGATE RESULTS WILL BE REPORTED.

Thank you for participating in this survey.

Part I. Demographic Information

Q1. Have you been teaching any on-campus class within the past 12 months?

- ☐ Yes
- ☐ No (If your answer is no, you will not be included in this study. Thank you for your time.)

Q2. Gender

- ☐ Male
- ☐ Female

Q3. Age

- ☐ 75 or older
- ☐ 65-74
- ☐ 55-64

- ☐ 45-54
- ☐ 35-44
- ☐ 25-34
- ☐ Under 25 years old

Q4. Highest degree held:
- ☐ Doctorate
- ☐ Masters
- ☐ Bachelors
- ☐ Other (please specify) _______________

Q5. Please indicate your current employment status:
- ☐ Full-time
- ☐ Part-time/adjunct

Q6. Please indicate your current academic rank:
- ☐ Full Professor
- ☐ Associate Professor
- ☐ Assistant Professor
- ☐ Instructor

Q7. How many years have you taught at university level?
- ☐ 40 years or more
- ☐ 35-39 years
- ☐ 30-34 years
- ☐ 25-29 years
- ☐ 20-24 years
- ☐ 15-19 years
- ☐ 10-14 years
- ☐ 5-9 years
- ☐ 0-4 years

Q8. How many years have you taught at your current department?
- ☐ 40 years or more
- ☐ 35-39 years
- ☐ 30-34 years
- ☐ 25-29 years
- ☐ 20-24 years
- ☐ 15-19 years
- ☐ 10-14 years

- ☐ 5-9 years
- ☐ 0-4 years

Q9. At this time, do you consider yourself an adopter of the ARS?

(For the purpose of this study, an adopter is defined as a faculty member who has made the decision to make use of ARS in his/her teaching when the use of it is deemed appropriate. Please note that the current study is not designed to investigate the actual implementation of ARS; therefore, an adopter is not necessarily a current user of the technology.)

- ☐ Yes
- ☐ No

Q10. Please select which of the following statements best describes your disposition toward the adoption of change:

- ☐ I consider myself traditional. I often refer to past for your guidance and resist innovations until certain that it will not fail.
- ☐ I consider myself cautious about change. I often require convincing of the economic necessity of a change, and I am uncomfortable with uncertainty.
- ☐ I consider all consequences fully and frequently interact with my peers. I am willing to change to a new way or method, but not willing to be a leader in the process.
- ☐ I consider myself judicious when it comes to innovation decisions. I decrease uncertainty by fully evaluating something new, and I often use interpersonal networks within my immediate area to gain more information.
- ☐ I consider myself venturesome. I am often obsessed with trying new things and seeking information outside of the immediate area.

Part II. Perceptions of adopting an Information Technology Innovation. For this study, you will consider the following innovation:

Audience Response System (ARS) – TurningPoint polling system

Please circle the number that best represents how you feel about each statement.

Relative Advantage

Q11. Using the ARS enables me to accomplish tasks more quickly.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q12. Using the ARS improves the quality of work I do.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q13. Using the ARS makes it easier to do my job.
0Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q14. Using the ARS enhances my effectiveness on the job.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q15. Using the ARS gives me greater control over my work.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Compatibility
Q16. Using the ARS is compatible with all aspects of my teaching.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q17. I think that using the ARS fits well with the way I like to teach.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q18. Using the ARS fits my teaching style.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Complexity/Ease of Use
Q19. I believe that the ARS is cumbersome to use.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q20. My using the ARS requires substantial mental efforts.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q21. Using the ARS is often frustrating.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q22. I believe that it is easy to get the ARS to do what I want it to do.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q23. Overall, I believe that the ARSs are easy to use.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q24. Learning to operate the ARS is easy for me.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Observability
Q25. I would have no difficulty telling others about the results of using the ARS.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q26. I believe I could communicate to others the consequences of using the ARS.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q27. The results of using the ARS are apparent to me.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q28. I would have difficulty explaining77 why using the ARS may or may not be beneficial.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q29. I have seen what others can do with the ARS.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q30. In my organization, ARS is used in many classes.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q31. ARSs are not very visible in my organization.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q32. It is easy for me to observe others using the ARS.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Trialability
Q33. I have had many opportunities to try out the ARS.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q34. I know where I can go trying out various functions of the ARS.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q35. The ARS is available to me to test run in various classes.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q36. Before deciding whether to use the ARS, I am able to try it out.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Q37. I am permitted to use the ARS on a trial basis long enough to see what it can do.
Strongly Disagree ---1---2---3---4---5---6---7—Strongly Agree

Thank you for your participation.

Please provide any additional comments you may have regarding your experience on and perceptions of adopting audience response system (ARS) in the higher education classrooms.

Comments:

____

____

____

____

Appendix C: Email Approval to Use Survey Instrument

izak.benbasat@sauder.ubc.ca
to Tan Fung Chan

Thu, Oct 24 11:12 AM

Re: Permission to use Adoption and Diffusion Survey Instrument

1 file attached

[redacted]

Mr Chan:

You may the use the adoption instrument for academic research.

Best wishes.

Izak Benbasat, Professor
Sauder School of Business
University of British Columbia
Vancouver, Canada V6T 1Z2
604 822 8396

On Oct 24, 2013, at 8:06, "Chan, Tan Fung" <TChan@[redacted]edu> wrote:

> Dr. Benbasat,
>
> I am a doctoral student at Walden University and I am in the process of preparing a data collection instrument for my research study. I came across the instrument you published back in 1991. I think it matches quite well with the purpose for my study. My research aims at investigating the relationships among the factors related to the adoption and diffusion of instructional technology by faculty members. If accepted, I would like to use your instrument in my study. I would very much appreciate if this request meets your favorable response. Looking forward to hearing from you.
>
> Cordially,
>
> **Ivan T. F. Chan, OTD., OTR/L**
> Assistant Professor
> Master of Science Program
> In Occupational Therapy
> College of Health Sciences
>
> tchan@[redacted]edu

Appendix D: Email – Cover Letter and Instructions

Dear. Dr./Mr. ______________

I am asking for your participation in my doctoral dissertation research. My research focuses on faculty's perceived attributes of the audience response system. The results of the study will help us understand the adoption decision process. The audience response system is known under different names, some examples of which are classroom response system (CRS), student response system (SRS), clicker, and classroom polling system. The commercial units that are available through the workplace and instructional technology services (WITs) are from Turning Technology.

You are asked to complete a 37-item web-based survey, which should take approximately 10 to 15 minutes of your time. Please complete the survey within one week. Any comments that you have may be placed on designated comment section on the survey questionnaire. In order to protect your privacy, no identifying information will be collected. Your participation is strictly anonymous and voluntary. Therefore, please do not indicate your name on the questionnaire. The anonymity and confidentiality of your responses will be assured because only aggregated data will be presented in my doctoral dissertation. There are no known risks involved in being a part of this project.

Your participation in this research is strictly voluntary. Your completion and submission of the questionnaire indicate your consent to participate in the study.

The website for the survey is http://www.surveymonkey.com/_______________. You can simply click the provided link to go directly to the survey. If the link does not work, "copy and paste" the address into the address bar of your internet browser.

If you have additional questions about the study, you can direct your question to the researcher, Ivan T. F. Chan, at tanfungivan.chan@waldenu.edu. If I have questions about participant's rights, you can contact ____________________, Institutional Review Board, at ____________________.

Thank you for your participation in this survey research.

Ivan T. F. Chan, OTD., OTR/L
Assistant Professor
Master of Science Program
In Occupational Therapy
College of Nursing and Health Sciences

tchan@[redacted].edu
(305) 899-3213/3374
Fax (305) 899-2958

Appendix E: Follow-up Email Reminder

Dr./Mr. ___________________

An invitation to participate in an important survey of faculty member's perceived attributes of audience response system was sent to you last week. You are asked to complete a 37-item web-based survey, which should take approximately 10 to 15 minutes of your time. Please provide your feedback on your perceptions on the instruction technology. If you wish to participate in research, please complete the survey by _______________.

The website for the survey is http://www.surveymonkey.com/_______________. Simply click this link to go directly to the survey. If the link does not work, "copy and paste" this address into the address bar of your Internet Browser. Your participation in this research is strictly voluntary. Your completion and submission of the questionnaire indicate your consent to participate in the study.

If you have additional questions about the study, you can direct your question to the researcher, Ivan T. F. Chan, at tanfungivan.chan@waldenu.edu. If I have questions about participant's rights, you can contact ____________________, Institutional Review Board, at ____________________.

Thank you for your participation in this survey research.

Ivan T. F. Chan, OTD., OTR/L
Assistant Professor
Master of Science Program
In Occupational Therapy
College of Nursing and Health Sciences

tchan@[redacted].edu
(305) 899-3213/3374
Fax (305) 899-2958

Appendix F: Facility IRB Approval

[redacted] University
Division of Academic Affairs

Institutional Review Board
[redacted]

Research with Human Subjects
Protocol Review

Date:	January 12, 2015
Protocol Number:	150102
Title:	Faculty Adoption of Instructional Technology
Name:	Dr. Tan Fung Ivan Chan
Address:	c/o Occupational Therapy [redacted]
Sponsor:	NA

Dear Dr. Chan:

Your protocol has been reviewed and accepted as exempt from further review. You may proceed with data collection

As principal investigator of this protocol, it is your responsibility to make sure that this study is conducted as approved by the IRB. Any modifications to the protocol or consent form, initiated by you or by the sponsor, will require prior approval, which you may request by completing a protocol modification form.

It is a condition of this approval that you report promptly to the IRB any serious, unanticipated adverse events experienced by participants in the course of this research, whether or not they are directly related to the study protocol. These adverse events include, but may not be limited to, any experience that is fatal or immediately life-threatening, is permanently disabling, requires (or prolongs) inpatient hospitalization, or is a congenital anomaly cancer or overdose.

The approval granted expires on December 1, 2015. Should you wish to maintain this protocol in an active status beyond that date, you will need to provide the IRB with and IRB Application for Continuing Review (Progress Report) summarizing study results to date.

If you have questions about these procedures, or need any additional assistance from the IRB, please call the IRB point of contact, Mrs. [redacted] or send an e-mail to [redacted].edu. Finally, please review your professional liability insurance to make sure your coverage includes the activities in this study.

Sincerely,

[redacted]

Note: The investigator will be solely responsible and strictly accountable for any deviation from or failure to follow the research protocol as approved and will hold [redacted] University harmless from all claims against it arising from said deviation or failure.

Appendix G: Walden University IRB approval

IRB@waldenu.edu Mon, Feb 16 7:08 PM
to tanfungivan.chan@waldenu.edu
cc Marianne Elizabeth Borja; IRB@waldenu.edu

IRB Materials Approved - Tan Fung Chan

1 file attached

CoverLetterEmail_Fol...
.docx 16.8 KB

Dear Mr. Chan,

This email is to notify you that the Institutional Review Board (IRB) confirms that your study entitled, "Faculty Adoption of Instructional Technology," meets Walden University's ethical standards. Our records indicate that the site's IRB agreed to serve as the IRB of record for this data collection. Since this study will serve as a Walden doctoral capstone, the Walden IRB will oversee your capstone data analysis and results reporting. The IRB approval number for this study is 02-16-15-0297465.

Please note, the attached cover letter and follow up email should be used, as per previous feedback Walden University's approval number should not be included.

This confirmation is contingent upon your adherence to the exact procedures described in the final version of the documents that have been submitted to IRB@waldenu.edu as of this date. This includes maintaining your current status with the university and the oversight relationship is only valid while you are an actively enrolled student at Walden University. If you need to take a leave of absence or are otherwise unable to remain actively enrolled, this is suspended.

If you need to make any changes to your research staff or procedures, you must obtain IRB approval by submitting the IRB Request for Change in Procedures Form. You will receive confirmation with a status update of the request within 1 week of submitting the change request form and are not permitted to implement changes prior to receiving approval. Please note that Walden University does not accept responsibility or liability for research activities conducted without the IRB's approval, and the University will not accept or grant credit for student work that fails to comply with the policies and procedures related to ethical standards in research.

When you submitted your IRB materials, you made a commitment to communicate both discrete adverse events and general problems to the IRB within 1 week of their occurrence/realization. Failure to do so may result in invalidation of data, loss of academic credit, and/or loss of legal protections otherwise available to the researcher.

Both the Adverse Event Reporting form and Request for Change in Procedures form can be obtained at the IRB section of the Walden website:
http://academicguides.waldenu.edu/researchcenter/orec

Researchers are expected to keep detailed records of their research activities (i.e., participant log sheets, completed consent forms, etc.) for the same period of time they retain the original data. If, in the future, you require copies of the originally submitted IRB materials, you may request them from Institutional Review Board.

Both students and faculty are invited to provide feedback on this IRB experience at the link below:

http://www.surveymonkey.com/s.aspx?sm=qHBJzkJMUx43pZegKlmdiQ_3d_3d

Sincerely,
Libby Munson
Research Ethics Support Specialist
Office of Research Ethics and Compliance

Email: irb@waldenu.edu
Fax: 626-605-0472
Phone: 612-312-1283

Office address for Walden University:
100 Washington Avenue South, Suite 900
Minneapolis, MN 55401

Information about the Walden University Institutional Review Board, including instructions for application, may be found at this link:
http://academicguides.waldenu.edu/researchcenter/orec

Appendix H: Raw Data Tables

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.927
Bartlett's Test of Sphericity	Approx. Chi-Square	5030.842
	df	276
	Sig.	.000

Reliability

Scale: Relative Advantage

Case Processing Summary

		N	%
Cases	Valid	201	100.0
	Excluded[a]	0	.0
	Total	201	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.935	5

Reliability

Scale: Compatibility

Case Processing Summary

		N	%
Cases	Valid	201	100.0
	Excluded[a]	0	.0
	Total	201	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.865	3

Reliability

Scale: Complexity

Case Processing Summary

		N	%
Cases	Valid	201	100.0
	Excluded[a]	0	.0
	Total	201	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.938	6

Reliability

Scale: Observability

Case Processing Summary

		N	%
Cases	Valid	201	100.0
	Excluded[a]	0	.0
	Total	201	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.891	5

Reliability

Scale: Trialability

Case Processing Summary

		N	%
Cases	Valid	201	100.0
	Excluded[a]	0	.0
	Total	201	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.928	5

Case Processing Summary

		N	%
Cases	Valid	201	100.0
	Excluded[a]	0	.0
	Total	201	100.0

a. Listwise deletion based on all variables in the procedure.

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	118	58.7	58.7	58.7
	Female	83	41.3	41.3	100.0
	Total	201	100.0	100.0	

Correlations

		RelativeAdvantage	Compatibility	Complexity	Observability	Trialability
RelativeAdvantage	Pearson Correlation	1	.829**	-.605**	.569**	.483**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	201	201	201	201	201
Compatibility	Pearson Correlation	.829**	1	-.588**	.643**	.539**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	201	201	201	201	201
Complexity	Pearson Correlation	-.605**	-.588**	1	-.541**	-.560**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	201	201	201	201	201
Observability	Pearson Correlation	.569**	.643**	-.541**	1	.584**

	Sig. (2-tailed)	.000	.000	.000		.000
	N	201	201	201	201	201
Trialability	Pearson Correlation	.483**	.539**	-.560**	.584**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	201	201	201	201	201

**. Correlation is significant at the 0.01 level (2-tailed).

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	RelativeAdvantage	.292	3.430
	Compatibility	.263	3.803
	Complexity	.525	1.906
	Observability	.496	2.017
	Trialability	.562	1.780

a. Dependent Variable: AtthistimedoyouconsideryourselfanadopteroftheARS

Mann-Whitney Test

Ranks

	AtthistimedoyouconsideryourselfanadopteroftheARS	N	Mean Rank	Sum of Ranks
RelativeAdvantage	Non-adopter	164	88.48	14510.50
	Adopter	37	156.50	5790.50
	Total	201		
Compatibility	Non-adopter	164	87.72	14386.50
	Adopter	37	159.85	5914.50
	Total	201		
Complexity	Non-adopter	164	112.41	18435.00
	Adopter	37	50.43	1866.00

	Total	201		
	Non-adopter	164	89.91	14746.00
Observability	Adopter	37	150.14	5555.00
	Total	201		
	Non-adopter	164	88.70	14546.00
Trialability	Adopter	37	155.54	5755.00
	Total	201		

Test Statistics[a]

	RelativeAdvantage	Compatibility	Complexity	Observability	Trialability
Mann-Whitney U	980.500	856.500	1163.000	1216.000	1016.000
Wilcoxon W	14510.500	14386.500	1866.000	14746.000	14546.000
Z	-6.439	-6.848	-5.862	-5.697	-6.358
Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.000

a. Grouping Variable: AtthistimedoyouconsideryourselfanadopteroftheARS

Logistic Regression

Case Processing Summary

Unweighted Cases[a]		N	Percent
	Included in Analysis	201	100.0
Selected Cases	Missing Cases	0	.0
	Total	201	100.0
Unselected Cases		0	.0
Total		201	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
Non-adopter	0
Adopter	1

Block 0: Beginning Block

Classification Table[a,b]

	Observed		Predicted		
			Atthistimedoyouconsideryourselfana dopteroftheARS		Percentage Correct
			Non-adopter	Adopter	
Step 0	Atthistimedoyouconsideryourself anadopteroftheARS	Non-adopter	164	0	100.0
		Adopter	37	0	.0
	Overall Percentage				81.6

a. Constant is included in the model. b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-1.489	.182	66.928	1	.000	.226

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	RelativeAdvantage	45.438	1	.000
		Compatibility	52.505	1	.000
		Complexity	40.260	1	.000
		Observability	29.574	1	.000
		Trialability	57.993	1	.000

	Overall Statistics	74.300	5	.000

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	80.544	5	.000
	Block	80.544	5	.000
	Model	80.544	5	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	111.421[a]	.330	.537

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	10.258	8	.247

Contingency Table for Hosmer and Lemeshow Test

		AtthistimedoyouconsideryourselfanadopteroftheARS = Non-adopter		AtthistimedoyouconsideryourselfanadopteroftheARS = Adopter		Total
		Observed	Expected	Observed	Expected	
Step 1	1	20	19.930	0	.070	20
	2	19	19.825	1	.175	20
	3	20	19.604	0	.396	20
	4	20	19.308	0	.692	20
	5	18	18.878	2	1.122	20
	6	17	18.375	3	1.625	20

7	21	18.450	0	2.550	21
8	16	16.214	4	3.786	20
9	9	9.875	11	10.125	20
10	4	3.540	16	16.460	20

Classification Table[a]

	Observed		Predicted		
			AtthistimedoyouconsideryourselfanadopteroftheARS		Percentage Correct
			Non-adopter	Adopter	
Step 1	AtthistimedoyouconsideryourselfanadopteroftheARS	Non-adopter	160	4	97.6
		Adopter	12	25	67.6
	Overall Percentage				92.0

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	95% C.I.for EXP(B) Upper
Step 1[a]	RelativeAdvantage	.356	.384	.859	1	.354	1.427	.673	3.028
	Compatibility	.895	.393	5.185	1	.023	2.447	1.133	5.285
	Complexity	-.270	.255	1.119	1	.290	.764	.463	1.259
	Observability	-.154	.312	.243	1	.622	.857	.465	1.580
	Trialability	.452	.161	7.859	1	.005	1.572	1.146	2.156
	Constant	-6.918	2.287	9.146	1	.002	.001		

a. Variable(s) entered on step 1: RelativeAdvantage, Compatibility, Complexity, Observability, Trialability.

Correlation Matrix

		Constant	Relative Advantage	Compatibility	Complexity	Observability	Trialability
Step 1	Constant	1.000	-.217	-.159	-.762	-.386	-.211
	Relative Advantage	-.217	1.000	-.607	.125	-.189	.091
	Compatibility	-.159	-.607	1.000	-.012	-.260	-.021
	Complexity	-.762	.125	-.012	1.000	.205	.315
	Observability	-.386	-.189	-.260	.205	1.000	-.325
	Trialability	-.211	.091	-.021	.315	-.325	1.000

Casewise List[a]

a. The casewise plot is not produced because no outliers were found.