Chapter 3

Methods

This chapter provides the methodological context for this study, including descriptions of the participants, materials, procedure, and analysis. As mentioned in Chapter 1, the Innovation Adoption Profile (IAP) was designed to describe two phenomena associated with the macro-adoption of technology innovations in schools: the outcome of teachers' micro-adoption decisions and the possible post-adoption outcomes of using a technology innovation. As illustrated in the introduction, these phenomena are separate and distinct, occurring on either side of the decision stage in Rogers' (2003) model. Correspondingly, this study was designed in two phases and consequently the methods for each phase are presented separately. Each phase examined a separate stage of the Innovation Adoption Profile (IAP) model. Phase 1 examined Stage 1 of the IAP, which indicates teachers' micro-adoption decisions, and Phase 2 of the study examined Stage 2 of the IAP, which indicates the post-adoption outcomes of using a technological innovation.

Phase 1: Teachers' Micro-Adoptions

Research Design. Meyer (2004), representing the diffusion of innovation research tradition, calls the research design used in this study a "point-of-adoption" design as data were "gathered from respondents at the time they adopt the innovation rather than at some point in the future" (p. 64). Within the educational research tradition, the design for Phase 1 of this study is a one-group correlational design (Bernard, Brauer, Abrami, & Surkes, 2004), which, while lacking a comparison condition, is appropriate for examining the relationships among the indicators in the IAP.

Participants. Access to the participant pool was enabled through the researcher's previous relationship with the staff development coordinator for a large suburban school district near a large metropolitan area in the Southern United States. The staff development coordinator brought the research study proposal to the attention of the assistant superintendent for instruction, who authorized access to potential participants. Participants (N=105) who volunteered to participate in this research were among a larger pool of teachers (N=123) attending a series of introductory workshops on the use of software innovation in late April, early May, and mid-August, 2005. Workshop attendees were secondary school faculty in the school district. This district was selected because all high schools and one middle school were *laptop schools*, where each teacher and student had been provided with a district-owned laptop computer for use at home and at school during the school year. Laptop schools are a subset of schools that offer *one-to-one computing*. One-to-one computing is defined as "each student and teacher has one Internet-connected wireless computing device for use both in the classroom and at home" (Greaves & Hayes, 2006). The computers used in one-to-one computing initiatives are usually, but not always, laptops (some school districts deploy wireless handheld computers). During the 2005-2006 school year 24% of school districts in the United States had one-to-one computing initiatives in at least one grade (Greaves & Hayes, 2006). Thus, the district in this study, with all laptop high schools and a laptop middle school, provided a level of computer access that set the district apart from the mainstream of secondary schools across the United States at the time the study occurred. A district with laptop schools was selected because an a priori decision was made that the software

innovation used in this study was best suited to an environment where the level of access to computers was eliminated as a possible barrier.

Recruiting for the workshops was facilitated by the district's staff development coordinator and one of the high school principals. Invitations were delivered to all secondary school teachers via e-mail and through an invitation by the researcher at a faculty meeting at one of the high schools. The e-mail invitation included a description of the workshop, the study, and the informed consent information. The population invited to attend a workshop were teachers from all content areas at the district's six laptop schools (four high schools, an alternative learning center, and one middle school). Faculty from the district's other middle schools were also invited and participated, but their students did not have the same level of access to computers, as they had in-school access to computer labs.

Materials. Materials used during Phase 1 included four online survey instruments, a workshop presentation, the digital annotation software that served as the innovation of interest in the study, online support materials, an online form for participants to register their micro-adoption decision, a follow-up interview protocol, and a participation incentive.

Survey instruments. The IAP used four survey instruments to gather (a) demographic data about the participants, including three proxies for individual innovativeness (e.g., age, educational attainment, career moves), (b) individual innovativeness data via the Hurt-Joseph-Cook Innovativeness Scale (IS) (Hurt, Joseph, & Cook, 1977), (c) perceptions of organizational innovativeness via the Hurt-Teigen scale

of Perceived Organizational Innovativeness (PORGI) (Hurt & Teigen, 1977), and (d) the Perceived Characteristics of Innovating Scale (PCIS) (D. R. Compeau & Meister, 2003).

The demographic information included was (a) gender, (b) age, (c) school site, (d) subject taught, (e) highest level of educational attainment, and (f) the number of career-related changes. Participants were requested to provide age, educational attainment, and career-related changes as these were found to be related to innovativeness in previous studies as "proxy variables for willingness to take risks" (Tornatzky & Fleischer, 1990 , p. 192). Subject taught was collected because the RepliGo™ digital annotation software, the innovation used in this study, may have been a better match for some content areas than others (i.e., teachers of English might find annotation software of more use than teachers of mathematics). Gender was collected because there may have been differences between adopter/non-adopters based on gender. School site was collected to enable site-based analysis of the PORGI survey's school-related data.

The Hurt-Joseph-Cook Innovativeness Scale (IS) (Hurt, Joseph, & Cook, 1977) was developed to measure Rogers' (2003) construct of individual innovativeness, which is defined as "the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than the other members of a system" (p. 475). The IS was included in the study because it measures the individual innovativeness construct in the IAP model, had an acceptable reliability coefficients across multiple studies, and was found to be a significant predictor of technology use. The IS "has the potential to predict willingness to adopt innovations across populations and socioeconomic status" (Hurt, Joseph, & Cook, 1977, p. 63) and has reported reliability coefficients ranging from 0.86 to 0.90 (Hurt, Joseph, & Cook, 1977; Hurt & Teigen, 1977; Pallister & Foxall, 1998;

Simonson, 2000). In the field of learning technology, Marcinkiewicz (1994), van Braak (2001), and Vannatta and Fordham (2004) all used some form of the IS as an independent variable related to teachers' classroom computer use. Marcinkiewicz (1994) used a short form of the IS and reported teacher innovativeness was significantly related to teachers' classroom computer use. van Braak reported an administration of the IS to a sample of 557 teachers and reported the group "displayed characteristics of innovators or early adopters" (p. 44), while Vannatta and Fordham adapted five questions from the IS for use in detecting teachers' "openness to change" (p. 253) and found that the construct was a significant predictor of teachers' classroom technology use.

The IS consists of twenty questions and participants responded using a five-point Likert scale from "strongly disagree" to "strongly agree." The scoring procedure resulted in individuals being categorized into one of five groups that have been defined by Rogers (2003): (a) Innovators, (b) Early Adopters, (c) Early Majority, (d) Late Majority, and (e) Laggards/Traditionalists (Hurt, Joseph, & Cook, 1977; Rogers, 2003). The complete instrument, scoring procedure, and definitions of the innovativeness categories appear in Appendix A.

The Hurt-Teigen scale of Perceived Organizational Innovativeness (PORGI) measures innovativeness at the organizational level through self-reports from organization members. The PORGI is included in the study because it measures the perceived organizational construct in the IAP model, and, when combined with the results of the IS in a previous study (Hurt & Teigen, 1977), was a significant predictor of employee participation in the innovation-decision process. The subjects for the initial test of the PORGI were educators, and the instrument has "exceptional reliability and equally

acceptable construct and predictive validity" (Hurt & Teigen, 1977, p. 383) and has reliability coefficients reported in two studies ranging from 0.95 to 0.98 (Hurt & Teigen, 1977; Simonson, 2000). While individual PROGI items are similar to those in the IS and participants took the PORGI immediately after the IS, Hurt and Teigen (1977) established low correlation between the PORGI and the IS (r = .073; N = 401; p > .05) on a dependent measure of communication anxiety. The PORGI consists of twenty-five questions and participants responded using a five-point Likert scale from "strongly disagree" to "strongly agree." The scoring procedure resulted in participants' organizations (i.e., schools) being categorized into one of five groups that have been defined by Rogers (2003): (a) Innovators, (b) Early Adopters, (c) Early Majority, (d) Late Majority, and (e) Laggards/Traditionalists. The complete instrument, scoring procedure, and definitions of the innovativeness categories appear in Appendix B.

The third survey included in Phase 1 is a variant of Compeau and Meister's (2003) Perceived Characteristics of Innovating Scale (PCIS[2]). Of the four surveys incorporated into the IAP, the PCIS has been used more frequently and has undergone considerable development, which is briefly summarized here to provide context for its inclusion in this study. Figure 6 displays the development of the PCIS.

Compeau and Meister's (2003) PCIS is modeled after Moore and Benbasat's (1991) original PCIS, which was comprised of eight subscales that measured office workers' perceptions of the perceived characteristics of computer workstations in a business setting. Moore and Benbasat began their survey development effort by focusing

[2] The abbreviation "PCIS" (pronounced "P-C-I-S") applies to the survey instrument. This is distinct from the plural of the perceived characteristics of the innovation (PCIs, pronounced "PC-eyes") mentioned earlier.

on Rogers' (1983) five perceived characteristics of the innovation, which are (a) *relative advantage*: the degree to which an innovation is perceived as being better than the idea it supersedes; (b) *compatibility*: the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters; (c) *complexity*: the degree to which an innovation is perceived as relatively difficult to understand and use; (d) *trialability*: the degree to which an innovation may be experimented with on a limited basis; and (e) *observability*: the degree to which the results of an innovation are visible to others. In addition to Rogers' five constructs, Moore and Benbasat also chose to include two others: (f) *image*: the degree to which use of the innovation is perceived to enhance one's image or status in one's social system, and (g) *voluntariness*: the degree to which use of the innovation is perceived as being voluntary or of free will. Additionally, as their PCIS was designed primarily for measuring the perceptions of adopting a technological innovation, Moore and Benbasat (1991) determined that it would be advantageous to substitute Davis's (1989) perceived *ease of use* construct for Rogers' complexity construct. Ease of use is defined as "the degree to which an individual believes that using a particular system would be free of physical and mental effort" (Moore & Benbasat, 1991, p. 197) . During their validation process Moore and Benbasat determined that observability was overly complex and they developed and substituted two other constructs: (a) *result demonstrability*: the tangibility of the results of using the innovation; and (b) *visibility*: the ease with which individuals can see the innovation in use. The instrument was found to be well-suited to a point-of-adoption study (Moore & Benbasat, 1991) and, with proper adaptation, usable across innovations and populations (Rogers, 2003).

Compeau and Meister (2003) found 178 articles that referenced Moore and Benbasat (1991), and, of these, thirty-one studies used portions of Moore and Benbasat's PCIS. Compeau and Meister's analysis of the reliability of the PCIS in these studies exposed weaknesses in several of the constructs, and they undertook an extensive refinement of the survey. Their effort yielded alterations to Moore and Benbasat's original PCIS by (a) breaking down compatibility into four sub-constructs as suggested by Agarwal, Karahanna, and Powers (1998), (b) substituting of visibility for *others' use*: the degree to which potential adopters are aware of other people using the innovation, and (c) breaking down of Moore and Benbasat's result demonstrability construct further into *measurability*: the degree to which the impact of the innovation can be measured; and *communicability*: the degree to which the results of using the innovation can be easily communicated to others. Figure 6 is excerpted from Compeau and Meister (2003) and traces the evolution of the PCIS constructs from Rogers' (Rogers, 2003) initial conceptions through Moore and Benbasat's original instrument to Compeau and Meister's revisions.

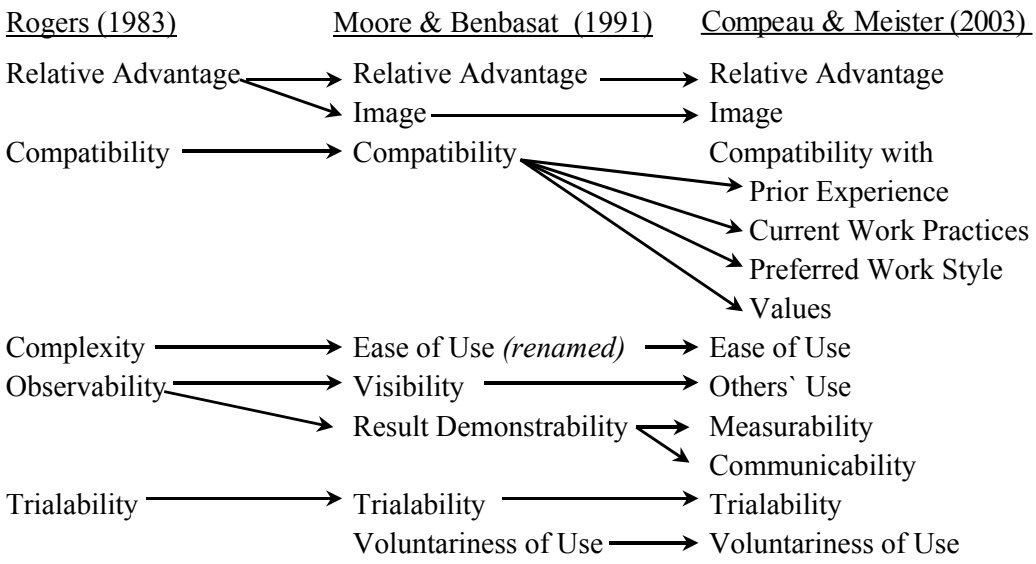

Figure 6. Evolution of the Constructs Included in the Perceived Characteristics of Innovating Scale

Note. From "The Perceived Characteristics of Innovating: A Reconsideration" by D.R. Compeau and D.B. Meister, 2003, p. 12. Copyright 2003 by D.R. Compeau and D.B. Meister. Reprinted with permission.

This study used a variant of Compeau and Meister's (2003) version of the PCIS. Compeau and Mesiter's PCIS was changed for this study in four ways. First, *other's use* was removed because it was deemed unlikely that participants had encountered the innovation prior to their workshop. Second, *voluntariness* was removed for two reasons: the acknowledgment by Moore and Benbasat (1991) that voluntariness was a measure of the context in which the innovation was to be adopted rather than a characteristic of the innovation itself, and, in this research context, the participating school district as well as the University of Minnesota's Institutional Review Board (IRB) required that the condition be put in place that all study participation be completely voluntary. Third, items

were reworded to reflect the point-of-adoption setting (i.e., just prior to the adoption decision versus after the innovation had been in use for some period of time). Fourth, each item was also reworded to make it specific to RepliGo™, the digital annotation software that served as the innovation. An example of how Compeau and Meister's items were reworded is: "Using Microsoft Excel™ enables me to accomplish tasks more quickly" became "Using RepliGo™ will enable me to accomplish tasks more quickly."

The PCIS used in this study consisted of 34 questions distributed among 10 subscales: relative advantage, ease of use, image, trialability, compatibility with preferred work style, compatibility with current work practices, compatibility with values, compatibility with prior experience, communicability, and measurability. Table 1 lists Compeau and Meister's (2003) reported reliability coefficients for each PCIS subscale used in this study. Participants responded using a seven-point Likert scale from "strongly disagree" to "strongly agree." The complete instrument and the scoring procedure appear in Appendix C. In Phase 1 of this study the PCIS measured 10 of the 15 constructs in the IAP model.

Table 1

Reliability Coefficients of the Compeau and Meister (2003) Perceived Characteristics of Innovating Scale (PCIS) Subscales.

PCIS Construct Subscale	ICR[a]
Relative Advantage	0.95
Ease of Use	0.89
Image	0.85
Trialability	0.88
Compatibility with Preferred Work Style	0.93
Compatibility with Current Work Practices	0.88
Compatibility with Values	0.82
Compatibility with Prior Experience	0.80
Communicability	0.82
Measurability	0.82

[a] Internal consistency reliability

All four survey instruments (i.e., demographics, Innovativeness Scale, Perceived Organizational Innovativeness, and Perceived Characteristics of Innovating Scale) were prepared for distribution using an online survey tool. The tool was provided by the University of Minnesota College of Education and Human Development.

Workshop presentation. A 90-minute workshop presentation on how to use RepliGo™ in the classroom was designed and delivered by the researcher. The workshop began with an explanation of digital annotation and a demonstration of its usefulness to teachers (10 minutes). Hands-on training in the use of the RepliGo™ digital annotation software followed (30 minutes), and teachers then engaged in individual exploration of the software and brainstorming more uses for digital annotation (25 minutes). Time was then allotted for survey completion including registering their choice to participate in a field trial of RepliGo™ in their classroom (15 minutes). The instructional approach for

the training portion of the workshop was the "Basics First, Immediate Feedback Direct Instruction" (BF) approach (CTGV, 1992) that has been found to produce acceptable performance on measures of procedural knowledge among pre-service teachers learning to use Geographic Information Systems software (Doering, 2003). An outline of the RepliGo™ workshop presentation appears in Appendix D.

Digital annotation software. The digital annotation software that served as the innovation considered for adoption by participants in this study was RepliGo™ version 2.0 (Cerience Corporation, 2003). RepliGo™ has three components: the standalone viewer software, a web-browser plug-in viewer, and a print driver that converts electronic files into RepliGo™ format so they can be used by the viewers. The RepliGo™ viewer software allows users to add highlighting and notes to electronic documents that have been prepared using the RepliGo™ print driver. Highlighting can be performed in one of eight colors, and annotations appear in a database displayed alongside the viewer window. RepliGo™ allows users to navigate rapidly between highlighted portions of the text by providing the option of viewing the text in a variety of magnifications. Screen shots of the standalone RepliGo™ viewer appear in Appendix E.

Online support materials. A website was created to organize and present the workshop materials including links to the informed consent documents, RepliGo™ software downloads, how-to movies and user guides, and RepliGo™ documents created to illustrate possible content-specific classroom uses of RepliGo™. Links to the IAP survey instruments were also available at the website. Participants in the April-May series of workshops at the district service center accessed these materials via the Internet. After encountering persistent network connectivity problems, the materials were

redesigned so that August participants had a choice of accessing the materials via the Internet or from a CD-ROM. Screen shots of the website appear in Appendix F.

Online form for registering the adoption decision. Near the end of the workshop, after participants had been trained to use RepliGo™ and after they had completed the IAP surveys, participants were presented with the adoption question that asked whether or not they would participate in a field trial of digital annotation in their classroom. April-May participants were given this question as part of a brief online survey that included an opportunity to schedule their follow-up interview. Due to time constraints, August participants were administered the field trial question by adding it to the end of the PCIS.

Follow-up interviews. A convenience sample of participants from the April-May workshops participated in an individual follow-up interview. August participants were provided with a script and encouraged to place a telephone call to a local voicemail service and leave their response on the voicemail system. The interview protocol and voicemail script are included in Appendix G. Interviews were recorded and transcripts of interviews and voicemail messages were prepared.

Incentives. As a large number of participants (N=150+) were sought, a participation incentive was offered during recruiting for the April-May workshops. Cerience Corporation, the developer of the RepliGo™ digital annotation software, initially offered a RepliGo™ license for each participant, but it was determined that offering the software during recruiting could disproportionably attract participants who were more likely to adopt. To avoid this bias, an incentive equally attractive to potential adopters and non-adopters of the innovation was offered. This incentive was a drawing for a $20 gift card for a local mass market retailer. At the end of each workshop

conducted during April and May a drawing occurred and a gift card was dispensed. A participation incentive was not offered for the August workshops as they were part of an optional staff development day held annually at the school that traditionally was very well attended.

Procedures

Workshops. The researcher led face-to-face introductory workshops in the district on RepliGo™ digital annotation software, the innovation used in this study, in late April, early May, and mid-August, 2005. In April-May, workshops were held at the district's staff development center and a middle school; in August, workshops were held at a high school in the district. The April-May workshops were offered on weekdays after school and on a Saturday while the August workshops all occurred on one day devoted to staff development. Workshops held during April and May lasted ninety minutes while the August workshops lasted seventy-five minutes due to district constraints. The same content was delivered in both workshops, but August workshops used more streamlined data collection procedures than the April and May workshops. Each participant used his or her district-supplied laptop computer in the workshop to become familiar with RepliGo™, connect to the Internet, complete all surveys using the online survey tool, and register his/her response to the adoption question. The sequence of events that comprised Phase 1 of the study, including the delivery of the surveys within the context of the workshops, is illustrated in Figure 7 and described below.

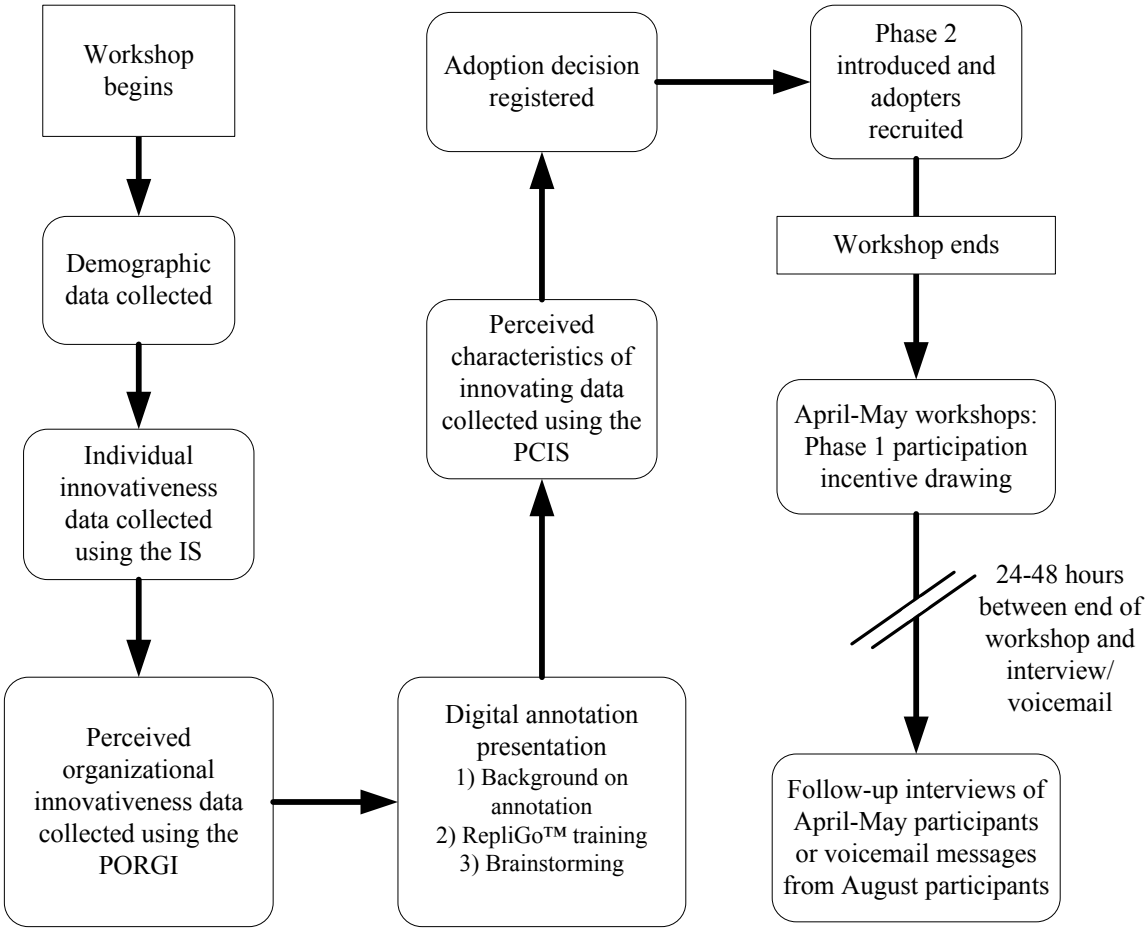

Figure 7: Sequence of events in Phase 1 of the study.

At the beginning of the workshop, participants connected to the Internet and completed the demographic questions, the Innovativeness Scale (IS) (Hurt, Joseph, & Cook, 1977) and the Perceived Organizational Innovativeness scale (PORGI) (Hurt & Teigen, 1977). For participants to gain context for using digital annotation and the RepliGo™ software, background information on using digital annotation in the classroom was presented. This was illustrated using several examples of RepliGo™ documents projected onto a screen at the front of the room. Each example was content-specific and several were drawn from the practice version of the state's exit-level standardized test. All examples were available to teachers at the project website. Ways

for teachers to use RepliGo™'s features by highlighting and commenting on the content in the examples were demonstrated. The "Basics First, Immediate Feedback Direct Instruction" approach (CTGV, 1992) was then used to train participants in the procedures for using RepliGo™ on their laptop computers. Participants were asked to pretend they were students working with an example from the project website. Participants then read an opinion column from a national newspaper and highlighted facts in one color and opinions in a second color. Next they experimented with RepliGo™'s thumbnail view to see multiple pages at a time, compared their highlighting with their neighbor's, and discussed if and how RepliGo™ could be useful to their teaching practice. Then a brainstorming session took place on how teachers could use RepliGo™ in their classrooms. After the brainstorming session, participants completed the Perceived Characteristics of Innovating Scale (PCIS) (D. R. Compeau & Meister, 2003) and then indicated if they would participate in the field trial. The April-May workshops concluded with the drawing for the participation incentive and the August workshops concluded with the distribution of the directions for how to leave the voicemail message.

For each April-May participant who volunteered, a follow-up interview was conducted between twenty-four and forty-eight hours after his/her workshop. August workshop participants were invited to leave a voicemail message using a script of questions provided to them. Interviews were recorded and transcripts of interviews and voicemail messages were made.

Phase 2: Describing Post-Adoption Outcomes

Research Design. Phase 2 used a case study design (Yin, 1994). A case study design investigates phenomena within a real-life context and thus was deemed appropriate for this examination of teachers' uses of digital annotation in their classrooms.

Phase 2 participants. Of the 21 Phase 1 participants who agreed to participate in the Phase 2 field trial, only 2, Richard and Julia (pseudonyms), actually participated in the field trial of RepliGo™ and fully participated in the Phase 2 research. The difference between the number who agreed to participate (N=21) and the number who actually participated (N=2) may be attributed to the level of technical support available at the start of the field trial. The initial plan for technical support relied upon the school district to fulfill its commitment to install RepliGo™ on all student and teacher computers in each of the laptop schools. When this support was not forthcoming, resource constraints and distance from the school district precluded on-site assistance by the researcher and participants were left to manage the RepliGo™ software installation themselves. This additional requirement proved overly burdensome to the majority of Phase 2 participants and hence they declined to participate.

Richard taught Spanish in primarily ninth and tenth grades at Adams High School (pseudonym). He became a teacher following a seventeen-year career in broadcast journalism and earning his Master's degree in Education. He was in his fourth year of teaching when he began the field trial.

Julia taught Reading at Madison High School (pseudonym) to ninth through twelfth-grade students who had failed to pass the required statewide reading assessment.

Julia completed her Bachelor's degree and was nearly finished with a Master's degree in experimental psychology at the time of the field trial. She was in her third year of teaching and second year at Madison High School.

Phase 2 materials. Materials included a participation incentive, the RepliGo™ digital annotation software (see Phase 1 materials), online support materials, a semi-structured telephone interview protocol, participant-provided curricular materials, and copies of student work. The incentive was a permanent license to the RepliGo™ digital annotation software provided by the publisher and was offered to all Phase 1 participants who chose to participate in the field trial and thereby were eligible to participate in Phase 2 of the study. The incentive was offered after teachers had recorded whether or not they were going to participate in the field trial and before they were invited to participate in Phase 2 of the study. The 21 Phase 1 participants who agreed to participate in Phase 2 were provided with RepliGo™ licenses.

Online support materials. A website was created to support Phase 2 participants. It included RepliGo™ software downloads, how-to movies and user guides, and RepliGo™ documents created to illustrate possible content-specific classroom uses of RepliGo™.

Semi-structured telephone interview protocol. Three weekly, semi-structured, individual telephone interviews were conducted with Richard and Julia during their field trials of RepliGo™. Interviews were between fifteen and thirty-five minutes and the questions allowed Richard and Julia to fully describe their uses of RepliGo™ and any changes in their teaching practice they noticed as compared to how they taught prior to using RepliGo™. See Appendix H for the interview protocol.

Participant-provided curricular materials. Richard and Julia used the RepliGo™ print driver to convert self-selected curricular material from their existing curricula for their students to access and manipulate using RepliGo™. The materials included paper documents that were scanned and converted in RepliGo™ files, web pages and word processing files. Examples included Richard's story excerpts he used for vocabulary assessment and a short story Julia used with her students to learn about purpose when reading. Richard and Julia provided these files to the researcher, and they were reviewed during the telephone interviews. The researcher asked Richard and Julia about the files to more fully understand their uses of RepliGo™.

Examples of student work. Julia provided seven anonymous examples of students' work on the short story mentioned above. She introduced and shared these examples during a telephone interview to illustrate how she was using RepliGo™.

Procedures. Phase 2 of the study consisted of two case studies of individual teachers, Richard and Julia, who chose to participate in the field trial of the RepliGo™ digital annotation software in their classrooms. Data for the case studies included three individual, semi-structured telephone interviews and classroom artifacts (e.g., RepliGo™ files provided to students, examples of student work). Interviews were conducted in October, 2005, ranged in duration from ten minutes to forty-two minutes, and focused on the variety of Richard and Julia's uses of RepliGo™ across three broad themes of technology use developed by Hughes (2000): (a) instructional method, (b) student learning processes, and (c) curriculum goals. Interviews were audio-recorded and transcribed.

Analysis

As a distinct analysis was required to answer each of the research questions, each analysis will be described separately. Note that unlike previous sections, this section is divided using the three research questions rather than the two phases of the study.

Question 1: To what extent does diffusion of innovations theory indicate the micro-adoption decisions of secondary school teachers? Data gathered during and immediately following the introductory workshops on RepliGo™ (i.e., the demographics, individual innovativeness, perceived organizational innovativeness, and perceived characteristics of innovating surveys and follow-up interviews) were analyzed to answer the question "To what extent does diffusion of innovations theory, as embodied in the Innovation Adoption Profile (IAP), indicate the micro-adoption decisions of secondary school teachers considering participating in a four-week trial of RepliGo™ digital annotation software?" Logistic regression was chosen to analyze the survey data because the dependent variable (i.e., teachers' decision to participate/not participate in the field trial of RepliGo™) is dichotomous and the independent variables (i.e., educational level, career changes, individual innovativeness, perceived organizational innovativeness, relative advantage, compatibility with current work practice, compatibility with preferred work practice, compatibility with prior experience, compatibility with values, ease of use, image, communicability, measurability, and trialability) are ordinal (DeMaris, 1995). Logistic regression has been used to analyze data from a study of the factors influencing the use of computer-mediated communication by teachers (van Braak, 2001), perceived characteristics of the innovation data from a study of e-Government adoption (Carter & Belanger, 2003), and data from the short form of the Innovation Scale (IS) in a study of predictors of classroom technology use (Marcinkiewicz, 1994). As survey data were

collected on each of the fifteen independent variables that make up the IAP, logistic regression was also well-suited because it described each variable's role in describing the likelihood of the micro-adoption decision.

Descriptive statistics were calculated for each of the variables and a reliability test (Cronbach's alpha) was performed on the IS, PORGI, and the PCIs data. To satisfy the assumptions for using logistic regression (Garson, 2006b), data on the independent variables were examined for correlation with the dependent variable, and multiple co-linearity. The data were also examined for normality of distribution. A logistic regression analysis was then performed on the independent variables to determine the significance (*p* value) of their contribution to the model. The results for each variable were analyzed to determine the ability of the IAP to indicate teachers' micro-adoption decisions.

Qualitative analysis of the interviews from a convenience sample of April-May survey respondents was conducted to triangulate the quantitative data and increase the understanding of what happened during teachers' micro-adoption decision making. Transcriptions were analyzed using content analysis (Weber, 1990) with phrases as the recording unit and coding based on the a priori coding categories of the ten perceived characteristics of the innovation (PCIs) included in the IAP. The definitions of each PCI (D. R. Compeau & Meister, 2003) were referred to during coding and are included in Appendix I with a sample of the coded data to illustrate the method. To reduce researcher bias, coding was completed before the survey data were analyzed.

To evaluate the reliability of the coding, a competent second coder (a doctoral candidate in education with experience coding data with Rogers' PCIs) coded 10 (13.5%)

of the 74 statements coded by the researcher. Initial agreement was acceptable (80%). Subsequent conversation resolved all discrepancies.

Once the interviews were coded for the ten PCIs, two frequency tables were created. First, a frequency table was created to illustrate the number of times each of the PCIs was present in the data. Three frequencies were generated from the data: overall (i.e., all mentions of any PCI), non-duplicates (i.e., counting as one PCI any PCI mentioned by the same participant multiple times), and perception (i.e., positive or negative). This was done to determine if participants spoke about RepliGo™ in terms of the PCIs and whether or not they considered the PCIs in their decision to participate/not participate in the field trial of RepliGo™. Second, a table was created to display for each interview participants their field trial response (i.e., "yes" or "no" to the invitation to participate in the field trial of RepliGo™), their PCIS subscale means, and their PCI frequencies from the first table. This table was used to triangulate participants' responses to the PCIS with what they said during their follow-up interview and compare those data points to their field trial response.

Question 2: What do deep-usage measures, as embodied in the Replacement-Amplification-Transformation (RAT) taxonomy (Hughes, 2000), tell us about the post-adoption outcomes of using RepliGo™ digital annotation software among secondary school teachers? The case study data gathered during Phase 2 were analyzed using Hughes' technology use taxonomy (Hughes, 2000) to answer the question, "What do deep-usage measures, as embodied in the Replacement-Amplification-Transformation (RAT) taxonomy (Hughes, 2000), tell us about the post-adoption outcomes of using RepliGo™ digital annotation software among secondary school teachers?"

First, a list of *instances* of use of RepliGo™ was compiled from the transcripts of the interviews with Richard and Julia. An instance of use occurs when technology is used before, during, or after a lesson. Then each instance was coded using Hughes' (2000) themes of teaching practice (i.e., instructional methods, curriculum goals, student learning processes) and focus of use (i.e., teacher, student) as an a priori coding scheme. Next, Hughes' descriptions of categories of technology use (technology as replacement, technology as amplification, technology as transformation) were applied to each instance to determine the degree to which each theme "remained the same, was more efficient, or changed" (Hughes, 2000, p. 18). Hughes' categorization protocol was followed whenever an instance of use fell across multiple categories of use; the entire instance was placed in a category based on the most transformed use. An example was when Richard amplified his previous assessment practice because using RepliGo™ was faster and transformed his interactions with his students because he spent time with them one-on-one during the assessment where he did not do this at all before. This entire instance was categorized as a time when the technology transformed the instruction.

To evaluate the reliability of the coding, a competent second coder (a graduate student with experience coding data with RAT under the supervision of a faculty member) coded 9 (16%) of the 58 statements coded by the researcher. Initial agreement was acceptable (78%) on both the coding of the theme and category of technology use. Subsequent conversation resolved all discrepancies.

Once the instances were classified according to taxonomy categories, two sets of rich descriptions of illustrative instances were created, one for Richard and one for Julia.

These rich descriptions were used to illustrate, using the RAT taxonomy, the post-adoption outcomes of using RepliGo™ generated by Richard and Julia.

Question 3: What is the relationship between teachers' IAP results and their deep-usage post-adoption outcomes from the four-week trial of RepliGo™ digital annotation software? Data from Richard and Julia gathered during Phase 1 and Phase 2 of the study were analyzed to answer the question "What is the relationship between teachers' IAP results and their deep-usage post-adoption outcomes from the four-week trial of RepliGo™ digital annotation software?" First, the transcripts of Richard and Julia's Phase 2 telephone interviews where they described their post-adoption outcomes of using RepliGo™ were coded a second time using the PCI categories applied to their Phase 1 interviews conducted after the introductory workshops. These a priori categories were used to label the occurrence of any perceived characteristic of the innovation (PCI) (i.e., relative advantage, ease of use, compatibility with current work practice, etc.) in the Phase 2 data.

To evaluate the reliability of the coding, the same individual who second-coded the follow-up interviews (a doctoral candidate in education with experience coding data with Rogers' PCIs) coded 9 (13%) of the 67 statements coded by the researcher. Initial agreement was low (67%). Subsequent conversation revealed that discrepancies arose around the overlapping of the relative advantage and compatibility constructs, which has also been noted by Karahanna, Straub, and Chervany (1999). It appears that the nature of the overlap centers around participants' perceptions of relative advantage as being bound to their perceptions of compatibility (i.e, if the innovation is not compatible with some aspect of their current or preferred practice, prior experience or values, they are less

likely to perceive its relative advantages). The issue was resolved by agreeing to double-code the statements in question, which resulted in full agreement between the second coder and the researcher.

Once the Phase 2 data had been re-coded using the PCI categories, a comparison was made between Richard and Julia's Phase 2 post-adoption data and their Phase 1 micro-adoption data. Phase 1 data used in the comparison were the mean scores for each PCIS subscale for Richard and Julia and transcripts from the follow-up interviews that occurred in early May after the introductory workshop where they first learned of RepliGo™. Two tables were then created to guide the comparison, one using the data from each phase. The tables allowed for the direct comparison of what Richard and Julia reported quantitatively and qualitatively as their first impressions of RepliGo™ when they saw the software in April-May with what they reported qualitatively while using RepliGo™ in their classrooms in the fall. In addition, a rich description was created for each participant from his or her Phase 1 and Phase 2 interview data to illustrate how perceptions of the PCIs altered over time. This pre/post-micro-adoption comparison allowed for the detection of those PCIs that Richard and/or Julia said were important when they made their micro-adoption decision *and* were important to their later use of RepliGo™. The comparison also captured those PCIs that were important to *using* RepliGo™ but did not appear to be important to *adopting* RepliGo™. The identification of PCIs that influence adoption versus those that influence use has been determined to be important by Karahanna, Straub, and Chervany (1999) and Chin and Marcolin (2001).