

CHAPTER 3:

RESEARCH DESIGN, DATA COLLECTION, AND ANALYSIS PROCEDURES

Overview

The purpose of this explanatory-sequential mixed methods study was to assess the impact of the IPI-T process on technology use and student cognitive engagement. The goal was to implement all strategies, including faculty collaborative study sessions four times per year to support teacher implementation of new technology to increase higher-order, deeper thinking by students and increase student use of technology. The impact was measured by comparing IPI-T data codes of those faculty that participate in the faculty collaborative study sessions with baseline data prior to the implementation of the faculty collaborative study sessions as well as participant responses from a web-based questionnaire created by the researcher. The design employed was an explanatory-sequential mixed methods approach. The explanatory-sequential approach allowed the researcher to look at key results in more detail, assuming either surprising or unexpected results may occur in the quantitative phase of the study. The additional collection of qualitative data helped to further understand the results (Creswell, 2015). Qualitative data collection followed the quantitative phase with priority or emphasis placed on the quantitative results. The quantitative portion of this study used the IPI-T instrument, a pre-determined and numerically coded instrument, to collect data concerning the frequency and scale of student cognitive engagement as technology is integrated into the classroom (Larinee, 2003; Valentine 2015c). Observational data collected using the IPI-T was recorded numerically for analysis and interpretation through descriptive and inferential statistics (Valentine 2015c). Data collected from the qualitative strand was analyzed for themes and then because the data was collected in sequence, findings were associated with the quantitative results of the IPI-T to determine how and why the data converged.

A web-based questionnaire, created by the researcher, was used to collect qualitative data. The questionnaire consisted of both closed-ended and open-ended questions. According to Creswell (2015), there is an advantage to creating a questionnaire with both closed and open-ended questions. The closed-ended questions are predetermined and can “net useful information to support theories and concepts in the literature” (Creswell, 2015, p. 219). Those participating in the qualitative phase and responding to the questionnaire included eight faculty members, four representing core courses, and four representing non-core courses. Prior to sharing the questionnaire with participants two committees participated in the creation and validation of the questions. A formative committee made up of three members from the IPI-T data collection team assisted in the formation and revision of the questions. In addition, three experts from the field served as the summative committed to validate the survey. The experts included the creators of the IPI-T instrument, as well as a Research Associate from Rockman et al. Finally, prior to surveying participants, two classroom teachers and one instructional coach trained in the collection of IPI-T data piloted the survey.

Participants

The research participants are employed within a school district located in southern, rural Iowa. The district includes five buildings: (a) preschool; (b) kindergarten and first grade; (c) second through fifth grade; (d) the middle school which houses students in grades six through eight; (e) the high school, grades nine through twelve. This research study involved only the high school, grades 9-12 because technology is nearly one device per two students.

Quantitative

A nonprobability sampling approach was utilized. Popular approaches in nonprobability sampling are convenience and snowballing sampling approaches (Creswell, 2015). A convenience sampling strategy was employed for the quantitative strand of the study because participants must be willing and available to participate (Creswell, 2015; Edmonds & Kennedy, 2017). Participants included 27 faculty members, 11 males and 16 females. Each participated in faculty collaborative study sessions within one week from the collection of data using the IPI-T Recorder App. A Google Form was distributed to collect demographic

information such as age, ethnicity, educational level, and number of years of teaching experience. By submitting the online survey, participants consented to volunteer to participate in the study.

Qualitative

The sampling strategy for the qualitative strand was a purposeful sample, utilizing a confirming and disconfirming sampling procedure during the study to follow up on and explore specific findings (Creswell, 2015). A single person from each content area, listed on the IPI/IPI-T Data Recording Form, was identified and invited to volunteer to participate in an open-ended, web-based questionnaire. Content areas included core classes: math, science, social studies, and English and language arts, as well as non-core classes: fine and performing arts, physical education and health, vocational technology, and special education. There was a possibility of eight participants, four representing core courses, and four representing non-core courses. According to Creswell, (2015) purposeful sampling allows the researcher to select individuals or sites that are “information rich” and may provide useful information about the central phenomenon (p. 205). In addition, purposeful sampling gives freedom to the researcher to choose individuals that may otherwise be silenced but rather give them a voice (Creswell, 2015).

Instruments

Instructional Practice Inventory – Technology

The Instructional Practice Inventory – Technology (IPI-T) is a walkthrough observation tool designed to collect data concerning how often and in what ways teachers are integrating technology as well as how often students are cognitively engaged in higher order, deeper thinking and can be used to help faculty align technology standards both at grade level and content areas.

Instructional Practices Inventory- Technology Process

Led by teacher-leaders, the IPI-T process is implemented school-wide, collecting data about student cognitive engagement to show how students are thinking when using technology.

Within a week after the collection of data, the teacher-leaders facilitate faculty collaborative sessions in an effort to disaggregate the data and participate in collaborative conversations. In comparison to the IPI process, the IPI data collection protocols for collecting basic IPI data will follow when the IPI-Technology Component is added. The observation/data collection process, however, is more complex. In the IPI-T process, the data collector documents the total number of students and the numbers using and not using technology and makes two IPI engagement codes, one for all students and one for ‘only the tech students’. The data collector documents how technology is being used for learning (Valentine, 2015a).

Instructional Practices Inventory-Technology Categories

There are six IPI-T categories. Each of the categories are represented numerically (see Appendix A). The six categories describe the level of student cognitive engagement and are referred to as (a) Student Disengagement; (b) Student Work with Teacher Not Engaged; (c) Student Work with Teacher Engaged; (d) Teacher-led Instruction; (e) Student Verbal Learning Conversations; (f) Student Active Engaged Learning. The IPI and the IPI-T both utilize each of these categories. It is important to note that the categories are not considered a hierarchy but rather “six distinct ways to categorize student engagement” (Valentine, 2017).

Categories 6 and 5 include learning activities that fall within the higher-order, deeper thinking spectrum of Bloom’s Taxonomy and Bloom’s Digital Taxonomy such as analysis and creating while Categories 4, 3, and 2 include lower-order, surface thinking activities such as recalling simple facts and googling for answers. Category 6 is coded when students are engaged in higher-order thinking and developing deeper understanding through analysis, problem solving, critical thinking and creativity. Likewise, Category 5 only differs from Category 6 because the higher-order, deeper thinking is driven by peer verbal interaction.

Teacher-led instruction is coded as a Category 4. Category 3 students are engaged in independent or group work designed to build basic understanding, new knowledge, and/or pertinent skills. This category is the same as Category 3 except the teacher is not attentive to, engaged with, or supportive of the students. Category 1 is associated with students not engaged in learning directly related to the curriculum.

Tech-Use Categories

According to Valentine (2015d) categories provide faculty with details about how students are cognitively engaged for each form of tech use. Following is a list of the Tech-Use Categories (see Appendix C) (1) Word Processing; (2) Math Computations; (3) Media Development; (4) Information Search; (5) Collaboration Among Individuals; (6) Experience-Based Immersion Learning; (7) Interactive Presentation Technology; and (8) Other (Valentine, 2015d).

Procedures

Research Design

The design employed was an explanatory-sequential mixed methods approach. The explanatory-sequential approach allowed the researcher to look at key results in more detail and assuming either surprising or unexpected results may occur in the quantitative phase of the study, additional collection of qualitative helped to further understand the results (Creswell, 2015). Qualitative data collection followed the quantitative phase with priority or emphasis placed on the quantitative results. The quantitative portion of this study used data from the IPI-T instrument, a pre-determined and numerically coded instrument, to collect data concerning the frequency and scale of student cognitive engagement when technology was integrated into the classroom (Larinee, 2003; Valentine 2015c). Observational data collected using the IPI-T was recorded numerically for analysis and interpretation through descriptive and inferential statistics (Valentine 2015c). Data collected from the qualitative strand was analyzed for themes and then because the data was collected in sequence, findings were associated with the quantitative results of the IPI-T to determine how and why the data converged.

Quantitative Data Collection

Participation in this study was not a requirement. However, if a faculty member chose to participate, after receiving an overview of this research study, they were asked to sign a research consent form. Each participant was given a signed copy of this form to keep. In addition to the general consent form, consent was sought at the district level, requiring

approval from the district's superintendent. IPI-T data collection process required 3-5 minutes in the classroom for the IPI data collection process and these additional steps:

Before entering the learning setting the researcher:

1. Recorded the *Page Number* at the top right portion of the Data Recording Form.
2. Recorded the *Observation Number* on the upcoming observation.

Upon entry into the learning setting the researcher:

3. Made a whole-class mental snapshot of student engagement, same as when collecting basic IPI data.

During the time in the learning setting the researcher:

4. Took an entry snapshot, worked the learning setting, moved among the students and talked with the students and teacher, if necessary, to obtain the specific details of the big picture snapshot taken upon entry. Next, a determination was made of the IPI Category that most appropriately defined student cognitive engagement for that learning setting. The IPI data collection protocols explained in the basic IPI Workshop govern both the IPI and IPI-T category codes. The researcher left the learning setting before recording the student engagement codes for both the IPI and IPI-T student engagement category codes.
5. Counted and recorded the total number of students in the learning setting during or immediately after leaving the learning setting.
6. Counted and recorded the number of students (if any) who were disengaged in the learning task(s) during or immediately after leaving the learning setting.
7. Counted and recorded the number of students (if any) who were using technology (and those who are supposed to be using technology) as part of their learning experience. Verified the total number of tech users and supposed-to-be users during or immediately after leaving the learning setting.
8. Counted and recorded the number of students who were supposed to be using technology but were disengaged from the learning task(s) during or immediately after leaving the learning setting.

Determined the IPI-T tech use category:

9. During the time spent in the learning setting (classroom) it was necessary to determine student head counts and IPI/IPI-T Codes. In addition, the researcher

determined how technology was being used by the students or by the teacher if only the tech user was the teacher.

10. The IPI-T Tech-Use Categories provided the faculty with details about how students were cognitively engaged for each form of Tech Use. Therefore, the data collector identified the Tech-Use Category that represented how the greatest number (most) of the “technology engaged” students were using technology (or, how the teacher was using technology if the teacher was the only user of the technology and no students were actively engaged in the use of technology). The Tech Use Category number is recorded on the Data Recording Form. When students were using technology in multiple ways, the data collector counted the varied uses and then selected the Tech Use Category most frequently used. Data collectors were encouraged to record information and make margin notes if needed. If no students were using, or supposed to be using technology, “0” was recorded in the appropriate locations on the Data Recording Form.

After leaving the learning setting the researcher:

11. Determined the primary user of the technology. Student use carries precedent in the coding process over teacher use for identifying the Tech-Use Category (i.e. if students and the teacher were using technology, student use, not teacher use, was recorded). For student use, the technology must be fostering active/direct student engagement, not passive engagement. For example, if the teacher was writing information from the students on a SMART Board, the teacher was the primary user of the technology, not the students. If the students were using their technology to engage with the learning task, then the students were the primary user of technology. If the teacher was the tech user (and no students are using tech) an IPI-T Category code was not given. Only student use generated a cognitive IPI-T engagement code.

12. Determined the producer/developer of the technology. Coded “1” if the tech being used was developed commercially specifically for education; “2” if the teacher developed the technology or modified existing technology to personalize the learning experience for the students; “3” if a student(s) developed the technology being used to support learning; or, “4” if the technology was developed commercially and not specifically for education. If the teacher influenced the learning experience (left a thumbprint) then the teacher was given credit as a producer/developer. Thus, teachers can understand student cognitive engagement when they have/have not personalized the technology for their students.

Finally, the researcher will double checked each row to be sure to have either marked a code for all cells or placed a “line” through items on the row that did not need a code.

Qualitative Data Collection

Upon institutional review board approval, eight participants, four representing core courses, and four representing non-core courses were informed about the study face-to-face. They learned about the purpose of the study as well as what to expect if they chose to participate. Once participants agreed they were asked to complete an informed consent form prior to participating. After the consent forms were complete, the eight participants responded to an open-ended, web-based questionnaire created using Google Forms. The questionnaire was distributed during the final faculty collaborative session to only those that agreed to participate.

Quantitative Data Analysis

An explanatory-sequential mixed method design was employed. The quantitative method was a quasi-experimental within-subjects approach utilizing a pretest and posttest design. Inferential statistics were used to analyze the nominal data collected from the IPI-T to test the null hypothesis using the parametric statistic of analysis of variance (ANOVA). According to Creswell, (2015) descriptive statistics describe general tendencies in the data such as mean, median, and mode and are used to summarize, organize and simplify the nominal data. In addition to inferential statistics, descriptive statistics will be used to organize the nominal data in a frequency distribution table to answer descriptive research questions three and four. The ANOVA is the inferential statistics technique chosen for this quantitative study because the test analyzes main effects of the independent variable on the outcome or dependent variable as well as interactive effects. (Creswell, 2015; Reeves, n.d.). The ANOVA is a parametric test and will be used to analyze main effects of participation in faculty collaborative sessions and the effect on IPI-T student cognitive engagement codes. Table 1 shows each research question and the corresponding statistical analysis that will be used for the study. Research questions 3 and 4 will employ descriptive statistics to report the frequency for each IPI-T category of technology use and student cognitive engagement codes. Research questions 1 and 2 will utilize the ANOVA. Contingency tables were created

to organize the categorical variables and make it easier to understand the null hypothesis (Reeves, n.d.). The contingency tables for research question 1-4 can be found in Tables 2, 3, 4, and 5.

Table 1. Research Questions and Corresponding Statistical Analysis Methods

Research Questions	Statistical Analysis
1. To what extent does participation in faculty collaborative study sessions affect faculty’s technology use as measured by codes on the Instructional Practices Inventory-Technology (IPI-T)?	ANOVA*
2. To what extent does participation in faculty collaborative study sessions affect students’ technology use as measured by codes on the Instructional Practices Inventory-Technology (IPI-T)?	ANOVA*
3. What categories of technology use, as defined by the IPI-T, are most frequently used in 9-12 classrooms within the targeted district?	Descriptive statistics
4. What categories of technology us, as defined by the IPI-T, are more frequently coded when student cognitive engagement codes 5 and 6 are recorded?	Descriptive statistics

*Note. Inferential statistics.

Research question one is addressed when participants are asked, *to what extent does participation in faculty collaborative study sessions affect faculty’s technology use as measured by codes on the Instructional Practices Inventory-Technology (IPI-T)?* The ANOVA analysis was utilized to calculate the strength or effect size between faculty’s use of technology IPI-T engagement categories and participating in the faculty collaborative study sessions. In other words, do the IPI-T codes of teacher use of technology IPI-T engagement categories reveal statistical significance as a result of participating in the faculty collaborative study sessions? The null hypothesis for this research question states that there is no difference in faculty’s technology use as measured by codes on the IPI-T of those that participated in the faculty collaborative sessions (see Table 2).

Table 2. Contingency Table for Research Question 1 & 2

Faculty Collaborative Session	IPI-T Engagement Codes					
	1	2	3	4	5	6
Baseline						
One						
Two						
Three						
Four						

Note. Frequency distribution of faculty’s use of technology IPI-T engagement categories.

Research question two asks, *to what extent does participation in faculty collaborative study sessions affect students’ technology use as measured by codes on the Instructional Practices Inventory-Technology (IPI-T)?* The ANOVA analysis was utilized to calculate the strength or effect size between faculty’s use of technology IPI-T engagement categories and participating in the faculty collaborative study sessions. In other words, do the IPI-T codes of student use of technology IPI-T engagement categories reveal statistical significance as a result of faculty participating in the faculty collaborative study sessions? The null hypothesis for this research question states that participating in faculty collaborative study sessions has no effect on student’s technology use as measured by codes on the Instructional Practices Inventory – Technology (IPI-T) (see Table 2).

Research question three asks, *what categories of technology use, as defined by the IPI-T, are most frequently used in 9-12 classrooms within the targeted district?* (see Table 3). Descriptive statistics will be used to organize the nominal data in a frequency distribution table to answer descriptive research question three. Research question four asks, *what category of technology use, as defined by the IPI-T, are most frequently coded when student engagement codes 5 and 6 are recorded?* (see Table 3). Descriptive statistics will be used to organize the nominal data in a frequency distribution table to answer descriptive research question four.

Table 3. Contingency Table for Research Question 3 & 4

Category of Technology Use	IPI-T Engagement Categories					
	1	2	3	4	5	6
Word Processing						
Math Computations						
Media Development						
Information Search						
Collaboration Among Individuals						
Experience-Based Technology						
Interactive/Presentation Technology						
Other						

Note. IPI-T engagement categories associated with categories of tech use.

Qualitative Data Analysis

Table 4 shows each qualitative research question, possible responses, and the type of question: closed-ended or open-ended. Using Google Forms, a web-based questionnaire was created. According to Creswell (2015), there is an advantage to creating a questionnaire with both closed and open-ended questions. The closed-ended questions are predetermined and can “net useful information to support theories and concepts in the literature” (Creswell, 2015, p. 219). Sub-questions a, c, and e were followed by an open-ended question to explore reasons behind the participant’s responses (see Table 4).

This study is based on an explanatory-sequential approach. Using the participant-selection design, quantitative data was collected, analyzed, and the results were interpreted. Next the participants were selected for the qualitative phase using a means of purposeful sampling. Following selection of participants, qualitative data was collected, analyzed, and the results were interpreted (Edmonds & Kennedy, 2017). Looking for overlapping themes within the open-ended questions, the researcher counted and recorded themes or the number of times

that the participants mention particular themes. This self-designed protocol assisted in the organization of information reported by each participant to each question (Creswell, 2015). Finally, both quantitative and qualitative data were interpreted to determine how and why the data converged (Edmonds & Kennedy, 2017).

Table 4. Qualitative Questions on Web-Based Questionnaire

Qualitative Questions	Type
1. Did you participate in all faculty collaborative study sessions?	Closed-ended
2. “Participating in faculty collaborative study sessions affected my use of technology in my classroom.” _____ Do you strongly agree? _____ Do you agree? _____ Are you undecided? _____ Do you disagree? _____ Do you strongly disagree?	Closed-ended
3. Please explain your response in more detail.	Open-ended
4. “Participating in faculty collaborative study sessions affected my students’ use of technology in my classroom.” _____ Do you strongly agree? _____ Do you agree? _____ Are you undecided? _____ Do you disagree? _____ Do you strongly disagree?	Closed-ended
5. Please explain your response in more detail.	Open-ended

Note. Distributed face-to-face during final faculty collaborative session.

Data Integration

Data collected during the quantitative phase was the emphasis of this study. After identifying themes, the qualitative strand was analyzed and then because the data was collected in

sequence, findings were associated with the quantitative results of the IPI-T to determine how and why the data converged. In addition, the researcher used the qualitative data to explore any key results found when collecting quantitative data that lead to the acceptance or rejection of the null hypothesis. Trustworthiness of the qualitative data was achieved through triangulation of the data. The nature of this explanatory sequential mixed method design included the best of both quantitative and qualitative data to inform or cast light on the topic of study and to valid claims that arose from the study (Creswell, 2015; Olsen, 2004).

Limitations

When conducting this explanatory sequential mixed method design the quantitative phase of the study was conducted first and followed up with the qualitative phase (Creswell, 2015; Edmonds & Kennedy, 2017). A difficulty using this design was that the researcher needed to decide which aspect of the quantitative results to follow-up on using qualitative data (Creswell, 2015). In addition, participants were chosen during the second, qualitative phase. The questions created for the second phase needed to build-on the quantitative phase in an effort to further understand the results (Creswell, 2015). This design was labor intensive because the researcher collected and analyzed two types of data, quantitative and qualitative.

According to Edmonds and Kennedy, (2017) “Major challenges when conducting research are often related to access to participants and an inability to randomly assign the participants to conditions” (p. 57). For this reason, the researcher chose to employ a quasi-experimental within-subjects approach utilizing a pretest and posttest design. The major difference between experimental and quasi-experimental is the “level of control and assignment to conditions” (Edmonds & Kennedy, 2017, p. 33). One group participated in this study. A convenience sampling strategy was employed for the quantitative strand of the study because participants were willing and available to participate (Creswell, 2015; Edmonds & Kennedy, 2017). The sample of teachers chosen from the population of teachers in the district was relatively small. The targeted district employs 100 teachers, 27 are employees within the high school chosen for the study. The sampling strategy for the qualitative strand was a purposeful sample, utilizing a confirming and disconfirming sampling procedure during the study to follow up on and explore specific findings (Creswell, 2015). A subgroup of eight teachers from the sample was asked to participate in the qualitative phase. Participants from the small subgroup had the potential to provide useful information for answering questions and hypotheses, however, it is

difficult for the researcher to say with confidence that the individuals represented the entire teacher population (Creswell, 2015; Edmonds & Kennedy, 2017).

Additional disadvantages to this approach were threats to internal validity which include maturation and history because the study took place over the course of several months (Edmonds & Kennedy, 2017). Edmonds and Kennedy (2017) stated, “Maturation is the natural process of changing, growing, and learning over time” and “History is any event that occurs during the time of the treatment and the posttest that could affect the outcome (e.g., natural life events such as a death in the family, change in job, or moving)” (p. 7). Further, an assumption is observations represented typical school days, and that teachers did not alter instruction when the IPI-T data collection team was present.

While the possibility of observer bias exists, training was provided to all teacher leaders who collected codes in an effort to standardize data collection. It is important to know that the process for developing the data collector’s validity, reliability, and inter-rater reliability during was the central focus during both IPI Level I Basic Workshop and the IPI-T Component Workshop. Participants were given multiple scenarios to code independently and then share out with the entire workshop participants in order to allow each participant to recognize their growth in coding throughout the day but also to realize they were growing together and building inter-rater reliability as they worked together. This transformation was crucial in the IPI and IPI-T learning process because data collectors must have confidence that their colleagues who are collecting data are coding just as accurately as they were throughout the school day (“Users Requirements” n.d.).

Upon the conclusion of each IPI-T workshop participants were required to complete a Reliability Assessment. The assessment results were sent directly to the participant and were not shared with others. Reliability ratings were used to gauge how each individual was able to participate in the IPI-T process (“Users Requirements” n.d.):

1. A reliability score of .90 or higher was necessary for permission to use the IPI-T Process for research purposes.
2. A reliability score of .80 or higher was necessary for permission to use the IPI-Process for internal use within a school or district to collect data for faculty study for school improvement.

3. A reliability score .70-.79 indicated the IPI-T Process may be used for personal or informal use only – not for research or to use in school improvement.
4. A reliability score below .70 indicated the IPI-T Process should not be used for data collection.

The researcher earned a reliability score of .95 on the IPI assessment and .98 on the IPI-T assessment. Each member on the data collecting team completed the IPI Level I Basic Workshop and IPI-T Component Workshop and earned a reliability score higher than .90 on both the IPI and IPI-T assessment (J. Valentine, personal communication, October 4, 2017).

Citation

Wallace-Spurgin, M. (2019). Research design, data collection, and analysis procedures. In I. Sahin & V. Akerson (Eds.), *Measuring student cognitive engagement when using technology* (pp. 36-50). Monument, CO, USA: ISTES Organization.