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Education is fundamentally relational, and the student-teacher relationship is central to student learning. However, high-enrollment classrooms, now common on college campuses, limit student-faculty interaction and opportunities for relationship building. "Clickers" facilitate communication in large classes, but there is a lack of research on the potential relational functions of this technology. This study addresses this gap in the literature by asking: How might the use of clickers in the classroom contribute to the student-teacher relationship? Employing a mixed-method descriptive research design, I created and analyzed three data sets to respond to this question: I observed 3 large clicker-based classes, surveyed students to explore their perceptions of clicker use and student-teacher relational dimensions, and I interviewed a subset of students for assistance interpreting the results. Data analyses resulted in four general findings: clickers can be used for multiple purposes and ends; clickers facilitate aspects of the student-teacher pedagogical relationship; clicker communication is not perceived as comprising a student-teacher relationship; and clickers are viewed as a tool for collective rather than individual communication and dialogue. Clickers may have value as relational tools, as they facilitate some aspects of the student-teacher relationship. The frame of the technology may explain why only some relational dimensions are facilitated, and not others. More research is needed to explore how clickers and other educational technologies may facilitate the student-teacher relationship.

DIGITAL CONNECTION IN A PHYSICAL CLASSROOM: CLICKERS AND THE STUDENT-TEACHER RELATIONSHIP

by

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Approved by

Kathryn Hytten
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for Emily and Grace, that they too may embrace Maxine Greene's philosophy of "I am . . . not yet"

APPROVAL PAGE

This dissertation, written by Stephanie Sedberry Carrino, has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

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CHAPTER I

CLICKERS AND THE PEDAGOGICAL RELATIONSHIP BETWEEN STUDENTS AND TEACHERS

Background

Digital technology has provided us with new ways of interacting with others in the world—new options for relating to, being with, and being in relation with other people. We text, instant message (IM), snap-chat, tweet, face-time, email, blog, face-book, podcast, you-tube, swipe, and push buttons to communicate with others. We live in digital times, and educational practice has not been immune to this cultural shift.

Teachers and educational institutions have incorporated new digital technologies as they have emerged, and new technologies have been developed specifically for educational practice. Teachers and students commonly use digital technology to communicate, to connect, and to relate with one another. Learning management systems like *Blackboard*, *Canvas*, and *Moodle* allow teachers to create and deliver content to students, and monitor students' progress. Online homework modules deliver web-based assignments and assessments, and allow students to pose questions and submit their work. In addition, most university learning management platforms offer email and other tools for both students and teachers to use to communicate. How far can educational technology take us in the realm of human relations? What are the limits of technology-mediated communication for educational practice?

These questions appear deceptively simple. However, they become more challenging when you consider the nature of education as a unique, ethics-based human process that is fundamentally, and necessarily, *relational*. If this is the case, then the use of technology-mediated communication in a classroom, with its potential for introducing new ways of relating and being in relation with others, may be more consequential than it initially appears. If the use of digital technology impacts and might potentially alter the ways we relate to and with others, then the use of digital technology as a tool for communication and relationship development in the classroom could potentially transform the educational process.

Education as Relational: A Sociocultural Framework

Education is a human activity that is ultimately relational. Teaching and learning are not individual, purely cognitive activities. Instead, education happens *between* people—in the encounter between teachers and students, when they collaborate to create common meaning. Education is a social and dialogical phenomenon, occurring in the context of a relationship.

This theoretical positioning of education as a social and relational phenomenon is based in sociocultural theory. A sociocultural theory of learning places the interaction between teachers and students at the center of teaching and learning activities—a shift from more 'teacher-focused' views of education. Sociocultural theorists believe that students develop and learn by integrating their previous knowledge and experience with new information *in the context of social interactions with others* (Scott & Palincsar, 2014). This theoretical framework has driven numerous pedagogical shifts in the

university classroom: flipped and inverted classrooms, peer-assisted learning, problem-based learning, collaborative learning, cooperative learning, active learning, and experiential learning (Bishop & Verleger, 2013; Jonassen & Easter, 2010).

However, to view educational practice through the lens of sociocultural theory is to see teaching and learning as involving much more than new classroom pedagogies. A sociocultural perspective on learning is premised on the fact that education is a social process involving many parts, including a teacher, student, content, context, tools, and an educational environment; but the presence of the parts alone does not constitute 'education.' Education is not just *mediated* by student-teacher interaction; the interaction itself *constitutes* education. Teachers guide their students in how to think about material, what to question, and how to integrate new knowledge into a way of being. What this means is that, from a sociocultural perspective, the student-teacher relationship is at the core of student learning. This means that teaching and learning require human interaction on a *relational* level.

While there are numerous philosophers who view 'being' itself as relational, Lev Vygotsky most directly articulates the centrality of relationality within the educational process. Vygotsky (1986), a prominent Soviet psychologist and early sociocultural theorist, argues that human beings are social beings, and that all development, growth, and learning come from experiences relating with others (p. 66). He says that teachers need to be present to create relational possibilities and engage in dialogue with students. For Vygotsky and other sociocultural educational theorists, student-teacher relationships

are not just important but *necessary*, because we learn, and "become," through dialogue with others. This theoretical perspective frames the present study.

The Student-Teacher Relationship

While there is a strong theoretical orientation underlying the claim that the student-teacher relationship is important to learning and development, there is also a significant base of research, across various research traditions and disciplines, on the positive effects of favorable student-teacher relationships, predominantly on student outcomes. A favorable student-teacher relationship has been associated with numerous positive student outcomes including higher academic achievement and intellectual development (Pascarella & Terenzini, 2005); increased confidence and self-direction (Ryan, Gheen, & Midgely, 1998); active student participation (Poirier & Feldman, 2007; Trees & Jackson, 2007); interest and motivation (Komarraju, Musulkin, & Bhattacharya, 2010; Zepke, Leach, & Butler, 2010); commitment (Strauss & Volkwein, 2004); increased effort (Lundberg & Schreiner, 2004); satisfaction (Calvo, Markauskaite, & Trigwell, 2010; Dobransky & Frymier, 2004); behavioral and emotional engagement (Hughes, Luo, Kwok, & Loyd, 2008; Zepke et al., 2010); and deep-learning (Trigwell, 2005).

However, a significant problem with this body of literature is that the construct 'favorable student-teacher relationship' has been operationalized in many different ways across these studies, and in a variety of contexts. There has been little research on the qualities of a favorable student-teacher relationship, thus there is no general agreement on the dimensions related to a favorable student-teacher relationship. This pedagogical

relationship is most certainly multi-dimensional—but just what those dimensions are remains unclear. For example, while some studies attempt to measure a specific aspect of the relationship or way of being in-relation (like connectedness, shared control, trust, or mutual respect), others measure teacher variables (like supportive behaviors, immediacy, and approachability) that facilitate the pedagogical relationship. There are a number of questionnaires available designed to measure student-teacher relationships, but there does not appear to be a consensus on the characteristics or components of this construct, how to measure it, or if certain aspects of the relationship might be more important than others.

Two recent articles in leading academic journals (*Teacher's College Record* and *The Oxford Review of Education*) claim that there are gaps in the literature on teacher-student interaction, and call for more attention to this area of inquiry. Bundick, Quagliam, and Haywood (2014) argue that the student-teacher relationship is central to "student engagement," which is strongly related to academic achievement and general student well-being. They offer a conceptual model of engagement that includes the interactions among students and teachers, and claim that there is a "glaring limitation in the literature" (p. 7) about the qualities of these interactions and social processes in the classroom. Similarly, Hagenaur and Volet (2014), in an article titled "Teacher-Student Relationship at University: An Important yet Under-researched Field," argue that the teacher-student relationship is important to understanding quality teaching and the sense of "belonging" and "represents a relevant and promising area for future research in the field of higher education" (p. 384).

Although there is a theoretical base for the assertion that positive student-teacher relationships are important (sociocultural theory), as well as a significant body of research supporting positive student outcomes resulting from or associated with a positive student-teacher relationships, and a call for more research in this area, many of our contemporary educational practices appear to ignore this compelling perspective on education. Kathy Hytten (2012), an educational philosopher interested in social justice education, says that students often find universities to be impersonal, and she believes that "it is the relationships I develop with students, through dialogue and confirmation, that matter most to them, not the materials I teach them" (p. 54). One such contemporary educational practice that limits personal connections between teachers and students is the prevalence of large, lecture-based classes.

High-enrollment Classes in Higher Education

In a "traditional" university classroom, there are approximately 20 students and a teacher in a shared space where students are actively involved in their learning, engaging in deep thinking, and receiving feedback and personal validation from the teacher (Cuseo, 2003). While not all traditional university classrooms live up to this ideal, this intimate educational environment promotes student-teacher interaction, offering the opportunity for student-teacher dialogue and relationship development.

However, universities have faced severe budget cuts over the past 6+ years, resulting in many changes that threaten the quality of education students receive, including increasing classes sizes (Iowa Department of Education, 2009; Oliff, Palacios, Johnson, & Leachman, 2013). While the traditional classroom of 20 or so students still

exists, mostly in upper level course offerings, many classes have been replaced by large (100+) or mega (250+) enrolled class sections. The University of Arizona, for example, offers a number of mega-size undergraduate classes each semester, enrolling as many as 1,200 students per section, and 18% of their total course offerings enroll more than 100 students (Ryman, 2012). Virginia Tech has one class that enrolls 3,000 students in an on-campus theatre, and routinely has 24 courses each semester with 300+ students enrolled (Parry, 2012), and UNC-Chapel Hill has recently increased the number of large classes by almost 20% (Hill, 2011). On my own campus, 67 of the 2,222 classes offered in the 2013-2014 academic year had enrollments exceeding 100 students (Office of Institutional Research, 2014). High-enrollment classes have become a part of the university experience for many faculty and students.

Large class sizes are not new a phenomenon. Joseph Lancaster, a British educator in the late 1700s and early 1800s, designed an economically feasible schooling model to educate the masses. His system, now called the Lancasterian or monitorial system, had one teacher and as many as 1,000 students in a single classroom. Students were arranged by ability, and monitored by older students who functioned as unpaid teachers. Early American schools adopted his model, and by 1930, Lancasterian schools were well established in the northwest (Nasaw, 1979).

These schools were marked by strict discipline. Older students walked along the rows of students giving instructions and punishing students for talking, tardiness, dirty hands, and any disobedience (Spring, 2010). According to an article in *History Today*,

this punishment included “suspending naughty children in a cage from the ceiling” (Vogler, 2015, p. 4).

While many aspects of the Lancasterian model are no longer employed in schools, the idea of few teachers educating large numbers of students at a low cost remains. These large classes are cost-effective because faculty can teach more students in the same course section, there are concerns with the *quality* of the educational environment in these massive classrooms. A central concern is that large classes limit student-faculty interactions, and result in an impersonal environment (Trees & Jackson, 2007). Physical and interpersonal distance means less opportunity for students to ask questions, and less opportunity for student-teacher relationship building. Studies show that students are less engaged and less participative in large classrooms (Phoenix, 1987; Rocca, 2010; Weaver & Qi, 2005). In terms of student performance, the effect of increased class size on performance is—as expected—negative. Students receive *lower* grades in larger classes, even when everything else remains equal (Bandiera, Larcinese, & Rasul, 2010; Keil & Partell, 1997). Clearly, mega-classes threaten the development of an environment conducive to student-teacher relationship building. Yet, amid these concerns, large and mega-classes remain a part of higher education.

Technology-mediated Communication in Education

While there are concerns about the impersonal environment of high-enrollment classes, they have emerged concurrent with educational technology that offers numerous opportunities for addressing the limitations of this classroom. In general, digital technology has allowed us to rethink how we interact and relate with one another, and has

offered new notions of what it means to be present with another person (Xu, Zhang, & Li, 2011). Technology-mediated communication in education has evolved to the point where many consider it an acceptable substitute for the kind of communication that occurs in traditional, small, intimate classrooms—and some might argue that technology-mediated communication offers an *enhanced* educational experience. For example, synchronous and asynchronous online courses rely on technology-mediated communication between student and teacher, and these digital platforms for education are ubiquitous. But what about the mega-class on campus? How might the use of technology in these classrooms allow us to rethink teacher-student communication and relationality?

Technology is a tool, but not just a neutral tool that improves human efforts in efficiency and effectiveness. The medium matters. The use of technology in general, and the kind of technology employed specifically, requires an ideological shift in our understanding of human action—it challenges our way of thinking and being and relating. So as technology-mediated communication tools have been implemented in classrooms to allow for student-teacher interaction in large classes, how have we needed to rethink what constitutes faculty-student interaction? How might technology use require that we re-conceptualize the student-teacher relationship?

There is some literature that suggests that current, traditionally aged students were born in the "digital age," and can be considered "generation Y" (Twenge, 2006), "digital natives" (Prensky, 2010), "millennials" (Price, 2010), or the "digital generation" (Jukes, McCain, Crockett, & 21st Century Fluency Project, 2010). The idea is that this generation, born in the 1980s and later, not only uses technology in a different way than

previous generations, but that this generation *thinks* about technology in a different way. Digital communication is a given and is foundational to who they are. This represents a shift in thinking, and may indicate that the use of technology itself is a "way of thinking" (Clark, 2008; Clark & Chalmers, 1998).

Is it possible that educational technology can redefine the impersonal nature of the high-enrollment class, and allow us to rethink what constitutes teacher-student relationality? Can technology-mediated communication systems mediate the limitations of the large lecture class by facilitating new ways of relating and being 'in relation' in the classroom? One technological innovation that may afford this possibility is clickers.

Clickers

"Clickers" is a generic term for classroom communication systems that promote student-teacher interaction by allowing students to provide real-time digital feedback to the teacher. Also referred to as Classroom Response Systems (CRSs), Audience Response Systems (ARS), Personal Response Systems (PRS), and Student Response Systems (SRS), these classroom-based mediated discourse technologies have been used in college classrooms for almost 20 years, and are now considered mainstream (Beatty & Gerace, 2009). According to Wankel and Blessinger (2013), clickers are "participatory tools that mediate discourse in the classroom" and facilitate student participation (p. 5).

While the percentage of classes that employ clickers was less than 7.4% across all types of institution five years ago (The Campus Computing Project, 2010), the impact on students is nonetheless significant. For example, at Berkley in the 2001-2002 academic year, only 3-4% of their undergraduate courses were large survey courses, yet 98% of

Freshman and 72% of transfer students took at least one of these high-enrollment courses (The Regents of the University of California at Berkely, 2003). And while STEM disciplines were the early adopters of this technology, it is becoming more widely used in other disciplines as well. Clickers are a part of today's college experience.

Clicker systems, like *TurningPoint, iClicker*, and *Learning Catalytics*, are hardware and software that allow a teacher to ask a question and students to submit answers using a handheld transmitter (a 'clicker' or other 'smart' device) that either beams a radio-frequency signal to a receiver (the "base") attached to the teacher's computer, or is digitally processed online from students' own smartphone or computer. Software on the teacher's computer collects the students' answers and produces a graphic showing aggregate student answers. The teacher can allow student responses to be anonymous (for informational or formative assessment purposes) or they can be tracked individually (for a grade or participation points). Figure 1 shows examples of handheld clickers and the iClicker "base" which connects to the teacher's laptop with a USB cable.

Figure 1. Examples of Clickers and the iClicker Receiver.

Some clicker systems are completely free (*Poll Everywhere*), while others require students to purchase the handheld clicker (*iClicker)*, and still others require students to purchase a user license (*Learning Catalytics*). One of the primary uses of clicker systems is for the teacher to use the students' feedback to make informed instructional choices in real-time. In many ways, clickers were designed to replace the verbal and non-verbal communication that is typical of smaller classrooms. Older clicker systems only allowed students to input answers to multiple-choice questions, but newer systems allow students to respond with numeric and text answers as well as to sketch, graph, and upload images and text. All clickers are one-way communication systems—from students to teacher with the response options pre-determined by the teacher.

Clicker use in the classroom has been the focus of extensive research, particularly in the field of STEM education. Some of this research focuses on the relationship between clicker use and student learning—a "bottom line" approach that examines clicker use with student performance (i.e., grades). While some find that clicker use in the classroom correlates with higher test scores, other studies find no such effect (Elicker & McConnell, 2011; FitzPatrick, Finn, & Campisi, 2011; Poirier & Feldman, 2007; Shaffer & Collura, 2009; Shapiro & Gordon, 2012; Yourstone, Kraye, & Albaum, 2008). The mixed results in this "outcomes" literature may indicate that a more nuanced approach to understating the benefits of clicker use is needed.

Toward this end, other studies look at more specific effects of clicker use, like increased student participation, the promotion of active learning, group work and peer instruction (Barr, 2013; Blasco-Arcas, Buil, Hernández-Ortega, & Sese, 2013; De Gagne,

2011; Denker, 2013; Jain & Farley, 2012; Oigara & Keengwe, 2011; Oswald, Blake, & Santiago, 2014; Patterson, Kilpatrick, & Woebkenberg, 2010; Shaffer & Collura, 2009; Stowell & Nelson, 2007; Wolter & Lundeberg, 2011).

Others have argued that understanding the benefits of clickers in the classroom requires an examination of the ways that clickers are used—that is, the pedagogies that are utilized with clickers. Numerous studies attempt to separate the technology and the pedagogy by comparing different response systems, like clickers vs. hand-raising vs. flashcards, with similar pedagogical approaches. This has resulted in a significant body of research on clicker-based pedagogies (Anthis, 2011; Barr, 2013; Beatty & Gerace, 2009; Gray & Steer, 2008; Greer & Mott, 2009; Hoekstra & Mollborn, 2012; Lasry, 2008; Mollborn & Hoekstra, 2010; Monk, Campbell, & Smala, 2014; Oswald et al., 2014).

Still others examine student, faculty, and classroom factors associated with effective clicker use (Beatty, 2011; Kolikant, Drane, & Calkins, 2010; Trees & Jackson, 2007; Trew & Nelsen, 2012). Most of the research on clickers, though, is focused on the concept of engagement.

"Engagement" is a multi-faceted construct that includes behavioral, cognitive, social, and emotional dimensions. Generally, student engagement is defined as motivation, attentiveness, interest, involvement, participation, and enthusiasm for learning. Student "engagement" is considered the best predictor of student learning and academic success (Quaye & Harper, 2015), and the research on clickers and engagement consistently shows that there is increased student engagement with the implementation of

clickers (Blasco-Arcas et al., 2013; De Gagne, 2011; Patterson et al., 2010; Trees & Jackson, 2007; Wolter & Lundeberg, 2011).

In a thorough review of the literature on clicker use, using multiple databases, I was unable to find any research on the use of clickers and the student-teacher relationship.

Clickers and the Student-Teacher Relationship

Though this technology is widely used in large classrooms for the express purpose of facilitating student-teacher communication, very little attention has been given to the potential relational functions of the clicker. While the use of clickers certainly increases student-to-teacher interaction and communication, do students consider this form of communication to be 'relational' communication? That is, might they consider the act of pushing buttons or typing responses to be participating in a pedagogical relationship with the teacher? This avenue of inquiry into the relational dimensions of clicker use represents an important direction for research in both the areas of educational technology and the student-teacher relationship in higher education.

If it is the case that education is relational—occurring in-between the student and teacher when they create shared meaning—then clicker communication may be perceived as a tool for relationship building. Is it possible that the use of clickers can facilitate the experience of a student-teacher relationship?

Problem Statement

Shrinking university budgets are resulting in large and mega-sized classrooms on college campuses, which limit student-teacher interaction and may threaten the quality of

student-teacher relationships. Classroom Response Systems (clickers) are common features in these large classrooms, and were designed to facilitate student-teacher communication. However, there has been little research on the potential relational functions of these clicker systems. Is it possible that clicker communication contributes to student-teacher relationships? Might clickers be perceived as relational tools?

This problem is significant because the importance of the student-teacher relationship has been theoretically grounded and supported by research. Since class sizes are increasing, it is important that we understand how the 'impersonal' nature of high-enrollment classes is impacting this relationship, and how the use of technology might function to mediate the negative effects.

Purpose of Study

The purpose of this study is to investigate students' perceptions of classroom clicker use and the student-teacher relationship in high-enrollment classrooms. Specifically, in this study I investigate student perceptions of their teachers along pedagogical relationship dimensions in high-enrolled classes where clickers are utilized, and address a gap in literature on the use of educational technology and the student-teacher relationship.

Research Question

The central research question that drives my study is as follows:

How might the use of clickers in the classroom contribute to the student-teacher relationship?

Research Design

The research design is the specific plan for answering the research question, and is structured based on the nature of the research question and the goal of the research. It outlines the methods used to collect, analyze, and interpret data, and provides the limits of the results. This investigation is a descriptive research study.

Descriptive Research

Descriptive research is designed to provide a snapshot of something: behaviors, attitudes, or characteristics of a selected group in a specific context. In addition, descriptive studies can illustrate or highlight associations or relationships between and among studied behaviors, attitudes, and/or characteristics. Descriptive research designs may include observations, surveys, and/or interviews, and it is an excellent method for exploring new research areas and suggesting foci for future research (Office of Research Integrity (ORI), 2014).

A descriptive study can be either quantitative or qualitative in nature, as the goal is to collect data and describe what is being studied. Data can be numerical, as in statistical frequencies, but can also be non-numerical and include categories, patterns, or themes that emerge from analyses of observations or text. Descriptive research allows researchers to organize and describe what is being studied (Glass & Hopkins, 2008). This study is a *mixed method descriptive design* because it includes both quantitative and qualitative data to respond to the research questions.

Mixed Methods/Methodological Triangulation

A mixed methods research design is the use of more than one method of data collection in a single study, and generally refers to the collection and analysis of both qualitative and quantitative data to respond to research questions. This study might also be referred to as a "triangulated" study because "methodological triangulation" refers to the use of multiple methodologies in a single study (Jick, 1979). Mixed method or triangulated research is used to establish and strengthen validity in a study (Guion, Diehl, & Mcdonald, 2011). The assumption is that looking at something from multiple viewpoints provides a better understanding of a phenomenon than any single approach alone (Duffy, 1987). For this study, I collected and analyzed three types of data:

1. Participant observation field notes (qualitative data)
2. Survey responses (quantitative data)
3. Interview responses (qualitative data)

Data Collection and Analysis

The population for this study is 342 undergraduate students enrolled in three large (90+ students) classes at a large, public university in the south during the Spring 2015 semester. In these classes, the teachers use clickers as a tool for student-teacher communication, and have consented to participate in the study. These classes were selected from a group of instructors who voluntarily agreed to work with the University Teaching and Learning Center to transform their classrooms by using clickers and active learning pedagogies in their large classes. The classes consist of one section of ACC 202: Managerial Accounting with a spring enrollment of 130, and two sections of NTR

213: Introduction to Nutrition (two different instructors), with enrollments of 122 and 90. I applied to the Institutional Review Board at UNCG for an exemption from full board review, and was approved. A copy of the approval letter is in Appendix A. Data collection protocols were as follows.

Participant observation. I observed the three classes a minimum of 1/3 of the scheduled class meeting times, and recorded field notes of my observations about clicker use in the classroom and student-teacher interactions. Specifically, I recorded behaviors, activities, events, features, and dynamics of the class meeting, and included both descriptive and reflective information. The observation form I used for each class meeting is included in Appendix B. I analyzed my field notes by developing thematic codes as topics appeared in both the descriptive and reflective notes.

Survey. I created a survey of questions designed to explore students' perceptions of clicker use in the classroom and dimensions of the student-teacher relationship. The items were based on aspects of the student-teacher relationship identified in the literature. The survey also included items requesting demographic data and classroom specific data, and was delivered electronically via Qualtrics, a survey-based research platform supported by the institution. Students were recruited from the enrolled student population of the three large classes, and participant recruitment took place verbally during regularly scheduled class meetings. Survey responses were anonymous. The format of items included multiple-choice and Likert-type scaled items.

I received a response rate of 36%, which is an above average response rate for an online survey (Resources, Instructional Assessment, 2011). There were no monetary or extra-credit incentives offered to participants who volunteered.

A preliminary version of this questionnaire was presented to two experts in educational measurement to establish face validity. In addition, I administered this survey to a small group of students outside the population for this study prior to study administration to ensure that students could easily interpret the items on the survey. A number of adjustments were made based on feedback received.

I analyzed statistical data from the survey using IBM SPSS 23. I ran descriptive statistical analyses, including frequencies and averages, and some inferential statistics including ANOVAs and Tukey post-hoc analyses. The descriptive statistics allowed me to summarize the results of the individual survey items, and the ANOVAS and Tukey's compared findings across demographic categories. I consulted with the Center for Educational Research and Evaluation (CERE) to ensure that these statistical analyses were appropriate, run correctly, and interpreted using best practices.

Interviews. Finally, I interviewed a small number of students enrolled in the three classes to attempt to clarify and explain any findings from the participant observations and survey analyses. The goal of these interviews was to solicit student interpretations and explanations to assist me in interpreting the results. I interviewed 18 students, six from each class. These interviews were informal and unstructured, and designed as follow-ups to the other forms of data collection.

Assumptions, Limitations, and Delimitations

All researchers make assumptions about the phenomenon being studied and the research process. As a college-level instructor for 20 years, I have pre-existing ideas about classrooms, teachers, students, curricula, educational technology, and the student-teacher relationship. My research focus grew out of my concern for the ethical and relational nature of education and the ways that technology may affect the practice of education.

I believe that the student-teacher relationship is important because students need to trust that the teacher is both credible and ethically oriented to the students' best interests before students will risk changes in thinking required for learning. As a "digital immigrant," Prensky's (2001) term for those born before the digital explosion, I am critical of the use of digital technology as a replacement for face-to-face human interaction, though I am open to exploring the possibilities. I view education as a moral activity of great import, and I believe the processes we use in this endeavor deserve interrogation.

I presumed that my presence in the classroom as an observer would not bias my results significantly since I was one of many in the classroom. I trusted that students would self-report accurately and I made every effort to provide a safe environment and anonymity to encourage honesty, but I am aware that some students may not have been particularly thoughtful in their responses, which affects the validity of the results. This limitation is a limitation of all self-report research, and is not particular to this study.

This study population consists of 342 students enrolled in three classrooms in the Spring 2015 semester. This is only a small sample of the approximately 15,000 undergraduate students enrolled in approximately 1,700 classes (Office of Institutional Research, 2014). The sample is not only small, but it is also not a random sample. However, I selected the classes from a group of teachers who volunteered to participate in a grant initiative to learn how to effectively integrate technology into their classrooms. Choosing this particular population contributes to my ability to trust my results because the participating teachers were attempting to use clicker technology in a way that optimized student-teacher communication, rather than just as a tool for taking attendance and testing.

There are some important aspects of the topic under investigation that I did not address in this study. I did not investigate the teachers' perceptions of clicker use and the student-teacher relationship. Though certainly teachers have opinions about large class sizes, use of clickers in the classroom, and student-teacher relationships—and these perceptions are important to understand—they are not the focus of this study. In addition, I did not consider clickers and academic outcomes (i.e., grades). The focus of this study was on students' perceptions of clicker use and the student-teacher relationship.

Significance of the Study

The purpose of this study was to investigate students' perceptions of classroom clicker use and aspects of the student-teacher relationship in high-enrollment

classrooms—specifically, to explore what dimensions of the student-teacher relationship, if any, students associate with clicker use in the classroom.

This is an important area of investigation because teaching and learning are social, ethical, and relational human activities. As classroom sizes grow, students and teachers have less opportunity for "relating" with one another. Since clickers have become common tools in large classrooms to facilitate student-teacher communication, it seems appropriate to ask if clickers might serve as *relational* tools—that is, if they might be perceived as facilitating, or constituting, a relationship between students and their teacher. Since it is a relatively new area for research, I utilized a mixed method descriptive research design to allow for the broadest possible range of results.

The results of this study should contribute to the literature on student-teacher relationships, large college classrooms, clicker technology, and ultimately allow me to comment on the possibilities for technology-mediated relationships in education.

Chapter Preview

In Chapter II—Education, Technology, and Student-Teacher Relationships, I offer an in-depth discussion of the literature for the theoretical frameworks of this study as well as each major concept included in this investigation. Topic areas include socioculturalism and its related philosophies, Lev Vygotsky's theory of relationality, the dimensions of the student-teacher relationship, technology-mediated communication, high-enrollment classes, and a review of clicker-use history and research findings. This provides the background context for the present study.

In Chapter III—Mixed Method Descriptive Research Design, I discuss mixed method descriptive research foundations and protocols, quantitative and qualitative research assumptions, a rationale for the approach I take for this study, an overview of the research setting and population, data collection methods, data analysis methods, issues of trustworthiness, and the limitations of the methodologies employed.

In Chapter IV—Clickers as Tool for Pedagogical Practice: Five Functions of Clicker Questions, I provide a summary of my findings, and analyze and interpret my participant observation data.

In Chapter V—Clickers Facilitate Communication and Connection, I summarize the findings, and analyze and interpret the survey data and the student interviews.

In Chapter VI—Technology and the Pedagogical Relationship between Students and Teachers, I answer my research question and situate my findings within the larger discussions of educational technology, the relational nature of education, and the student-teacher relationship. I also discuss the limitations of the findings, the practical applications of the results, and make recommendations for future research in this area.

CHAPTER II

EDUCATION, TECHNOLOGY, AND STUDENT-TEACHER REATIONSHIPS

A Relational Approach to Education

Education is a unique, ethics-based human process that is necessarily *relational*. It is more than just curriculum. It is "concerned with what it means to be a human being and how we live with others who share our world" (Shapiro, 2010, p. 16). Education is humans interacting with one another with the potential to help or hurt self and others, which makes it a moral, relational endeavor (Jarvis, 1995).

Some education researchers focus on teachers and their qualities and practices; some on students and their qualities and practices; some on curriculum issues; and others focus on the learning environment. To view education as a moral, relational activity, however, is to highlight the human encounter—the relating and relationship between the people involved—the student and teacher. You might have students in a classroom with a teacher, tools, and a lesson plan, but that does not mean that teaching and learning will take place. Education is not simply the assembly of the required elements. Education happens when the teacher and student, in the context of a learning environment and ideas, acknowledge each other and begin a dialogue. Education happens between people, and this encounter is a moral one.

A relational, dialogical approach to understanding education is based on sociocultural and social constructivist/constructionist philosophies. In the following

sections, I offer an overview of these theoretical perspectives in order to illustrate the relational dimension of education, and then provide an overview of the literature on student-teacher relationships, technology-mediated communication, and clickers in the classroom.

Sociocultural Theory and Lev Vygotsky

Sociocultural theory is a theory of learning and development that proposes that people learn when they interact with others and the culture in which they live. That is, development is a social phenomenon, not an individual one. Lev Vygotsky (1978), the Soviet psychologist who has been credited with framing the sociocultural theory of development, says education is

> an interpersonal process is transformed into an intrapersonal one. Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people . . ., and then inside the child. This applies equally to voluntary attention, to logical memory, and to the formation of concepts. All the higher [mental] functions originate as actual relations between human individuals. (p. 57)

What Vygotsky means in this statement is that students develop and learn by integrating their previous knowledge and experience with new information *in the context of social interactions with others* (Scott & Palincsar, 2014; Tharp & Gallimore, 1988). He argues that human beings are social beings, and that all development, growth, and learning come from experiences relating with others (Vygotsky, 1989, p. 66). He summarizes this position in his famous quote: "Through others we become ourselves" (Vygotsky, 1997, p. 105).

This idea about the relationality of education even applies to what appear to be individual learning processes, for example reading a book or taking a nature walk. Vygosky (1978) differentiates between "learning" and "development." Learning is what happens between people, and precedes development (p. 35). So, a person might read a book, for example, and their understanding of the text will be limited by their present "development." However, interaction with a "more knowledgeable other" in the form of collaborative dialogue, what Vygotsky calls teaching, can result in "mental development." So, a student who engages in a collaborative discussion about the text with a teacher (or other person) not only learns, but can also "develop" more complex thinking capabilities. What this illustrates, and what is important about sociocultural theory, is the idea that learning is not an independent, cognitive activity undertaken by an individual, but instead it is dependent on human relations with others.

Vygotsky sees learning as a mode of experience that is embedded in a social context, always. The context is place, time, culture, and both conceptual and material tools. It is not a purely cognitive activity contained within an individual—not the result of a person thinking—but the result of social participation.

One of Vygotsky's most well-known ideas is the Zone of Proximal Development (ZPD). While ZPD does not directly relate to the student-teacher relationship, I will offer a brief discussion to be thorough in my review of Vygotsky, since his ZPD is used by contemporary researchers who study student-teacher relationships (Compernolle, 2012; De Marsico, Sterbini, & Temperini, 2014; Karlström & Lundin, 2012; Kuusisaari, 2014; Mestad & Kolsto, 2014; Wass, Harland, & Mercer, 2011). The ZPD is "the distance

between the actual developmental level . . . and the level of potential development . . . under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p. 86). The ZPD is where learning and development potential lie—in the space between what someone can do independently, and what they have the ability to do with support. The idea is that the most effective instruction is targeted not to what the student can already do, but within this ZPD. Understanding the ZPD can help teachers to increase skills and understandings, and also advance development.

For example, when I read Plato's *The Republic* for the first time, I could summarize what I read, but I did not understand what, or why, he said certain things in the ways he said them. According to Vygotsky, I could read, and reread and reread, and still not have much of an enhanced understanding. What I could understand was limited both by my knowledge and my way of thinking about texts. After an engaging classroom discussion where Dr. Hudak talked about how Plato was challenging conventions of the time, and he introduced the notion of scaffolding arguments in the text, I was able to read *The Republic* again and understand it differently, more richly. In Vygotskian terms, Dr. Hudak's discussion was within my ZPD, and advanced both my learning and development.

Vygotsky's positioning of education as fundamentally relational means that teachers must engage in dialogue with students in order to create relational possibilities. In his theory of cognitive development, Vygotsky (1978) says that interaction with a "more knowledgeable other," like a teacher, doesn't just guide students in how to think about material, what to question, and how to integrate new knowledge. This interaction

also provides what he calls “tools of the mind,” which are the tools that allow a person to develop “higher mental functions” (Vygotsky, 1997). The “tools of the mind” extend mental abilities and mediate mental processes, like language, for example. These “tools” are socio-historical, and reflect cultural values and understandings. I believe that my ability to understand Plato’s scaffolding of arguments, and the idea of “thought experiments,” were tools of the mind that I learned from interacting with Dr. Hudak.

There are many others who view education as a social and cultural practice: Aristotle, Buber, Dewey, Freire, Gadamer, Heideggar, and Noddings, to name a few. There is actually a manifesto of relational pedagogy that was jointly authored by a group of philosophers interested in advancing relational pedagogy as an educational philosophy (Bingham & Sidorkin, 2004, pp. 5–7). For these philosophers, student-teacher relationships are not just important but *necessary*, because we learn, and “become,” through dialogue with others.

Education is not just mediated by student-teacher interaction; the interaction itself constitutes education. This means that learning happens not as a result of student-teacher relations, but that the relating itself is the learning. This defines the “where” of learning—learning is co-created in-between the student and teacher, “The social dimension of consciousness is primary in time and in fact. The individual dimension of consciousness is derivative and secondary” (Vygotsky, 1979, p. 30). Gert Biesta, a contemporary educational philosopher, summarizes this idea well:

> A theory of education should be a theory about the interaction between the teacher and the student. A theory of education is, in other words, a theory about the educational relationship. It is not about the ‘constituents’ of the relationship

> (i.e., the teacher and the learner) but about the 'relationality' of the relationship. (Biesta, 2004, p. 13)

Though Vygotsky published his ideas in the 1920s and 1930s, they did not become popular until almost 50 years later when a socio-cognitive paradigm began to emerge in education and the social sciences. This new way of thinking about human development situated learning within a specific context, driven by social, cultural, and historical influences (Scott & Palincsar, 2014). This view of learning as socially constructed was concurrent with the post-positivist and social constructionist thinking that became popular in the 1970s (Alvesson & Gergen, 2009).

Contemporary theorists are applying Vygotsky's ideas to emerging educational practices and technologies, like online education and educational game construction, as well as exploring the application of Vygotsky's theories to educational philosophies, like moral development and creativity in education (Hansson, 2014; Karpov, 2014). The sociocultural theory of learning continues to be relevant today as we try to understand the historical, cultural, and social nature of learning, knowing, and being.

Social Constructivism (with a "v") and Social Constructionism (with an "n")

The terms social constructivism and social constructionism provide a broad framework for understanding sociocultural theory in education, so I will briefly review them here. Both of these terms refer to the idea that reality is socially constructed; that it is an active process of knowledge co-construction where people collaborate to create common meaning; and that language is the tool, or system, through which reality is negotiated. Both social constructivism and social constructionism begin from the

premise that knowledge, development, and meaning are relational, collaborative, and emerge from the joint activities of people (Alvesson & Gergen, 2009; McNamee, 2006; Wankel & Blessinger, 2013). Villaverde and Carter (2009) highlight the power distribution in constructivist thinking. Instead of positioning the teacher as 'expert,' "students are regarded as knowledge producers in contrast to passive recipients or "empty vessels" in more traditional learning environments" (p. 178).

Berger and Luckmann are considered the pioneers of social constructionist thinking. In their classic book, *The Social Construction of Reality: A Treatise in the Sociology of Knowledge* (1967) , they argue that the constructs "reality" and "knowledge" are contextual, and that people use language to construct both society and the self. Thus, reality is "an ongoing human product" (pp. 69–70).

The terms social constructionism and social constructivism are used almost interchangeably in the literature. Though they reference the same idea, the focus is different. According to the *Oxford Dictionary of Sociology*, social constructionism refers to how social reality is constructed through interaction with others and is the term used in sociology. The focus is on the shared reality created. Social constructivism refers to how an individual constructs the world through interactions with others—the cognitive processes we use to create reality. This term is used in psychology, and the focus is on the individual doing the constructing. For my purposes, the social constructionism perspective is more relevant because I am concerned with the interactions that are the basis for how individuals understand the world, and I am less interested in how each

individual makes sense of the interactions. However, the ideas are closely linked, and both frame the sociocultural perspective.

While a sociocultural perspective is based in constructivist/constructionist thinking, the focus is on what and how students learn and how meaning is co-constructed through social interactions. Whichever term is used, the focus in education is the pedagogical relationship between the student and teacher.

The Student-Teacher Relationship

If we presume that learning is a social process arising from the interactions between teachers and students within the context of a pedagogical relationship, what does this relationship look like? How do they need to be "in-relation" for learning to occur?

Attempts to describe or characterize the student-teacher relationship have revealed significant differences in focus. Hagenaur and Volet (2014) claim that there are inconsistencies in how the student-teacher relationship is conceptualized and operationalized in the literature, which is one of the major issues with the body of research. Hoffman (2014), in a review of literature on student-teacher relationships, agrees that attributes of the student-teacher relationship remain ambiguous and unclear. While clearly the age of the students, the social context, and the subject taught are factors that influence the kind of relationship that teachers and students may have, there does not appear to be a consensus on the *type* of relationship, or *qualities* of the relationship, that are necessary to facilitate student learning at the university level. Though it is clear that a student-teacher relationship is important, the nature of that relationship is unclear. What should the pedagogical relationship between the university student and teacher look like?

Should it be marked by professionalism? Care? How dialogic does it need to be? If learning is "relational," what kind of relationship promotes student development?

Though there is no consensus in the literature, there have been a few attempts to describe the nature of the relationship. Anderson and Carta-falsa (2010) noting the importance of quality interpersonal teacher-student relationships to effective teaching, asked students and teachers what they wanted from their relations with each other. The authors analyzed the written narratives of 100 university students and 24 teachers, and three themes emerged: both students and instructors wanted "an open, supportive, comfortable, respectful, safe or non-threatening, and enjoyable interpersonal climate"; students reported a "desire to work together, to share, and to learn and interact with each other, but they did not state a strong desire to work with the instructor"; and instructors "did not express a strong need to collaborate with students" (pp. 136–137). This study indicates that students and teachers share notions of the type of classroom environment that is desirable, but do not report a desire to work closely together.

Helterbran (2008) also surveyed students about the attributes they viewed as important for constructive relationships with faculty. She found that students wanted to be treated with respect and compassion, wanted faculty to demonstrate enthusiasm for their subject, and for them to be available for discussions. Tyler (2014) asked college faculty to rank order 75 statements about the student-teacher relationship and found that teachers want positive communication and emotional closeness, and for students to feel respected and accepted.

It follows that if a construct is not well defined in the literature, then it is also difficult to measure. There are a number of surveys designed to measure the student-teacher relationship at the college level, but they each focus on a different aspect of the relationship and rely heavily on frequency of interaction rather than the quality or qualities of the interactions. For example, the *Student-Instructor Relationship Scale* (Creasey, Jarvis, & Knapcik, 2009) was created for the college population, and focuses on perceptions of instructor connectedness and instructor anxiety. The *Professor-Student Rapport Scale* (Wilson, Ryan, & Pugh, 2010) looks at perceived "rapport" which they define as interactions between teachers and students characterized by friendliness, caring, and closeness. They found that their scale correlated with another scale measuring professor "immediacy," which they define as psychological availability. The *Student–-Professor Interaction Scale* (Komarraju et al., 2010) is a 40-item questionnaire designed to assess various types of student–faculty interactions, though it does not attempt to characterize the student-teacher relationship. For the purposes of this dissertation study, I am not operationalizing "student-teacher" relationship as a variable. Instead, since I am looking at student perceptions of a possible connection between clicker use and a student-teacher relationship, I have chosen to create my own survey items reflecting dimensions and qualities of the relationship identified in the literature.

It is difficult to summarize the research findings related to the student-teacher relationships since the concept of the student-teacher relationship is so broad. There are multiple possibilities for the types, dimensions, and context of these relationships and a myriad of ways in which they may occur. For example, the research on the student-

teacher relationships for primary and secondary grades is plentiful but it is under-researched for higher education environments (Hagenauer & Volet, 2014). What is clear, though, is that positive student-teacher relationships are important, even at the college level.

The focus of most studies on the student-teacher relationship in higher education is on student academic outcomes associated with the relationship, including increased student engagement, reduced drop-out rates, and increased student academic performance. For example, Creasey et al. (2009) claim that connected relationships between students and faculty in the classroom are closely associated with positive achievement attitudes, including student self-efficacy and student satisfaction. Trigwell (2005) found that student contact with faculty correlates significantly with academic achievement and deep thinking/learning, and Halawah (2006) says that engagement with faculty can enhance student academic achievement, intellectual growth, personal development, and college persistence. Kuh (2008), who is considered an expert on student-teacher relationships, considers faculty-student interaction a "best-practice" for student engagement and a "high-impact" practice for student success at the college level (Koljatic & Kuh, 2001).

In one study of student-teacher relationships, researchers asked students about their perceptions of student-teacher interactions along eight different constructs: respect, guidance, approachability, caring, interactions outside of class, connectedness, accessibility, and negative experiences. They conclude that the results of their study "offer strong empirical support for the notion that students' relationships with their

faculty members are associated with important psychosocial and academic outcomes" (Komarraju et al., 2010, p. 339). A two-year study in New Zealand found similar results. Zepke et al. (2010) analyzed the results from 1,246 student surveys across 9 institutions that asked students about what influenced their engagement in classrooms. More than 90 percent of their respondents reported that the teacher was a highly important factor in their motivation and commitment levels—a strong indicator that the student-teacher relationship is important to student engagement. Dobransky and Frymier (2004), in a quantitative correlational study, focused on the interpersonal dimensions of shared control, trust, and intimacy as part of student-teacher relationships. They found that students who perceived their teachers as exhibiting higher levels of shared control, trust, and intimacy reported greater learning.

Other outcomes associated with positive student-teacher relationships in higher education include higher academic achievement and intellectual development (Pascarella & Terenzini, 2005; Eccles, 2004; Goldstein, 1999; Plecha, 2002; Cotten & Wilson, 2006); interactive student participation (Trees & Jackson, 2007); increased interest and motivation (Christensen & Menzel, 1998; Komarraju et al., 2010; Rugutt & Chemosit, 2009; Zepke & Leach, 2010); greater commitment (Strauss & Volkwein, 2004); increased effort (Lundberg & Schreiner, 2004); satisfaction (Dobransky & Frymier, 2004; Pascarella & Terenzini, 2005); enhanced behavioral and emotional engagement (Decker, Dona, & Christenson, 2007; Zepke & Leach, 2010); and deeper learning (Trigwell, 2005).

All of these studies found that student-teacher relationships, however they defined them, were positively related to student outcomes. What this review shows is that most of the research focuses on outcomes related to the student-teacher relationship rather than on the characteristics or qualities of a positive student-teacher relationship in a university setting.

Another way to look at the student-teacher relationship is to consider theoretical approaches to the pedagogical relationship. One of the most compelling theoretical definitions of the pedagogical relationship is from Nel Noddings and her philosophy of care as it relates to the students and teachers.

Noddings's Pedagogical Relation of Care

Nel Noddings (2005, 2013) is a philosopher who views "human caring" as the foundation for ethical response in the world and the source of all moral life, and she extends this idea into pedagogy and the student-teacher relationship. She argues that "ethical caring" is the basis for how teachers and students should meet and treat one another—the ethic that should guide the state of being in-relation in the classroom. She calls this the pedagogical relation of care. In her view, pedagogy is more a matter of disposition than technique. Pedagogy is relation, a physical and emotional presence, and education is the lived relationality between teacher and student.

The basis for this ethic of care arises from a natural instinct to nurture, which Noddings argues is a maternal, feminine instinct. She explains that "women and men differ on social attitudes and approaches to relationships" based on differences in "evolutionary experience" (2010, p. 24). Though she rejects an essentialist view of

gender, she stops short of describing the natural instinct to care as a social construct assigned to women and de-emphasized for men. She argues that the instinct to care is both biological (because it is central for human survival) and social, and that natural caring springs from *maternal* instinct. I would argue that this instinct to care is a *human* instinct, and is expressed as 'maternal' because of the social roles assigned to women. However, the important point here is that Noddings (2013) argues that "natural caring," or our instinct to care for specific others, is what gives way to "ethical caring," which is when one acts caringly because it is the appropriate response in a specific situation. This caring is based in "receptivity, relatedness, and responsiveness" (p. 2) rather than from a more culturally masculine view of ethics based in principles, fairness, laws, and justice. Noddings's pedagogical relation of care is an ethical caring that emerges from our natural inclination to care for others.

Noddings defines this relation of care as a mode of being, or a way of being together that is characterized by three states: engrossment, motivational displacement, and mutual recognition. She acknowledges the power relationship between student and teacher as uneven, and her label of the teacher as the "one-caring" (2013, p. 30) and the student as the "cared-for" (2013, p. 59) reflect this recognition.

The state of engrossment is a form of attentiveness, or "an open, nonselective receptivity to the cared-for" (Noddings 2005, p. 15). This attentive way of being includes displacing your interest in your own reality to focus on the reality of another, and constitutes a shift in perspective. It is a movement away from self to other, and "when we see the other's reality as a possibility for us, we must act" (Noddings, 2013, p. 39).

What she means is that when we allow ourselves to see another's reality, which requires that we displace our own, we feel the need to care. So this pedagogical relation of care requires that the teacher is attentive to the world from the student's eyes. She says: "Caring involves stepping out of one's own personal frame of reference into the others'" (Noddings, 2013, p. 24). Engrossment is not empathy—or the act of putting yourself in the shoes of the other. The act of projecting yourself into another is still a focus on self. Instead, engrossment is remaining open to the world view of the other.

The second part of the pedagogical relation of care is a state of motivational displacement. This is the act of making a commitment to do something, to act, based on the needs of the other. Noddings (2005) says that motivational displacement is "the sense that our motive energy is flowing towards others and their projects" (p. 16). What she means is that a caring pedagogical relationship involves a teacher who is committed to act on the needs of the students rather than on their own needs. According to Noddings (2005), when I become engrossed, and my personal motivations are displaced by the needs of the cared-for, I "respond as positively as my values and capacities allow" (p. 2).

The third part of the pedagogical relation of care focuses on the mutual recognition of the relationship. She says that the cared-for (the student) must perceive the engrossment and motivational displacement of the one-caring (the teacher). The cared-for needs to receive the caring and show that it has been received for the encounter to be considered caring (Noddings, 2005). The response does not need to be verbal

acknowledgement or gratitude, but they must be receptive to the caring. Noddings (2005) explains it this way:

> The relational sense of caring forces us to look at the relation. It is not enough to hear the teacher's claim to care. Does the student recognize that he or she is cared for? Is the teacher thought by the student to be a caring teacher? When we adopt the relational sense of caring, we cannot look only at the teacher. This is a mistake that many researchers are making today. They devise instruments that measure to what degree teachers exhibit certain observable behaviors. A high score on such an instrument is taken to mean that the teacher cares. But the students may not agree. (pp. 1-2)

Noddings's pedagogical relation of care requires the engrossment and motivational displacement of the one-caring and it requires recognition by the cared-for. Her position that ethical caring should guide the student-teacher relationship supports my own understanding of education as a fundamentally moral practice. However, in an increasingly technological world, what might this ethical caring look like?

Technology-mediated Communication

Digital technology has provided us with new ways of interacting with others in the world, and new ways of relating in the classroom. One change has been the use of computer-mediated communication in the bricks and mortar classroom, often referred to as classroom mediated discourse technology. "Classroom mediated discourse technologies" can be defined as a set of technologies that facilitate student participation in learning activities and mediate communication in the classroom (Wankel & Blessinger, 2013).

Today's college students have grown up using technology for entertainment, information, and communication—digital communication is a part of who they are

(Evans & Forbes, 2012). Prensky (2001, 2010) refers to this generation as "digital natives" and argues that they are different not because they use and understand technology differently, but because they don't distinguish between the online and offline versions of themselves in the way that "digital immigrants" do. Clearly, digital technology has blurred notions of bodies, time, and space in ways that affect who we are in relation to others. Some even take this idea further by postulating that digital technology may itself be considered a "way of thinking" (Clark, 2008; Clark & Chalmers, 1998). Though Prensky's distinction between digital natives and digital immigrants may oversimplify the complex relationships we have with technology, I think it is important to acknowledge that the current generation of college students is the first generation to have grown up in the digital age.

We have always used tools in education, for example, chalkboards and calculators. The difference is that digital tools, like classroom mediated discourse technologies, may have the potential to redefine our ways of thinking and being. Certainly, the speed of the development and implementation of new digital technologies represents a difference from other educational technologies. But the use of digital technology may represent something different altogether. Friesen (2011) argues that digital technologies "make certain experiences, practices, and meanings possible and practical, while reducing the significance, purpose, and practicality of others" (p. 14). He says digital technology highlights the quantifiable aspects of human action and identity, while downplaying or eliminating the qualitative aspects. Based on Heidegger's critique of technology and Gadamer's discussion of environment and context, Friesen develops

the idea that technology frames, or "enframes," our experiences in certain ways, particularly a more outcome-oriented way, and distorts experience (p. 48). He argues that using digital technology results in a different relationship between the self and world.

Another way to position technological mediation is to look at digital technology with a cultural lens. Hudak (2008, 2009) frames digital space as a "culture," with a conceptual framework that informs thinking and action. One aspect of digital culture he highlights is that it is more "agile," or more "fluid" compared with the relatively fixed nature of physical space. He has named digital space "the electropolis" to reflect this differently mediated reality and culture that results in a translated modality of being (Hudak, 2008, n. p.).

What is common in these philosophies of digital mediated communication is the idea that technology shapes human experience in a particular way by making some aspects of reality more visible than others. Both Ihde (1998) and Verbeek (2005) are well known for their work in the philosophy of technology the technological mediation of human action. They both conclude that technology co-determines human experience and alters the character of human relations.

It may be the case that digital technology is not just a neutral tool that improves human efforts in efficiency and effectiveness. The medium matters—it always has—but the digital medium may be a game-changer. The use of digital technology in the classroom may require an ideological shift in our understanding of human action because it challenges our way of thinking and being and relating. So as technology-mediated communication tools have been implemented in classrooms to allow for student-teacher

interaction in large classes, we may need to re-think the notion of the pedagogical relationship to account for digital natives and the frame of digital technology. As Turkle (2011) notes, even as we shape our tools they also shape us.

Clearly, classroom mediated discourse technologies do not 'teach' independent of human user and the pedagogy employed in the use of the technology. There is an extensive body of research on the need for technology-focused pedagogies and specific pedagogies for certain technologies. Beatty and Gerace (2009) argue that that any discussion of clickers should begin with a question about how they are being used—the pedagogical assumptions and strategies employed when implementing clickers in a classroom. They argue that clickers themselves are not pedagogies, but tools that can be used in multiple ways. However, both Greer and Mott (2009) and Monk et al. (2014) have looked at how clickers support a specific type of pedagogy: learner-centered instruction.

From a constructivist/constructionist position, the users within a specific context determine the meaning and experience of the technology. However, Vygotsky (1978) was concerned with the concept of mediation through language and tools and how they both influence and support human activity and the construction of knowledge, and how they are, themselves, internalized by users.

The idea that tools influence the construction of knowledge means that we may need to view digital classroom mediated discourse technology as something that re-structures or transforms in-class teaching and learning. Biddix, Chung, and Park (2015) say that there is a structural shift in the college classroom that they call the "hybrid shift"

(p. 163). They posit that student use of mobile, digital technology in the classroom has restructured the "traditional face-to-face classroom" into an "online-enhanced" environment (p. 162). While Biddix et al. position this shift as creating a more personalized learning environment, which may be the case, I think we also need to consider how this shift may affect student-teacher interaction and communication in the classroom and the potential for student-teacher relationship development.

Clickers in the Classroom

The specific classroom mediated discourse technology under investigation in this study is clicker systems. 'Clickers' is the generic term for the technology that promotes student-teacher interaction in classrooms by allowing students to provide real-time digital feedback to the teacher using a handheld device. Clicker systems are also referred to as Classroom Response Systems (CRSs), Audience Response Systems (ARSs), and Individual Response Technology (IRT), and these classroom-based mediated discourse technologies have been used in college classrooms for almost 20 years. Though they are now considered mainstream, they are used primarily in the sciences (Beatty & Gerace, 2009). Clickers are a part of today's college experience. The current literature in higher education on the topic is primarily found in the professional schools of medicine, dentistry, physical and occupational health as well as in schools of business and sciences such as physics (Bruff, 2006; Draper and Brown, 2004; Schackow, Chavez, Loya, & Friedman, 2004; Trapskin, Smith, Armstead, & Davis, 2005).

Clicker systems are both hardware and software utilizing either a radio-frequency signal or the internet. Students have a handheld transmitter (a 'clicker' or other 'smart'

device) that they use to respond to questions. The teacher's base unit or computer collects the students' answers and produces a graphic showing the students' responses. The teacher can allow student responses to be anonymous or can be tracked individually depending on the purpose of the question.

One of the primary functions of clicker systems is for the teacher to receive real-time feedback from students to make informed instructional choices. As class sizes have increased as a result of budgetary pressures (Iowa Department of Education, 2009; Oliff et al., 2013), educators have turned to clicker systems to address the limited student-faculty interactions that are characteristic of larger classes (Trees & Jackson, 2007). Physical and interpersonal distance means less opportunity for students to ask questions, and less opportunity for teachers to receive immediate feedback from students. These digital student responses via clickers can provide valuable feedback to teachers in large lecture halls where one-on-one communication is difficult. Teachers can then tailor their class time to address the needs of the students.

Another primary function of clickers is to *engage* students in high-enrolled classes where students tend to be placed in a more passive role as listeners. Question-based class meetings where students interact with the teacher through clickers have been found to increase student motivation, make class more interesting and interactive, increase student participation, and to promote active learning (Denker, 2013; FitzPatrick, Finn, & Campisi, 2011; Jain & Farley, 2012; Shaffer & Collura, 2009; Stowell & Nelson, 2007). Gok (2011) found that students are more engaged in class when they are using clickers because they motivate students to attend class, increase student participation in

class, provide the ability for teachers' to solicit real-time student feedback, and facilitate active learning. In a study across three universities, Barr (2013) found that compared with hand-raising, students reported that using clickers helped them feel more confident and increased their understanding, concentration, and engagement in the class. Blasco-Arcas et al. (2013) tested their theory that clickers facilitate increased learning because they promote interactivity, active collaborative learning, and engagement, and the results of their empirical study supported their theory. There is a book in its 6th edition, *Increasing Student Engagement and Retention Using Classroom Technologies: Classroom Response Systems and Mediated Discourse Technologies* (Wankel & Blessinger, 2013) devoted to reporting case studies, survey results, and literature reviews on the ways in which clicker technology can be used to promote student engagement in the classroom.

Many studies have compared student outcomes in classes which use clickers with similar classes that do not use clickers, and have found that clicker use correlates with higher test scores (Morling, McAuliffe, Cohen, & D'Lorenzo, 2008; Poirier & Feldman, 2007; Shapiro & Gordon, 2012). Some of the research on both high enrollment classes and clicker use centers on the construct "student engagement," and findings consistently show that student engagement in mega-classes is limited but that there is increased student engagement with the implementation of clickers (Hoffman & Goodwin, 2006; Caldwell, 2007; Martyn, 2007; Trees & Jackson, 2007; MacGeorge et al., 2008; Ghosh & Renna, 2009; Salemi, 2009). However, 'student engagement' has multiple dimensions, including behavioral, cognitive, and emotional (or affective) dimensions.

The student-teacher relationship may contribute to engagement, and student engagement may contribute to a student-teacher relationship, but the two are not synonymous.

Though clicker technology is widely used in large classrooms for the express purpose of facilitating student-teacher communication, very little attention has been given to the potential relational functions of the clicker. While the use of clickers certainly increases student-to-teacher interaction and communication, do students consider this form of communication to be 'relational' communication? That is, might they consider the act of pushing buttons to be participating in a caring pedagogical relationship with the teacher? If it is the case that education is relational—occurring in-between the student and teacher when and where they create shared meaning—then clicker communication may be perceived as a tool for relationship building. Given that most college students today are considered "digital natives," and the possibility that the use of digital technology may re-frame human relationality, in this study I explore the possibility that students may perceive using clickers as relational—that is, something that can facilitate or constitute a student-teacher relationship.

Summary

This review of literature has spanned decades and disciplines to provide grounding and context for the present study. In this dissertation, I bring together the ideas of student-teacher relationships and clickers in the classroom against the backdrop of sociocultural and constructivist theories, an ethic of care, and digital technology as possible cultural shift.

While the literature supporting this question is varied, I believe that the central research question, “How might the use of clickers in the classroom contribute to a student-teacher pedagogical relation of care?” emerges naturally from thinking about education, technology, students and teachers, and caring in the classroom.

In the next chapter, I describe the research method and design for this study.

CHAPTER III

MIXED METHODS DESCRIPTIVE RESEARCH DESIGN

The purpose of this study is to investigate students' perceptions of classroom clicker use and how it might contribute to a student-teacher pedagogical relationship in high-enrollment university classrooms. I use a mixed methods descriptive research design to answer my central research question.

Introduction

I begin this chapter with a discussion of the philosophical foundations of research and research methodologies, followed by definitions of both mixed methods and descriptive research. I then present a justification for the overall research design and the three research methods I use in this study. Next, I discuss the research setting, participant selection, and the specific procedures for data collection and analysis. I conclude with a reflection on the potential benefits and limitations of this research design.

Research and Philosophy

Research is a method for understanding the physical and social world. We conduct research so we will "know" something about something, thus it is itself also a *way* of "knowing." The philosophical study of knowledge and knowing is called epistemology, and generally deals with questions about what counts as knowledge, how we can know something, ways of knowing, and what is worth knowing (Metaphysics Research Lab, Center for the Study of Language and Information (CSLI), 2014). It is

also related to notions of truth—how can we know what is true? Are there universal truths, or is all knowledge subjective?

Since research is based on philosophies of epistemology, the practice of research reflects historical and contemporary debates about knowledge and knowing. There are two primary research paradigms in education, or research methodologies, that are divided by issues of epistemology: the quantitative and qualitative paradigms. Each of these methodologies involves a bundle of "epistemological assumptions, sufficiently divergent to constitute different ways of knowing and finding out about the social world" (Scott & Morrison, 2007, p. 155).

A research methodology provides the philosophical frame for research because it guides the type of research question asked (what is worth knowing?), the role of the researcher, the methods used to respond to the question, and the scope of what can be known as a result of the research. For these reasons, I offer an overview of the epistemological assumptions of both quantitative and qualitative research methodologies, and justify my choice to engage mixed methods in the present study.

Quantitative and Qualitative Methodologies and Methods

Quantitative research is based on the assumption that there is real world "out there" that can be known—it can be measured objectively, relationships can be identified, and generalizations can be made. Quantitative research is typically guided by specific protocols and conventions. Quantitative research is based on a "positivist" or "realist" view of the world, and is the paradigm that has dominated research in both the physical and social sciences for most of the 20th century (Alvesson & Gergen, 2009).

On the other hand, qualitative research is based on an "interpretive" or "postmodern" belief system that assumes that the world is "constructed" and understood by people in unique ways—thus, there is no one "truth" out there that can be measured. The central idea is that the world does not exist in the same way for everyone—each "subject" has a different perspective and interpretation of the world.

Qualitative research from a "social constructionist" perspective emerged in the 1960's, and while it is used heavily in some disciplines (like sociology and anthropology), it is still considered to be less "scientific" than quantitative research by many (Alvesson & Gergen, 2009; Duffy, 1987). The primary distinction between qualitative and quantitative research has to do with what and how we can "know" something (Brown & Baker, 2007).

Quantitative researchers tend to believe that the world can be objectively known, that the researcher can be independent of the inquiry, and that research findings can be generalized because they reflect something that is "true." Qualitative researchers tend to the believe that the world can only be known subjectively—that is, the researcher is a large part of the research because their "world view" is reflected in the question, design, and interpretation of data, and that research findings are primarily contextual. They believe that there is no one truth, but multiple truths that can be identified, but not generalized.

The research *methodology* is the theory behind how knowledge is generated. The research *methods* are the tools and techniques used to collect, analyze and interpret data. For this study, I use three research methods: one from the quantitative paradigm, and two

from the qualitative paradigm. This type of research is known as "mixed methods" research.

Mixed Methods Research

A mixed methods research design is the use of more than one method of data collection in a single study, and generally refers to the collection and analysis of both qualitative and quantitative data to respond to research questions. This type of research is also referred to as "methodological triangulation" (Jick, 1979) or "multiple methodology" because the research methods are drawn from both the qualitative and quantitative paradigms (Duffy, 1987; Smith, 2006).

There are numerous benefits to a mixed methods design, the most notable being that an examination of something from multiple viewpoints offers a better understanding than any single approach alone (Creswell & Plano-Clark, 2006; Duffy, 1987; Guion et al., 2011). The idea is that each method has strengths, and that utilizing numerous methods offers a researcher numerous vantage points and the ability to compare and contrast different types of data.

In this study, I am utilizing methods from both paradigms, quantitative and qualitative. However, my own epistemological beliefs are more aligned with the subjectivist/qualitative paradigm because I believe that all "knowledge" and "knowing" is from a particular subject position. I believe that all knowledge claims are all partial, provisional, and contextual because we do not have access to a "God's eye" view of the world. All knowing is filtered through a person with a unique experience and view of the world.

Though I believe all knowledge claims are partial and provisional, I also believe they are valuable. The articulation of "reality" from a particular position adds to out understanding of the world outside our own experience. Our collective knowledge of the world, based on our own experiences as well as the experiences of others, is what constitutes our shared world. All contributions to this shared world are important, even if limited.

I have chosen to employ a quantitative research method, a survey, even though I place myself as epistemologically subjectivist, because I value multiple ways of knowing. The view from more than one place is more complete than the view from a single perspective. There are many ways of knowing, all incomplete. Smith (2006) says a "multiple methodology" study "simply constitutes a more adequate science" (p. 459). It is both appropriate and sensible, if you want to understand something, to look at it from as many different perspectives as possible.

A second reason I have chosen to use more than one research method is that I am interested in pursuing research as a career, and I'd like experience with multiple forms of data collection, analysis, and reporting to enrich my own understanding of the benefits and limitations of each method.

Finally, I have chosen a mixed methods design for this study because I am drawn to the spaces in between binaries. I'm convinced that inductive/deductive, outsider/insider, modern/post-modern, and quantitative/qualitative are not necessarily either/or propositions. Issues of ontology and epistemology, being and knowing, are very complex and are not likely to be determined by one set of procedures or resolved in one

study. I endeavor to stay open to liminal spaces where knowing can be explored in new ways.

There are, of course, pitfalls with mixed methods research designs as is the case with all research designs. First, some research communities may not readily accept the findings, as many researchers are firmly planted in one paradigm or the other. Second, Scott & Morrison (2007) note that mastering a research methodology is difficult, and an investigator could end up doing a poor job managing multiple methods, particularly if they are both qualitative and quantitative. I attempted to work through the accepted protocols in an effort to follow best practices for each method utilized.

Descriptive Research

According to L. Cohen and Monion (1989), authors of *Research Methods in Education*, most educational research is descriptive, with the goal of describing and interpreting what is (p. 70). A descriptive study can be either quantitative or qualitative in nature, as the goal is to collect data and describe what is being studied. Data in a descriptive study can be numerical, as in statistical frequencies, but can also be non-numerical and include categories, patterns, or themes that emerge from analyses of observations or text. Descriptive research allows researchers to explore, organize and describe what is being studied (Glass & Hopkins, 2008).

Descriptive research offers a snapshot of behaviors, attitudes, or characteristics of a selected group in a specific context, and can illustrate or highlight associations or relationships between and among studied behaviors, attitudes, and/or characteristics. Descriptive research designs may include observations, surveys, and/or interviews, and

are excellent methods for exploring new research areas and suggesting foci for future research (Office of Research Integrity (ORI), 2014). I chose a descriptive design because it allows me the flexibility to observe and explore clickers and relationality from multiple vantage points.

Research Design

Institutional Review Board

As with all research on and about people, there are ethical considerations and it is important to respect the rights and confidentiality of all potential participants. I completed training on protection of human subjects in research, and I applied to the Institutional Review Board, a part of the Office of Research Integrity at my institution, to conduct this study. I received approval without a full board review. The IRB approval documents are in Appendix A.

Research Setting

This study took place at a large, public university in the southeastern United States. The university offers 79 undergraduate programs in over 100 areas of study, 72 masters programs and 27 doctoral programs, and has the Carnegie classification "Doctoral/Research University." It is one in a 17 campus state system, and the fifth largest in terms of enrollment. The enrollment for the Fall 2014 semester was approximately 18,500: 15,000 undergraduates (67% female and 33% male), and 3,500 graduate students. The undergraduate population is ethnically diverse, with 27% African American and 7% Hispanic students, and a total non-white population of 47% (Office of Institutional Research, 2014, 2015; UNC, 2015).

Research Sample/Participants

Population selection. The population for this study was students enrolled in three classes in the Spring 2015 semester: Accounting 202—Managerial Accounting, and two sections of Nutrition 213—Introduction to Nutrition, each with a different professor. These three classrooms were selected because they met two primary criteria: enrollments exceeding 90, and staffed by teachers who implement clickers as tools for active and interactive learning, not just as tools for testing and attendance. All three professors are volunteer participants in a grant-funded initiative through the University Teaching and Learning Center to transform high enrollment classrooms through the use of clickers and clicker pedagogies. The focus of the grant is to support teachers in the use of clickers as tools for engaging students and promoting active participation, thereby increasing student performance. The program offers instruction and support for the use of clickers based on two research-based, technology-mediated pedagogies: TEFA and JiTT.

TEFA stands for Technology-Enhanced Formative Assessment, and is a pedagogy for using clickers based on question cycles designed to encourage students to apply the concepts under study—to encourage reasoning rather than memorization. JiTT stands for Just-in-Time-Teaching, and requires teachers to post a set of web-based questions and/or assignments for students to complete before class, usually pertaining to the homework, to be due the evening before or day of the class meeting. JiTT has several virtues: it encourages students to prepare for class and it provides the teacher with a snapshot of what students know and understand before the class meeting so that they can adapt their class plan accordingly. JiTT is a specific pedagogy that is also employed when teachers

"flip" their classrooms, requiring students to engage with the material prior to class so class time can be used for dialogue, projects, and problem-based learning. TEFA provides a structure for the classroom activities by promoting student-teacher and student-student interaction and reflection (Beatty & Gerace, 2009; Beatty, 2007).

I served as the graduate assistant on this grant-funded program for 16 months in 2014 and 2015, which offered me access to numerous teachers and classrooms utilizing clickers in various stages of implementing technology-based pedagogies. In this capacity, I assisted with instructional workshops and observed hundreds of class meetings where TEFA and JiTT were being implemented. I selected the students in these three classes as my research population because these three teachers utilized clickers to promote interaction and student engagement, and utilized both TEFA and JiTT pedagogies, which represent best practices. Each of these three professors consented to my observing their classes as well as soliciting their students to participate in this study. In addition, the principal investigators of the grant also consented to the dual use of my grant activity for dissertation data collection.

I focus my study of clicker use and the student-teacher pedagogical relation of care on students enrolled in courses where the technology is being employed intentionally for communication purposes. Clickers are just hardware and software, and can be used in a number of ways. I chose teachers who exemplify best practices with clickers, and attempt to engage their students even in large classrooms. In this way, I believe that I am asking my question in the best possible environment and under the best conditions. I

hope that if students' perceive relational possibilities with clicker use, I would see it in these classrooms.

Clearly, these classrooms are not representative of all college classrooms, or of classrooms at this university, or of classrooms where clickers are used. It is not my goal to generalize my findings beyond these classrooms. However, I believe that my findings may offer some insight into the relational functions of clickers in these classrooms, which will contribute to the literature on clicker use, student-teacher relationships, pedagogical care, and technology use in education.

Research participants. The participants of this study were students who volunteered to participate from a total population of 342 students enrolled in the three classes combined. I requested participation by asking them to complete an online survey about clicker use. I also asked selected students to volunteer to be interviewed. In each of the three classrooms, I recruited volunteers by reading a verbal recruitment script in each class. I did not offer any monetary or extra-credit incentives for participation. This type of sampling is called nonprobability sampling, and may not result in a representative sample of the population (Trochim, 2006). However, since I was not attempting to generalize my findings beyond the participants, I was not concerned with the limitations of this non-random sampling technique. I worked to have participants who represented varied ages, academic classifications, genders, ethnicity/race, and majors, but I could not guarantee a particular distribution. Most of the participants were 18–22 years of age (74%), and were either sophomores or juniors (77%). The distribution for gender was 62% female and 36% male, which closely reflects the gender ratio of the institution (65%

female and 35% male). Almost half of the participants self-reported as white (48%), one-fourth African American (25%), 11% Asian/Pacific Islander, 7% Latino, 6% mixed race, and 4% other. These numbers also reflect the institution's overall enrollment.

For the survey portion of the study, a brief online instrument, my goal was a response rate 30%, or approximately 110 survey respondents across the three classes. This is an average response rate for an online survey (University of Texas at Austin, n.d.). I followed my initial recruitment effort with a one-week reminder, then another reminder the following week, for a total of 3 requests. I received 124 complete survey responses, representing 36% of my population. For the interview portion of the study, I was able to recruit 6 students from each class, for a total of 18 students.

My response rate goals did not ensure that my sample was representative of the population; I would need approximately 70% or more of the population to participate in order to argue that the sample is not markedly different from the population (Patel, Doku, & Tennakoon, 2003). However, I was not concerned about a non-random sample because my goal was to learn about how participants perceive clicker use and the teacher's relation of care, not to make generalizations about what this population believes. The non-responders may significantly differ from those who volunteered to participate, which was acceptable given the goal of this study.

Research Methods

In this descriptive mixed methods research design, I employed three research methods to respond to the central research question: How might the use of clickers in the classroom contribute to a student-teacher pedagogical relation of care? The methods are

(a) Participant Observation, (b) Survey, and (c) Interviews. I discuss each method in detail below, including the procedures I used to collect, analyze, and interpret data as well as the type of results that I anticipate from each method.

Participant Observation

I observed three classes (ACT 202, and the two NTR 213 sections) a total of 37 times, and record field notes of my observations about clicker use in the classroom, student-teacher interactions, and indicators of a pedagogical relation of care. Specifically, I recorded behaviors, activities, events, features, and dynamics of the class meeting, and I included both descriptive and reflective information. My goal was to observe unobtrusively and attempt to understand and describe each classroom setting as a specific context. My observations offered me, as the researcher, an understanding of each classroom including the procedures, norms, typical behaviors, and general setting so that I could better interpret the results from the survey and interviews.

I created an observation form that I used for each class meeting (Appendix B). It is a simple layout with space for observations and reflection on those observations. The form was purposefully open and unstructured because unstructured formats for field notes allow for a broad range of observations (Wiersma & Jurs, 2005). In addition to using an unstructured form, I attempted to follow best practice guidelines for field note content including: describing the social environment, noting patterns of interactions, reflecting on ideas and/or any criticisms I had, including unanswered questions and insights about what I observed, and speculating why I believe specific phenomenon occurred (USC Libraries, n.d.). The following prompts guided my observations:

- Note *how* the instructor used clickers/types of questions/discussion generated
- Quantity and quality of student-teacher interaction/patterns/frequency
- Any relational meta-communication by teacher or student?
- Indicators of caring student-teacher relations?
- The impact of my presence in the classroom?
- My impressions/questions based on observations
- Insights? Speculations?

I analyzed my field notes by developing coding categories as I identified recurring topics in both my descriptive and reflective notes. I first reviewed my notes by class (each of the three classes considered separately) and then as one set of observations. In the results chapters of this dissertation, I offer a detailed description of the themes that I identified in my field notes.

Survey

In addition to my participant observations, I solicited volunteers from the three classes to take on online survey I designed to explore students' perceptions of the relationship between care and clicker use in the classroom. Survey research allows a researcher to ask participants about their attitudes, opinions, and perceptions. This survey was a sample cross-sectional design because I measured the perceptions of a sample of a population at one point in time. I received a 36% response rate, or 124 survey respondents across the three classes. The teachers were helpful in that they allowed me to address their classes multiple times, and each of them posted the link to the survey on Canvas as an announcement.

Item creation. I created the items on the survey to reflect dimensions of the student-teacher relationship identified in the literature. In addition, I included two items based on the primary benefits of clickers and a number of items requesting demographic information.

Survey review. I asked a number of experts in educational measurement at the Center for Educational Research and Evaluation on my campus to review the survey for structural integrity and clarity. In addition, I solicited feedback from a number of colleagues who are seasoned classroom professors to establish face validity. Finally, I conducted a practice run of the survey with a group of students who are not part of the population for this study, but who are similar, to check for confusion and ambiguity and time to complete the survey. As a result of these reviews, I made numerous revisions and adjustments to the original version. I submitted the revised survey to the IRB as a study modification, and it was approved.

The survey. The survey items and the instructions are below, followed by a brief justification for including each the item in the survey. A copy of the survey, without notations, is included in Appendix C.

Research Survey with Justification Notes

This survey is part of a study of clicker use in large classes. As you answer these questions, please consider only this class and this teacher. This survey will ask your opinions about your teacher and the use of clickers in this class. *Your responses are anonymous!* Thank you for participating.

Part 1 Instructions: Choose the answer that best reflects your opinion.

1. Do you think the use of *clickers* in this class helps you feel more *engaged* in the course? (*engaged*=involved, interested, motivated)

Definitely	Probably	Not Sure	Probably Not	Definitely Not
5	4	3	2	1

NOTE: This question reflects the literature about the benefits of clickers in the classroom. The rationale for implementing clickers is the belief that clicker use increases student engagement, which then contributes to numerous other benefits including enhanced academic performance.

2. Do you think using *clickers* in this class has helped you learn course content?

Definitely	Probably	Not Sure	Probably Not	Definitely Not
5	4	3	2	1

NOTE: This question is also based on the literature about the benefits of clickers in the classroom. One of the primary results of increased student engagement is increased academic performance. This item relates to student academic learning.

3. Would you say that using *clickers* is an important way you communicate with the teacher?

Definitely	Probably	Not Sure	Probably Not	Definitely Not
5	4	3	2	1

NOTE: Clickers were designed as a tool for student-teacher communication in high-enrollment classrooms. This item asks participants if they view clickers in this way.

4. Do you think the teacher pays careful attention to clicker responses?

Always	Sometimes	Not Sure	Rarely	Never
5	4	3	2	1

NOTE: This item asks participants about teacher attentiveness to clicker responses, which is an important aspect of relational communication.

5. Does the teacher *respond* to the information provided by the clicker answers?

Always	Sometimes	Not Sure	Rarely	Never

5	4	3	2	1

NOTE: This question asks about teacher responsiveness to clicker input. Though it does not ask about the quality of the teacher response, it does ask if the participant perceives that the teacher takes action based on the clicker information.

6. Would you say that clicker questions and answers promote *dialogue* between you and the teacher?

Always	Sometimes	Not Sure	Rarely	Never
5	4	3	2	1

NOTE: This item asks participants about their perception of the role of clicker questions and answers, which is important because the idea of "dialogue" represents a deeper level of interaction.

7. Do you think your teacher *cares* about you and your success in this class?

Definitely	Probably	Not Sure	Probably Not	Definitely Not
5	4	3	2	1

NOTE: This item relates to the students' perception of teacher care, which is an important part of the pedagogical relation according to Noddings.

8. Does the use of *clickers* in the class make *you* feel . . .

	Definitely	Probably	Not Sure	Probably Not	Definitely Not
Supported?	5	4	3	2	1
Respected?	5	4	3	2	1
Anxious?	5	4	3	2	1
Encouraged?	5	4	3	2	1
Connected?	5	4	3	2	1
Safe?	5	4	3	2	1

10. Does the use of *clickers* in the class make the *teacher* seem . . .

	Definitely	Probably	Not Sure	Probably Not	Definitely Not
Nurturing?	5	4	3	2	1
Trustworthy?	5	4	3	2	1
Honest?	5	4	3	2	1
Professional?	5	4	3	2	1
Fair?	5	4	3	2	1
Manipulative?	5	4	3	2	1
Open-minded?	5	4	3	2	1
Approachable?	5	4	3	2	1

NOTE: Items 9 and 10 include qualities and dimensions of the student-teacher relationship that I drew from my review of the research literature. The exceptions are the words “anxious” in #9 and “manipulated” in #10, which were added to balance the other descriptors, which are all worded in a positive way.

Part 2 Instructions: Please choose the best answer from the choices offered.

11. Which of the following classes are you enrolled in this semester? (This survey is being distributed to 3 different classes this semester, and I may want to look at the results by class).

a. ACC 202: Managerial Accounting, TTH 2-3:15
b. NTR 213: Introduction to Nutrition, TTH 12:30-1:45
c. NTR 213: Introduction to Nutrition, Tuesdays 6:00-8:50pm
d. More than one of the above
e. None of the above

12. How old are you?

a. 18-22
b. 23-30
c. 31-50
d. 51 or older

13. What is your academic classification?
    a. Freshman
    b. Sophomore
    c. Junior
    d. Senior
    e. Other

14. What is your gender?
    a. Female
    b. Male
    c. Other

15. Which of the following best describes your Ethnicity or Race?
    a. Latino (a)
    b. Black or African American
    c. White
    d. Native American
    e. Asian / Pacific Islander
    f. Mixed Ethnicity/Race
    e. Other

16. Which of the following best describes your major?
    a. Humanities/Arts
    b. Education
    c. Social Sciences
    d. Health/Human Services
    e. Business
    f. Science/Technology/Engineering/Math
    g. Other

Thank you for your responses!

Survey data analysis. The survey items are Likert scales with five response options, which provide ordinal data. The demographic questions are nominal scale. I conducted a number of statistical analyses using IBM SPSS 22. My primary statistical analyses were descriptive: frequency distributions (e.g., how many participants answered X for question #1?) and the mean (average) for each item by class and as a whole. I

consulted with the Center for Educational Research and Evaluation to ensure that these statistical analyses were appropriate, and that I interpreted them using best practices.

Survey administration. The survey was delivered electronically via Qualtrics, a survey-based research platform supported by my institution. Participants were asked to complete the survey by following a hyperlink included in an email to them. Survey responses were anonymous, as no individual identifiers were requested.

Interviews

Finally, I interviewed a small number of students enrolled in the three classes in order to attempt to clarify and explain any findings from the participant observations and survey analyses. The goal of these interviews was to solicit student interpretations and explanations for findings to assist me in interpreting the results. I interviewed six students from each class for a total of 18 students. These interviews were unstructured, and designed as follow-up interviews. An in-depth description of the interview process is included in Chapter IV.

According to D. Cohen and Crabtree (2006), unstructured interviews are characterized by open-ended questions based on clear goals for the interview, but without a list of specific questions. Unstructured interviews are useful when the researcher is open to having his or her understanding revised by respondents, and when understanding is evolving. They also allow researchers the opportunity to test a preliminary understanding, yet remain open to other ideas. In the interviews, I opened with a question about a specific finding and asked the participant to explain why, from

their point of view, that particular finding emerged. In this way, I solicited their interpretations and allowed for a variety of responses.

For analysis purposes, I reviewed the interview responses for an understanding of how participants viewed their clicker interactions with the teacher and how they contributed to my findings in the study. I coded interview responses for recurring themes that related to the research question. A detailed discussion of the coding process is included in Chapter V.

Assumptions

All researchers make assumptions about the phenomenon being studied and the research process. I have 20+ years of experience in the college classroom, and all but one class were small, intimate, and face-to-face. In my experience, the student-teacher relationship was essential because students first needed to trust that I was both credible and ethically oriented to their best interests before they would risk the changes in thinking required for learning. In the one online course I taught, I felt unable to establish the type of relationship necessary for what I consider a 'real' educational experience. This made me uneasy about the trend toward digital education, and fueled my curiosity about how education, a moral activity of great import, might be affected by the use of digital technology

Limitations

This study population consisted of 365 students enrolled in three classrooms in the Spring 2015 semester. This small, non-random sample was selected because the teachers participated in a faculty development grant initiative to learn how to effectively

integrate technology into their classrooms. This contributes to my ability to trust my results because the participating teachers were learning to use clicker technology to optimize student-teacher communication rather than just as a tool for taking attendance and summative assessment.

I did not run statistical analyses to estimate the internal consistency of the survey items, thus they are not statistically reliable. This study is a snapshot of student perceptions, and is not designed for replication purposes. This study is context specific, and the results only reflect the classrooms studied. Regarding validity, I attempted to establish content validity by using dimensions of the pedagogical relation from the literature, and by having content experts review the survey prior to administration.

My goal in this study was to explore the possibility of clicker use for a student-teacher pedagogical relation of care. As such, I am less concerned with statistical reliability and validity and more concerned with identifying possible connections between clicker use and classroom relationality. This information might be valuable for future research efforts, and might advance thinking around issues of technology and educational practice.

Delimitations

There are some important aspects of the topic under investigation that are not addressed in this study. For example, I did not investigate the teachers' perceptions of clicker use and the student-teacher relationship, or consider clickers and academic outcomes (i.e., grades) as part of this study.

Conclusion

I used a descriptive mixed methods research design to respond to my research question: How might the use of clickers in the classroom contribute to a student-teacher relationship? I utilized research methods from both the quantitative and qualitative paradigms to examine clickers and classroom relationships from multiple viewpoints. The population under study was students enrolled in three high-enrollment classrooms at a large southeastern university where the teacher was using clickers to promote student engagement in the class. I observed these three classrooms to understand the classroom context, distributed a survey to volunteer participants asking about their perceptions of clicker-use and a pedagogical relation of care, and interviewed several students for the purpose of gaining their perspective on my observation and survey findings. The results of this study consist of reflections from my classroom observations, survey results, and interview notes summarized in a discussion of my interpretations and understandings that emerged from analyzing the data. My findings are presented in two chapters as follows:

Chapter IV—Clickers as Tool for Pedagogical Practice: Five Functions of Clicker Questions

Chapter V—Clickers Facilitate Connection, not Relation

CHAPTER IV

CLICKERS AS TOOLS FOR PEDAGOGICAL PRACTICE: FIVE FUNCTIONS OF CLICKER QUESTIONS

The purpose of this study is to investigate students' perceptions of classroom clicker use and the student-teacher relationship in high-enrollment university classrooms. I used a mixed method research design to create three data sets for analysis: (a) field notes from participant observations, (b) survey results, and (c) notes from interviews with students. In this chapter, I focus on the results from my participant observations. In Chapter V, I discuss the results from the other two data sets, the survey and the interviews. The final chapter, Chapter VI, presents a discussion of the findings across all three data sets.

Participant Observations

I observed three classes during the Spring 2015 semester: Managerial Accounting with Dr. Davis, Introduction to Nutrition with Dr. Nelson, and a second section of Introduction to Nutrition with Ms. Miller (teachers' names are pseudonyms). All three classes are 200 level with high student enrollments, and each of the faculty members were volunteer participants in a University Teaching and Learning Center initiative to transform their classrooms by using clickers and active learning pedagogies in their large classes. This faculty education initiative was funded by a grant, and the funding was used to provide the technology and periodic trainings as well as a graduate assistant to support their efforts in class. I served as the graduate assistant for the grant for 16

months in 2014 and 2015. The principle investigators of the grant gave their permission for me to use my class observations for research purposes, as did the three teachers. In addition, the teachers allowed me to solicit their classes for study participants for the survey and interviews.

For the purposes of this study, I observed and took field notes during 37 class meetings total: 14 with Dr. Davis; 15 with Dr. Nelson; and eight with Ms. Miller, a once weekly night class. I wrote field notes during each observation about clicker use in the classroom and student-teacher interactions. I recorded both descriptive information as well as notes reflecting on what I observed. For each class meeting I tried to note *how* the instructor used clickers and the types of questions and discussion they generated, the quantity and quality of student-teacher interactions, any relational meta-communication by teacher or student, and my impressions and questions based on observations as well as and any insights or speculations. Figure 2 shows an example of my field notes from a class observation.

The three classes had both common features (large class size and the use of clickers) and unique features (content, time of the class meetings, physical classroom, and the personality of the teacher). In each of the classes, I was introduced early in the semester as graduate student assisting with technology. I sat in the front of each classroom along the side—so I was not sitting with the students, but in a space between the front row of student seating and the teacher's instructional area. This afforded me the ability to see both the teacher and the class as a whole.

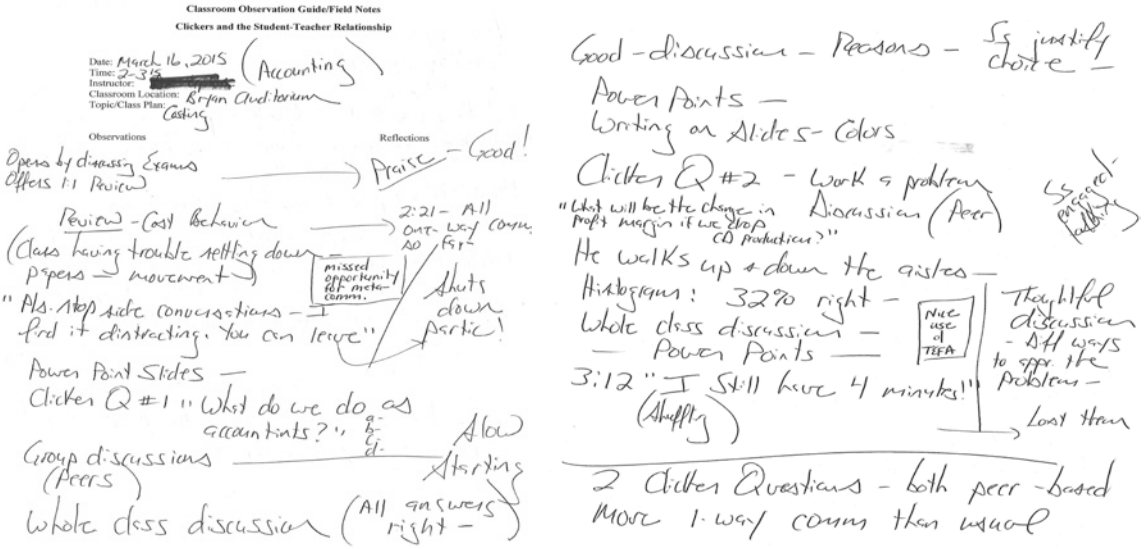

Figure 2. Class Observation Field Notes Sample.

I was a participant-observer in all cases, but the degree of my participation varied by class. I was most active in Dr. Nelson's class because she used the new technology consistently, and was comfortable asking for my assistance. I assisted her with initial set-up at the beginning of each class, and I also assisted her in the middle of class numerous times as she practiced new teaching methods with the technology. Ms. Miller was the most comfortable with the technology, and asked for my assistance on only a few occasions. However, in that class, I also helped her pass out and collect class materials for demonstrations, so I served as a general assistant as well as a technology assistant. In Dr. Davis's class, I was more of an observer than a participant. I helped him set-up the technology at the beginning of class, but I did not help him during the class in any capacity.

Analysis and Findings

As I reviewed my field notes, I looked for patterns in how the clickers were used and the behavior of the students regarding clickers. As I reviewed my notes, it was easy to see that each of the three teachers had their own "style" of using clickers and interacting with students, and that there were different types of clicker questions that elicited different responses in students. As I attempted to characterize the teacher styles and question types, I began to see that the "styles" and questions were actually different ways of using the clickers, and that there was significant overlap across the classes and teachers. This complicated my initial analysis by teacher. In addition, the teachers were not consistent in their use of clickers. For example, one day Dr. Nelson presented two clicker questions, and in the next class meeting, she presented 8. Another day, she used the clickers for a quiz at the beginning of class, and did not ask any more clicker-based questions that day. This varied clicker use also made it difficult to analyze clicker use by teacher.

As I further analyzed my notes, I was able to see some patterns in the *functions* of clickers across classrooms: that is, a grouping of clicker question types, or styles, that appeared to elicit similar types of interactions. I observed these types across the three classrooms. Though there was some overlap, I identified seven categories of clicker questions. I found that clickers were used to:

- Initiate Dialogue
- Frame Peer Interaction
- Assess Student Understanding (Formative Assessment)

- Allow Students to Self-assess
- Encourage Deep Thinking
- Evaluate Students for a Grade (Summative Assessment)
- Build Rapport

As I attempted to use my classification system to sort the clicker questions I recorded, I discovered that two of the categories overlapped significantly, making it difficult for me to distinguish between them. So I reduced the categories from seven to five. The resulting five categories are:

- Initiate Dialogue/Build Rapport
- Frame Peer Interaction for Peer Instruction
- Assess Student Understanding/Allow Students to Self-assess (Formative Assessment)
- Initiate Dialogue/Encourage Deep Thinking
- Evaluate Students for a Grade (Summative Assessment)

In the following sections, I will define each category I observed, and offer examples of the type of clicker questions that comprise each category. In an effort to define the context clearly, I'll begin with a generalized, amalgamated description of a clicker classroom.

Clicker class, general description. *Students enter a large, auditorium-style classroom from the back, through two doorways that open to wide stairs leading down to the front of the room. The seats are fixed in rows, in three sections, with desk-tops that swing noisily into place. There is a general murmur as students greet one another and*

slide past those already seated in the end chairs to claim the open seats in the middle of the rows. Students rummage through their bags to retrieve notebooks, pens, the text, and their handheld clicker: a white, slim remote-looking device. They arrange their class supplies, turn on their clicker, and look at the front of the room for the first question of the day.

The front of the room is framed by large white boards, which are covered by two large screens. The teacher is already in place at the smart station in the front, left corner of the classroom. She is busy preparing for the class by opening her power point software and slides on her laptop, connecting her laptop to the smart station so her slides will project onto the screens, connecting her iClicker receiver base and USB to her laptop, and attaching the microphone to her waist and collar. This just takes minutes, and she stands at the front of the room, ready to begin. In her hand is a bright blue clicker that controls the clicker software and advances her slides.

She has already projected the "warm-up" clicker question on the screens, and has 'opened' the question to receive student answers. A small counter at the top of the screen changes quickly as it registers the number of students who have selected a response. The number climbs to over 100 as the class start time approaches.

The teacher greets the students, makes a few announcements about an upcoming assignment, then turns to the screen. "Let's see what you think," she says and 'closes' the polling so no more responses can be recorded. She pushes the "display graph" button on her master clicker and a chart appears on the screens showing the distribution of student answers—a histogram showing the number and percentage of students who

answered each (a), (b), (c), and (d). The graph shows that most students answered (a) or (b), though there are students who selected the others as well.

There is audible response from the students as the histogram is presented and they see how the rest of the class answered the question—it sounds like a combination of surprise, grumbling, and general commentary to a neighbor. The teacher comments on the distribution, and asks for a volunteer who answered (a) to share why they selected that answer. After hearing from a few students, she asks for someone who answered (b) to share their rationale for their answer, and so on. After hearing from a number of students, she says that they will return to the question later in the class period to further discuss the answers.

She then introduces the days' topic by showing an introductory slide. She talks through the introductory material on the next few slides, then presents another clicker question. She instructs students to consider the question, and talk with their neighbors before submitting an answer. She calls this "Think, Pair, Share." She sets the clicker timer for four minutes, and walks up and down the aisles as students turn to talk with their peers. The large lecture hall, with seats fixed facing forward, becomes a hub of twisted bodies and conversation as students turn to the person sitting next to them, or turn around in their seats to talk with others seated behind them. The quiet classroom suddenly gets noisy, then quiet again as the timer counts down and students have registered their answers and anticipate the results.

By the time the class is over, students have responded to 4-5 clicker questions, consulted with their peers on numerous occasions, assessed their understanding of the

material, and interacted with the teacher. The class was a combination of group work, class discussion, and lecture. The more than 100 students file out of the auditorium, having participated in a clicker-based class.

Category #1—Initiate dialogue/build rapport. These clicker questions encourage student-teacher interaction, provide a common basis for discussion, and keep students engaged with the material. The seeming result is a general feeling of closeness and understanding based on a shared ideas and feelings. The clicker question generally asks students their opinion or attitude toward something, and their responses are the focus of the dialogue between the students and the teacher.

Example 1. *It is almost 6 pm on a Tuesday night. Ms. Miller is standing in the front, center of the auditorium, near the middle section of student seating, chatting quietly with the few students seated in the front row. Her power-point and clicker software are up and running, her microphone is clipped to her collar, and the large screen in the front shows a picture of the campus covered in snow. She begins by welcoming the students back to campus, as the previous class was cancelled because of the weather, and briefly discusses the video and assignment she posted online in lieu of class. After responding to a few questions about the assignment, she asks the class, "Are you ready to begin?" Students respond by showing their clickers. She advances the slide to the following clicker question:*

"How often do you think about food safety when preparing, selecting, or eating food?" The possible answers are "(a) never, (b) sometimes, (c) almost always, (d) it depends."

Students enter their responses, and it takes less than a minute for the counter to stop. "Are there any more responses?" she asks. She waits another few seconds, and noting that the counter has stopped moving, she closes the polling and displays the histogram. Answers (b) and (d) are the highest, with 33% and 38% respectively. Only 6% answered (a).

She asks for someone to volunteer to explain his or her answer. A number of hands are raised, and she calls on 3–4 students. The comments are mostly from students who answered "it depends," and they talk about being more concerned about food safety when eating out vs. cooking at home. This generates significant discussion about restaurant sanitation ratings, including horror stories from students who work at restaurants. After entertaining a few stories, she redirects the students' attention by advancing the slide to a list of food related illnesses, and begins talking about types of bacteria and their effects on the human body.

This question generated a 7-minute class discussion characterized by student-teacher interaction in a whole-classroom setting. Most of the students in the class seemed engaged in the discussion and I sensed a feeling of cohesion in the class, especially when students shared common experiences with their teacher. This question and the discussion that surrounded student responses also provided students with a personal connection to course material.

Example 2. *Dr. Nelson begins most class meetings with a "warm-up" question. The question today is: "Which of the following companies has just introduced a new product called "Super-Milk?" The answer choices are: "(a) Pepsi, (b) Coca-Cola, (c)*

Miller Brewing, and (d) Anheuser-Busch." Students submit their answers, and the counter stops, indicating that all answers have been received.

After greeting the class with a "good morning," she stops the polling and displays the histogram. She comments that one student answered (e), even though there is no (e) option. She jokes that this person must have started their weekend early. She reveals the correct answer to be (b) Coca-Cola.

Then she asks the class if anyone might buy the new "Super-Milk" product. Several students raise their hands and offer reasons why they would buy the new product. After 2-3 students offer their reasoning, she asks for someone who would not *buy it to explain their reasoning. After listening to 2-3 students offer their rationale for not buying the product, she then advances the slide to show the topic for the day: Vitamins and Minerals. A student asks Dr. Nelson if she plans to buy "Super-Milk." Before turning her attention to the next slide, Dr. Nelson tells the students that he will know the answer to that question by the end of class.*

This question generated a class discussion characterized by student-teacher interaction in a whole-classroom setting. Students appeared interested in the discussion, evidenced by the large number of students who raised their hands to offer a comment. In addition, many students reacted to the comments of other students with head nods or verbalizations, contributing to a feeling of cohesion in the class as students.

Category #2—Frame peer interaction for peer instruction. These clicker questions encourage peer interaction by providing a specific framework for student-to-student discussion in small groups. Students are typically given a minute or two to think

about an issue, then they spend two to three minutes discussing their answers in a peer group and attempt to come to a consensus on the response. According to Boud, Cohen, and Sampson (2002), peer learning encompasses a broad range of activities, both formal and informal, that involve the sharing of knowledge, ideas and experience between peers. "Peer Instruction" is a specific interactive pedagogy developed by Mazur in the 1990's that has become popular because it has been found to be more effective in engaging students than a lecture (Crouch & Mazur, 2001; Lambert, 2012). This peer interaction allows students to talk about course material with their peers, both teach and learn from their peers, and facilitates active participation in class.

Example 1. *Dr. Davis started class by displaying the course syllabus on the screen, and asking students if they had any questions about the course content or schedule. It is the second day of class. After a quick review of major components, he presents the following on the screen: "What do managerial accountants do? Discuss in small groups, settle on an answer, and input your answer using a clicker." Students look around and, it takes a minute or two, but they slowly begin talking with the people who are siting near them. The chairs are attached to the long tables, so movement is limited, but some students turn around to talk with those seated behind them. Soon, the volume increases significantly as discussions begin. After a few minutes, Dr. Davis asks for all groups to input their open-ended answer, and he closes the polling. When he pushes "display graph," a list of the answers entered scrolls across the screen. Answers include "present financials, manage, evaluate business practices, conduct cost benefit analyses, control the money, manage money, provide info to managers, controls the budget, and*

make financial decisions," among others. More than one group has answered with "manage money." He reads the responses out loud and asks, "What do all these functions have in common?" After a short discussion about the decision-making responsibilities of a managerial accountant, he advances his slide and begins discussing the tools that managerial accountants use to make decisions.

This question allowed students to express their thoughts about the class and what they would learn in a safe environment—a small group of their peers—rather than asking for students to share their initial thoughts in front of the whole class. In addition, they got to hear other perspectives from their fellow students. This question guided their small-group discussion.

***Example 2**. Ms. Miller has been discussing the problem of obesity in the United States and the health problems associated with being overweight. She advances her slide to show a Body Mass Index (BMI) chart for adults. At the bottom of the slide is this clicker question: "Which of the following are true about BMI (Body Mass Index)? (a) it is a measure of overweight, (b) it is the most accurate measure of weight as related to health risk, (c) it is a measure of overfat, (d) it is a measure of weight for height, (e) it is a measure of body composition." Students begin to click in their answers. After a minute or two, she stops the polling, and presents the students' responses. She discusses the distribution, and tells the class which items are true and which are false. Then, she asks students to work in groups to re-write each statement so that all the statements are true. Students begin discussing the statements, and Ms. Miller walks up and down the main aisle, listening to some of the group discussions. When she returns to the front of the*

room, she asks for a volunteer to read their re-worded statement. She solicits a number of examples before returning to her slides.

This question asked students to consider various definitions of a key term. Then, the teacher used those responses to frame a peer discussion by asking them to work together to refine those definitions. The clicker question gave students the opportunity to think about the content first and also provided a common ground for peer interaction.

Category #3—Assess student understanding and allow students to self-assess. This type of clicker question asks students to work a problem or answer a question and provides the teacher with a summary of how well their students understand a particular concept. These answers are not recorded for points; rather, the idea is for teachers to monitor student learning so they can target areas that need additional instruction. These questions provide valuable feedback that teachers can use to assess understanding and address student needs. In addition, these questions allow students to self-assess their working knowledge so that they can recognize problems immediately and focus their studies accordingly.

Example 1. *Dr. Davis has been talking about how to calculate return-on-investment (ROI). He has presented and reviewed the formula, and worked an example by showing the steps involved on the screen. He asks the class if there are any questions about this calculation. No one raises a hand. He then advances the slide to reveal the following clicker question: "Redmond Awnings, a division of Wrap-Up, Corp., has a net operating income of $60,000 and average operating assets of $300,000. The required rate of return is 15%. What is the division's ROI? (a) 25%, (b) 5%, (c) 15%, (d) 20%."*

He sets the timer for two minutes, and watches the counter as students enter their response. As the two-minute mark approaches, he notes that the counter has stopped, so he shows the histogram. Eighty-two percent of the class answered correctly. He says, "Excellent. It looks like most of you understand how to calculate ROI. Those of you who missed this, please review the formula and see me if you still have questions. Let's move on to calculating residual income."

This question allowed Dr. Davis to assess what percentage of the class was able to successfully work the problem, so he could adjust his instruction accordingly. In this case, he did not spend more time on ROI because most of the students seemed to understand the concept and how to use the formula. In addition, students were able to test their own understanding, so they can focus their study time accordingly.

Example 2*. Ms. Miller has spent 15 minutes lecturing on how to calculate the total number of calories needed per day, and how to understand the nutritional information provided on food labels. After walking through an example with a food label displayed on the screen, she advances the slide to reveal the following clicker question: "If you consume 300 grams of carbs in a day that you consume 2400 kcal, the carb will provide _____% of your calorie intake for that day. (a) 12.5%, (b) 30%, (c) 50%, (d) 60%." After a minute, she stops the polling and displays the histogram of student answers. Twenty-four percent answered (a) and 68% answered (c). She tells the class that the correct answer is (c). Then she asks, "Who can tell me why a. 12.5% is incorrect?" A number of students raise their hands, and one student explains that a gram of carbohydrate is 4 calories, so 300 grams of carbs is 1,200 calories, or half of the*

2400 consumed that day. Ms. Miller says, "Let's try another example," and forwards her slide to reveal another problem.

This question, with one right answer, told Ms. Miller that there was still some confusion surrounding the calculation of calories from weight, so she continued by offering additional examples with instruction until most of the class got the calculation correct. By the third question, 93% of the class answered correctly. She was able to skip the fourth problem she had prepared on a slide, and begin a discussion of the energy value of proteins and fats.

Category #4—Encourage deep thinking. These questions ask students to apply the material in a new way, or to synthesize ideas to make a judgment. They go beyond basic rule-based thinking like remembering, understanding and applying, to encourage higher levels of thinking like analyzing, synthesizing, and evaluating. These questions typically do not have a correct answer, but instead encourage students to reason through a number of viable options.

Example 1. *Dr. Davis has been talking about the concept of return-on-investment for most of the class period. After a number of clicker questions early in the class, it has now been close to 25 minutes since the last clicker question. It is almost 3:00, and class ends in 15 minutes. Dr. Davis presents the following clicker question to his students:*

"Suppose the Teddy Bear Division of Toyco has a project with the potential profit of $80 and a cost of $1,000. The company has a target rate of return of 5%. As a division manager, would you invest in this project? (a) yes, (b) no."

He asks the class to consider the question, and talk with their neighbors before selecting an answer. The room had been quiet while he was talking, but there is suddenly a swell of noise as students begin to talk with other students. Some students pair up, and others create larger groups by turning around in their seats. One student gets up from his seat and sits on the table to get better access to his small group.

The small clicker counter on the screen starts to rise as students click in their answers. Dr. Davis has given them five minutes to register their response. At the end of the five minutes, he stops the polling, and presents the histogram: 71% have answered (a) yes and 29% said (b) no.

He then says, "Someone who answered yes . . . please explain why you would support the project." He selects a student who has his hand raised, and the student explains his rationale for his answer. "Does anyone have another reason for selecting yes?" Dr. Davis hears from a few more students, mostly commenting on return-on-investment.

"I'd like to hear from someone who answered (b)" he says. No one raises a hand.

"Twenty-nine percent of you answered (b). Who will explain why they chose this answer?"

Someone from the back finally volunteers. The student says that the return on investment meets the company's goals, but reduces the return on investment of the division from 10% to 8%. Students then debate the merits of each answer, and a number of students volunteer that they have changed their opinion based on the comments of

other students. This initiates a discussion of about congruence and alternate measures of performance.

For this question, there is no right or wrong answer because there is more than one way to evaluate the financial benefits of a project. This question encouraged students to think about a course concept beyond the simple application of a formula, representing a deeper level of thinking.

Example 2. *Dr. Nelson has spent some time discussing how the digestive system breaks down food into nutrients so they can be absorbed. Then she says, "Here is a think/pair/share question" and displays the following clicker question: "Which of the following organ systems are most important to the digestive system? Choose your top two and be prepared to justify your answer. (a) Nervous, (b) Respiratory, (c) Urinary, (d) Reproductive, (e) Cardiovascular/Circulatory, (f) Lymphatic/Immune, (g)Muscular, (h) Skeletal, (i) Endocrine, (j) Integumentary."*

She says, "Talk with others around you and submit your choices with your clickers. Be sure you can defend your answer!" She allows five minutes for group discussion, and monitors the counter to see when most students have answered. After confirming that all answers are in, she stops the polling and displays the histogram. "Wow, there is a huge spread here. I'd like to hear from a group who selected the nervous system as one of the most important. Why did you choose it over other organ systems?" She continues to solicit group justifications for selecting the various systems. As the discussion continues, it becomes clear that all the systems are important at different stages of digestion.

This question asked students to define and compare the organs systems, and to evaluate their importance to a particular function. This question and the discussion that followed facilitated a deeper-level of thinking about the relationships among the primary organ systems of the body.

Category #5—Evaluate students for a grade. This use of the clicker system allows the teacher to administer a quiz or exam in class, and record their responses for a grade. The USB drive records all clicker responses, which the teacher can access after class and import into the class management system.

Example. *Dr. Nelson begins class with a quiz on the chapter students were assigned to read for this class meeting. As students are filing in and taking their seats, the image projected on the screens in the front of the room announces the quiz. After class officially begins, she asks students to put away all their class materials and prepare their clickers. After visually sweeping the room to see if all students appear ready, she begins by advancing the slide to show the first question. Students have one minute per question to register their answer. The timer on the screen counts down the time and displays the number of students who have answered. At the end of minute, she closes the questions, advances her slide, and opens the new question for student responses. This continues until all 10 questions have been presented.*

After the quiz is finished, she returns to the first quiz question slide, reads the question, and asks students to identify the correct answer. The students express their feelings (yes! Awwww, no!) as the correct answer is revealed. After reviewing all 10

questions, and fielding questions about the items, she advances the slide and introduces the topic of the day.

There are pros and cons to the use of clickers for summative evaluation. One the one hand, clickers offer an efficient way to administer a quiz or test to a large classroom, and allow the teacher to provide immediate feedback to students by reviewing the correct answers immediately following the quiz or test. However, clicker-based evaluations prevent students from being able to skip a question and return to it later, which can be a useful test-taking strategy.

While there is some overlap in the ways these clickers are used, these five functions offer a clear picture of different ways that clickers were used in the three large classrooms that were the focus of my study.

Other observations. In addition to noting patterns in the types of clicker questions, I also made some general observations about clicker use in the classroom.

First, it takes time and dedication for faculty to learn to manage new educational technology seamlessly. One teacher experienced numerous "problems" with the technology in the beginning of the semester that were operator errors, not "technology problems." For example, he would claim that the clickers weren't working, yet he failed to stop the polling before attempting to show the results. Another teacher, who is in her second year of teaching, seemed to have some issues juggling both the power-point software and the clicker software in the beginning of the semester, and occasionally asked me to run one or the other for her. By the end of the semester, she was able to run both without needing assistance from me.

Managing the technology while simultaneously implementing a new way of teaching can be overwhelming. On many occasions, as I observed these classes, I was struck by the dedication and persistence of these teachers who had committed to trying something new in front of the gaze of 90+ students. I watched as some classes went smoothly and others faltered with stops and starts. In both instances, I was aware of the risks these teachers took to try to improve their craft. It was encouraging and inspiring to observe their commitment to learning and teaching.

Second, there were far fewer problems with the clickers than I initially imagined. The student devices are simple, and there were very few issues with student use other than the occasional student who forgot to bring theirs to class. However, one teacher allowed students to use the internet-based "app" for the iClicker, called "i>clicker GO," which did create problems. The students who responded using the app rather than the radio-frequency device slowed the system significantly. This problem lies with limitations of bandwidth or access points in the classroom, which are infrastructure problems at the institution rather than issues with the software. The teachers' solution to this problem was to require all students to use the handheld clicker rather than the app. I observed a similar problem with the use of *Learning Catalytics*, which is an internet based clicker system. When one of teachers attempted to use this program during a "peak" time of day (a Tuesday and Thursday midday class), the system was too slow to be useful and some students could not connect at all. This tells me that internet-based classroom technology may require more "connectivity" than my university's present classroom capabilities.

Finally, immovable seats make it difficult for students to work together in small groups, and impossible for the teacher to walk around and observe all groups. One of the auditoriums had long tables instead of individual chair-desks that facilitated student movement better than individual seats, but still limited the teacher to the aisles only. I believe that auditorium classrooms need more aisles to facilitate movement.

Interpretation

What I most learned from the participant observations I conducted was about the various ways that clickers are used in the classroom. I organized these into 5 broad categories of functions of clicker questions. These categories for types of clicker questions emerged as I observed hundreds of clicker questions that I had described in my notes and the student responses they elicited.

These functions of clickers that I identified are ways that I observed clickers being used for teaching and learning—in other words, ways that teachers used clickers to facilitate pedagogical practices. These pedagogical practices (building rapport with students, facilitating peer instruction, assessing student understanding, encouraging deep thinking, and evaluating students) exist as contemporary instructional practices. What this means is that clicker technology facilitates the implementation of pedagogies that are already in practice. Even without clickers, teachers build rapport with students, facilitate peer interaction, assess student understanding, etc.

However, it is sometimes the case that technology creates pedagogical possibilities, rather than facilitating pedagogies already in use. For example, homework programs that are “computer adaptive” generate the next practice question based on how

a student answers the first question so that a student who answers a question correctly will receive a more challenging item, while an incorrect answer generates an easier question. This represents a new teaching strategy that was not available prior to the technology. In my observations, clickers facilitated the use of existing pedagogies in a large classroom rather than creating pedagogical possibilities.

The various uses for clickers that I observed are consistent with the literature on the uses of clicker questions. Many uses for clickers have been identified including recording attendance, testing, voting, and group activities (Duncan, 2005; Fies & Marshall, 2006). Hoekstra and Mollborn (2012) reviewed this literature and found that clickers could facilitate five principles of good teaching: eliciting student feedback, identifying students' preconceptions and assumptions about course material, facilitating opportunities for small and large-group discussions, improving social cohesion in the learning community, and gathering anonymous data from students to support conceptual application. My findings are similar in that I also identified pedagogies that clickers facilitated.

My findings seem to support the notion that technology is not itself pedagogy, but that it is a tool that can be used in many ways. Beatty and Gerace (2009) summarize this position well:

> We argue that tools should be evaluated on their affordances, whereas approaches and methodologies should be evaluated on their student impacts. In other words, don't ask what the learning gain from CRS use is; ask what pedagogical approaches a CRS can aid or enable or magnify, and what the learning impacts of those various approaches are. (p. 147)

However, since technology may frame experience in particular ways, I believe that we also must consider the frame of clickers—the ways that clickers mediate experience—in order to understand clicker use in the classroom. As an educational technology, clickers may shape pedagogical practice in a particular way that is distinct from the practice without clickers. After all, clickers are a tool for asking questions and receiving answers, and question-based teaching is pedagogy. In the final chapter, I will re-visit the notion of tools as mediators, and attempt to account for both the frame of clickers as mediators of student-teacher interaction and my findings that clickers facilitate multiple instructional strategies in the classroom.

Reflections on the Experience

When I began observing classes that included the use of clickers, I anticipated a rather sterile classroom environment where students clicked answers to teacher questions for the benefit the teacher and their understanding of student comprehension of content. What I did not anticipate is how the use of clickers might affect the students.

I watched as large classrooms "came alive" with clicker use. Students, instead of assuming the role of listener in a lecture-based class, became active participants in an interactive class. There was dialogue, discussion, and problem solving. These classrooms were marked by engaged students! This was not the case in every class meeting, and not the case for every student, but in general, clicker-based classrooms were lively and filled with activity rather than passivity. Students seemed interested, and on occasion, downright enthusiastic.

As a student in a classroom for almost 20 years (Kindergarten through college in the late 1980s and doctoral classes in the early 2010s), I never had a class with more than 35 or so students. Though I attended a small, private college for my first two college years, I attended a large, public university for my last two undergraduate years. My experiential reference for college classroom were small and interactive, and my perception of large lecture classrooms was a talking head in front of bored, note-taking students. I feel very encouraged and hopeful after observing high enrollment classes with active, engaged students. I believe that clickers, in the hands of trained and dedicated teachers, can, and do, transform large classrooms and the experience of education for teachers and students in them.

In the next chapter, Chapter V, I offer findings from the other two data sets: the survey and the interviews.

CHAPTER V

CLICKERS FACILITATE COMMUNICATION AND CONNECTION

In this chapter, I present the results and analysis from the survey and interview data I collected for this study. I first present results by data collection method, and then I discuss overlapping themes. I conclude with a synthesis of the findings from all 3 data sets.

Overview

The results of the survey and interview responses indicate that clickers may have potential for facilitating some aspects of the student-teacher relationship. While most participants reported that they associate clicker use with certain aspects of the student-teacher relationship, the interview responses were clear that clicker communication did not comprise a "relationship." Participants perceived clickers as a communication tool—something that facilitates communication between students and teachers and promotes feelings of connectedness. These finding shows that this line of research, clickers and the pedagogical relationship, has promise as productive for future lines of research.

Survey Administration

I solicited participants for the survey portion of this study by reading the recruitment script, approved by the IRB, to each of the 3 classes in week 9 of the semester (just over half way through the term). I created the survey in Qualtrics, on online survey program, and each of the teachers posted the link to the survey as an

"announcement" on Canvas, the course management platform. Through the announcement, students who chose to participate could easily access the survey. Following the advice of Wiersma and Jurs (2005) who say that "follow ups are considered necessary for questionnaire surveys" (p. 177), I addressed each class again a week later, reminding them about the survey and where they could find the link. One week after the reminder, I greeted each class at the door as they entered the classroom with a basket of candy and another request for participation attached on a slip of paper.

The result of this 3-step recruitment effort was a strong survey return rate. The total enrollment in all three classes was 342 students and I received 124 surveys for a return rate of 36%, which is above the 30% average for online surveys (University of Texas at Austin, n.d.). All were complete.

I downloaded the data from Qualtrics and imported it into IBM SPSS Statistics Premium 23. I met with staff in the *CERE: Center for Educational Research and Evaluation* in the Educational Research Methodology Department in the School of Education for assistance with running and analyzing my results in SPSS.

Survey Results

The survey contained 27 items total: 20 items related to clicker use in the classroom, one item about teacher care, and six items requesting demographic information. The survey is included in Appendix C. In the following six sections, I present the survey results. First, I present the raw data in SPSS tables. Then I describe the parameters of my analyses and offer an interpretation of those results. The seven sections of survey findings are:

A. Participant Demographics

B. Full Survey Item Frequencies, Raw Data

C. Survey Data Analysis Procedures

D. Relational Dimensions Category Results

E. Clickers as Communication Category Results

F. Teacher Relational Qualities Category Results

G. Other Survey Item Category Results

H. Gender, Age, and Classification

A. Participant Demographics

Tables 1–6 present the data for the survey items requesting participant demographic information, followed by a summary and discussion of the participant profile for this study.

Table 1

Age

How old are you?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18–22	96	77.4	77.4	77.4
	23–30	16	12.9	12.9	90.3
	31–50	12	9.7	9.7	100.0
	Total	124	100.0	100.0	

Table 2

Academic Classification

What is your academic classification?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Freshman	14	11.3	11.3	11.3
	Sophomore	50	40.3	40.3	51.6
	Junior	45	36.3	36.3	87.9
	Senior	13	10.5	10.5	98.4
	Other	2	1.6	1.6	100.0
	Total	124	100.0	100.0	

Table 3

Gender

What is your gender?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	77	62.1	62.1	62.1
	Male	44	35.5	35.5	97.6
	Other	3	2.4	2.4	100.0
	Total	124	100.0	100.0	

Table 4

Ethnicity/Race

Which of the following best describes your ethnicity or race?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Latino (a)	8	6.5	6.5	6.5
	Black or African American	31	25.0	25.0	31.5
	White	60	48.4	48.4	79.8
	Asian/Pacific Islander	13	10.5	10.5	90.3
	Mixed ethnicity/race	7	5.6	5.6	96.0
	Other	5	4.0	4.0	100.0
	Total	124	100.0	100.0	

Table 5

Major

Which of the following best describes your major?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Humanities/Arts	7	5.6	5.6	5.6
	Education	1	.8	.8	6.5
	Social Sciences	7	5.6	5.6	12.1
	Health/Human Services	38	30.6	30.6	42.7
	Business	56	45.2	45.2	87.9
	Science/Technology/ Engineering/Math	6	4.8	4.8	92.7
	Other	9	7.3	7.3	100.0
	Total	124	100.0	100.0	

Table 6

Class Section Enrollment

Which of the following classes are you enrolled in this semester? (This survey is being distributed to 3 different classes this semester, and I may want to look at the results by class).		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ACC 202: Managerial Accounting, TTH 2-3:15	55	44.4	44.4	44.4
	NTR 213: Intro to Nutrition, TTH 12:30-1:45	33	26.6	26.6	71.0
	NTR 213: Intro to Nutrition, Tuesdays 6:00-8:50pm	36	29.0	29.0	100.0
	Total	124	100.0	100.0	

Most of the participants were 18–22 years of age (74%) and were either sophomores or juniors (77%). The female to male ratio was 62%/36%, which reflects the gender ratio of the institution, which is 65%/35%. Almost half of the participants self-reported as white (48%), one-fourth African American (25%), and one-fourth as Asian/Pacific Islander, mixed race, Latino or other combined (26.6%). This sample generally reflects the institution as a whole, which is 55% white, 27% African American, and 18% Latino, Asian, mixed-race, and other. Most students reported majoring in one of two categories: Health and Human Services (31%) and Business (45%). These results reflect the subject of the class sections observed, and are not reflective of the institution as a whole.

The class section enrollment numbers are interesting. The table shows that 44% of the participants were enrolled in the Accounting class, while 27% and 29% came from the two Nutrition classes. What the table does not show is the response rate from each class. The overall return rate for the survey is 36%, but the response rates varied by class enrollment. In the Accounting class, 55 of the 130 students enrolled took the survey for a 42% return rate. In the daytime Nutrition class, 33 of the 122 students took the survey for a 27% response rate and in the evening Nutrition class, 36 of the 90 enrolled students took the survey for a 40% return rate. I cannot explain the disparity in return rates across the classes, or how this might have affected my results. However, since I am not claiming that the participants reflect the population (instead I am looking for possible associations between clicker use and the pedagogical relationship). I am not concerned about these uneven return rates by class.

B. Full Survey Item Frequencies, Raw Data

Tables 7–27 present the raw data for the 21 survey items. I present a summary, analysis, and interpretation of these results following these SPSS-generated tables.

Table 7

Clickers and Engagement

Do you think the use of *clickers* in this class helps you feel more *engaged* in the course? (*engaged* = involved, interested, motivated)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely	61	49.2	49.2	49.2
	Probably	46	37.1	37.1	86.3
	Not Sure	1	.8	.8	87.1
	Probably Not	11	8.9	8.9	96.0
	Definitely Not	5	4.0	4.0	100.0
	Total	124	100.0	100.0	

Table 8

Clickers and Learning

Do you think using clickers in this class has helped you learn course content?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely	47	37.9	37.9	37.9
	Probably	41	33.1	33.1	71.0
	Not Sure	14	11.3	11.3	82.3
	Probably Not	13	10.5	10.5	92.7
	Definitely Not	9	7.3	7.3	100.0
	Total	124	100.0	100.0	

Table 9

Clickers and Communication

Would you say that using clickers is an important way you communicate with the teacher?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely	39	31.5	31.5	31.5
	Probably	42	33.9	33.9	65.3
	Not Sure	18	14.5	14.5	79.8
	Probably Not	14	11.3	11.3	91.1
	Definitely Not	11	8.9	8.9	100.0
	Total	124	100.0	100.0	

Table 10

Clicker and Feedback

Do you think the use of clickers helps the teacher know what information you need to understand the course material?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely	56	45.2	45.2	45.2
	Probably	51	41.1	41.1	86.3
	Not Sure	7	5.6	5.6	91.9
	Probably Not	6	4.8	4.8	96.8
	Definitely Not	4	3.2	3.2	100.0
	Total	124	100.0	100.0	

Table 11

Clickers and Teacher Attentiveness

Do you think the teacher pays careful attention to clicker responses?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely	50	40.3	40.3	40.3
	Probably	30	24.2	24.2	64.5
	Not Sure	29	23.4	23.4	87.9
	Probably Not	13	10.5	10.5	98.4
	Definitely Not	2	1.6	1.6	100.0
	Total	124	100.0	100.0	

Table 12

Clickers and Teacher Response

Does the teacher respond to the information provided by the clicker answers?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely	76	61.3	61.3	61.3
	Probably	26	21.0	21.0	82.3
	Not Sure	8	6.5	6.5	88.7
	Probably Not	12	9.7	9.7	98.4
	Definitely Not	2	1.6	1.6	100.0
	Total	124	100.0	100.0	

Table 13

Clickers and Dialogue

Would you say that clicker questions and answers promote dialogue between you and the teacher?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely	49	39.5	39.5	39.5
	Probably	50	40.3	40.3	79.8
	Not Sure	7	5.6	5.6	85.5
	Probably Not	11	8.9	8.9	94.4
	Definitely Not	7	5.6	5.6	100.0
	Total	124	100.0	100.0	

Table 14

Clickers and Care

Do you think your teacher cares about you and your success in this class?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely	60	48.4	48.4	48.4
	Probably	39	31.5	31.5	79.9
	Not Sure	15	12.1	12.1	92.0
	Probably Not	7	5.6	5.6	97.6
	Definitely Not	3	2.4	2.4	100.0
	Total	124	100.0	100.0	

Table 15

Clickers and Support

Does the use of clickers in the class make you feel...-Supported?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely	33	26.6	26.6	26.6
	Probably	41	33.1	33.1	59.7
	Not Sure	26	21.0	21.0	80.6
	Probably Not	13	10.5	10.5	91.1
	Definitely Not	11	8.9	8.9	100.0
	Total	124	100.0	100.0	

Table 16

Clickers and Respect

Does the use of clickers in the class make you feel...-Respected?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely	26	21.0	21.0	21.0
	Probably	25	20.2	20.2	41.1
	Not Sure	39	31.5	31.5	72.6
	Probably Not	23	18.5	18.5	91.1
	Definitely Not	11	8.9	8.9	100.0
	Total	124	100.0	100.0	

Table 17

Clickers and Awareness

Does the use of clickers in the class make you feel...-Anxious?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely	16	12.9	12.9	12.9
	Probably	29	23.4	23.4	36.3
	Not Sure	16	12.9	12.9	49.2
	Probably Not	36	29.0	29.0	78.2
	Definitely Not	27	21.8	21.8	100.0
	Total	124	100.0	100.0	

Table 18

Clickers and Encouragement

Does the use of clickers in the class make you feel...-Encouraged?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely	26	21.0	21.0	21.0
	Probably	53	42.7	42.7	63.7
	Not Sure	23	18.5	18.5	82.3
	Probably Not	18	14.5	14.5	96.8
	Definitely Not	4	3.2	3.2	100.0
	Total	124	100.0	100.0	

Table 19

Clickers and Connection

Does the use of clickers in the class make you feel...-Connected?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely	55	44.4	44.4	44.4
	Probably	45	36.3	36.3	80.6
	Not Sure	11	8.9	8.9	89.5
	Probably Not	8	6.5	6.5	96.0
	Definitely Not	5	4.0	4.0	100.0
	Total	124	100.0	100.0	

Table 20

Clickers and Safety

Does the use of clickers in the class make you feel...-Safe?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely	37	29.8	29.8	29.8
	Probably	21	16.9	16.9	46.8
	Not Sure	42	33.9	33.9	80.6
	Probably Not	12	9.7	9.7	90.3
	Definitely Not	12	9.7	9.7	100.0
	Total	124	100.0	100.0	

Table 21

Clickers and Nurture

Does the use of clickers in the class make the teacher seem...-Nurturing?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely	16	12.9	12.9	12.9
	Probably	30	24.2	24.2	37.1
	Not Sure	38	30.6	30.6	67.7
	Probably Not	34	27.4	27.4	95.2
	Definitely Not	6	4.8	4.8	100.0
	Total	124	100.0	100.0	

Table 22

Clickers and Trustworthiness

Does the use of clickers in the class make the teacher seem...-Trustworthy?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely	25	20.2	20.2	20.2
	Probably	35	28.2	28.2	48.4
	Not Sure	40	32.3	32.3	80.6
	Probably Not	18	14.5	14.5	95.2
	Definitely Not	6	4.8	4.8	100.0
	Total	124	100.0	100.0	

Table 23

Clickers and Professionalism

Does the use of clickers in the class make the teacher seem...-Professional?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely	46	37.1	37.1	37.1
	Probably	56	45.2	45.2	82.3
	Not Sure	11	8.9	8.9	91.1
	Probably Not	7	5.6	5.6	96.8
	Definitely Not	4	3.2	3.2	100.0
	Total	124	100.0	100.0	

Table 24

Clickers and Fairness

Does the use of clickers in the class make the teacher seem...-Fair?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely	55	44.4	44.4	44.4
	Probably	45	36.3	36.3	80.6
	Not Sure	14	11.3	11.3	91.9
	Probably Not	7	5.6	5.6	97.6
	Definitely Not	3	2.4	2.4	100.0
	Total	124	100.0	100.0	

Table 25

Clickers and Manipulation

Does the use of clickers in the class make the teacher seem...-Manipulative?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely	5	4.0	4.0	4.0
	Probably	9	7.3	7.3	11.3
	Not Sure	25	20.2	20.2	31.5
	Probably Not	37	29.8	29.8	61.3
	Definitely Not	48	38.7	38.7	100.0
	Total	124	100.0	100.0	

Table 26

Clickers and Open-Mindedness

Does the use of clickers in the class make the teacher seem...-Open-minded?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely	37	29.8	29.8	29.8
	Probably	43	34.7	34.7	64.5
	Not Sure	34	27.4	27.4	91.9
	Probably Not	7	5.6	5.6	97.6
	Definitely Not	3	2.4	2.4	100.0
	Total	124	100.0	100.0	

Table 27

Clickers and Approachability

Does the use of clickers in the class make the teacher seem...-Approachable?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Definitely	41	33.1	33.1	33.1
	Probably	40	32.3	32.3	65.3
	Not Sure	26	21.0	21.0	86.3
	Probably Not	7	5.6	5.6	91.9
	Definitely Not	10	8.1	8.1	100.0
	Total	124	100.0	100.0	

C. Survey Data Analysis Procedures

As I reviewed the frequency distributions for the survey items—that is, the number of participants who answered each of the five possible responses (definitely, probably, not sure, probably not, definitely not), I made a number of decisions for analysis purposes. My survey yielded a high quantity of data, and I needed methods for data synthesis.

First, I grouped the 21 non-demographic items into four general categories (or "classes") to facilitate analysis: Clickers and Relational Dimensions, Clickers as Communication, Clickers and Teacher Relational Qualities, and Other Survey Items. I created the categories based on my literature review of dimensions of student-teacher relationships and findings related to clicker use in the classroom. According to Sullivan (2010), researchers need to organize their raw data into a meaningful form prior to

analysis. These four categories, or groupings, partition the data into meaningful groups for analysis purposes.

Second, I combine the responses "definitely" and "probably" into one category. This is referred to as collapsing or combining response categories (a type of "data transformation"), and is a common practice to "extract the maximum amount of useful meaning from the responses observed" (Wright & Linacre, 1992, n.p.) and "to combine categories that logically go together" (De Vaus, 2014, p. 162). I chose to collapse "definitely" and "probably" into one category because they both indicate agreement, or at least probable agreement with a statement about clickers and some aspect of the student-teacher relationship. Since this study is exploratory in nature, it makes sense to highlight the items where participants indicated some level of agreement so I can identify areas with the potential to contribute to the pedagogical relationship. The frequency tables in the following sections present the data in the combined definitely/probably response category. However, I comment on the raw distribution where there is a notable split between the two original categories, and this information is available in the raw data tables presented in the previous section.

Finally, to help me interpret my findings, I needed to create a system for estimating the strength of the survey results. All results are reported in percentages—specifically, the percentage of participants who responded "definitely" or "probably" for each survey item. This reporting of descriptive statistics shows the "relative frequency" of responses (the number of responses in a category relative to the total number of respondents), and allows me to make "relative comparisons." I needed to establish

guidelines for interpreting the strength of the percentages relative to the whole group in order to be able to evaluate the results. For example, if 70% of participants agreed with an item, is this a strong result? Is it a moderate result? How do I make this decision?

I cannot offer levels of "statistical significance" because there is no "baseline" to use to compare my results to. For example, 82% of participants in this study reported that they definitely or probably think the teacher cares about them and their success in the class. I could calculate statistical significance of this percentage if I knew the percentage of students who say this in a "normal" or "typical" non-clicker class. However, there is no baseline or "average" result for the questions I asked on the survey, so significance cannot be calculated statistically.

My other two options for estimating the strength of results are to rely on prior research and/or make a personal assessment (Howell, 2010). As I reviewed the research, I could not find a commonly accepted standard for claiming that a relative frequency result is strong, moderate, or weak because that judgment is dependent on the variable measured. For example, a batting average of .300 in baseball is considered excellent (a strong frequency), but a completion average of .300 for a quarterback in football is career ending (a weak frequency).

So, since I could not calculate statistical significance and there is no standard in the literature, I considered choosing a well-established guideline for interpreting the strength of the percentages relative to the whole group in the academic environment: the grading scale. The most common grading scale in the United States is:

90-100%	Very Strong
80-89%	Strong
70-79%	Moderate/Average
60-69%	Weak
0-59%	Very Weak, Failing

I considered interpreting the results presented in the frequency tables utilizing this scale as a guide, e.g. if 86% of participants said “definitely” or “probably,” I would consider that a strong result and a relative frequency of 65% will be considered a weak result. However, I find this scale to be relative (and arbitrary) as well. A score of 90% may be outstanding on one assessment, and average on another. In addition, I’m not sure a percentage correct on a single assessment is always a good assessment of what is a “strong” outcome versus a ”weak” outcome (which is why I employ three distinct methodologies in this study).

So, I decided to interpret the results of this survey using the only guideline that I can justify: relative frequency. I interpret my survey findings based on how the result relates to and with the other results of the survey instead of using external criteria.

The following sections present and discuss the results by analysis category.

D. Clickers and Relational Dimensions

The first of the four categories I created to organize the data into meaningful groups for analysis purposes is “Clickers and Relational Dimensions.” While there is no general agreement on the dimensions related to a favorable student-teacher relationship, some studies have explored certain aspects of the relationship or way of being in-relation.

The survey items listed below all refer to participant perceptions of aspects of relational dimensions that appear in the literature. They are:

- Does the use of *clickers* in the class make *you* feel . . . Supported?
- Does the use of *clickers* in the class make *you* feel . . . Respected?
- Does the use of *clickers* in the class make *you* feel . . . Anxious?
- Does the use of *clickers* in the class make *you* feel . . . Encouraged?
- Does the use of *clickers* in the class make *you* feel . . . Connected?
- Does the use of *clickers* in the class make *you* feel . . . Safe?

Figure 3 shows the percentage of participants who answered "definitely" or "probably" to the survey items related to relational dimensions of the student-teacher relationship identified in the literature.

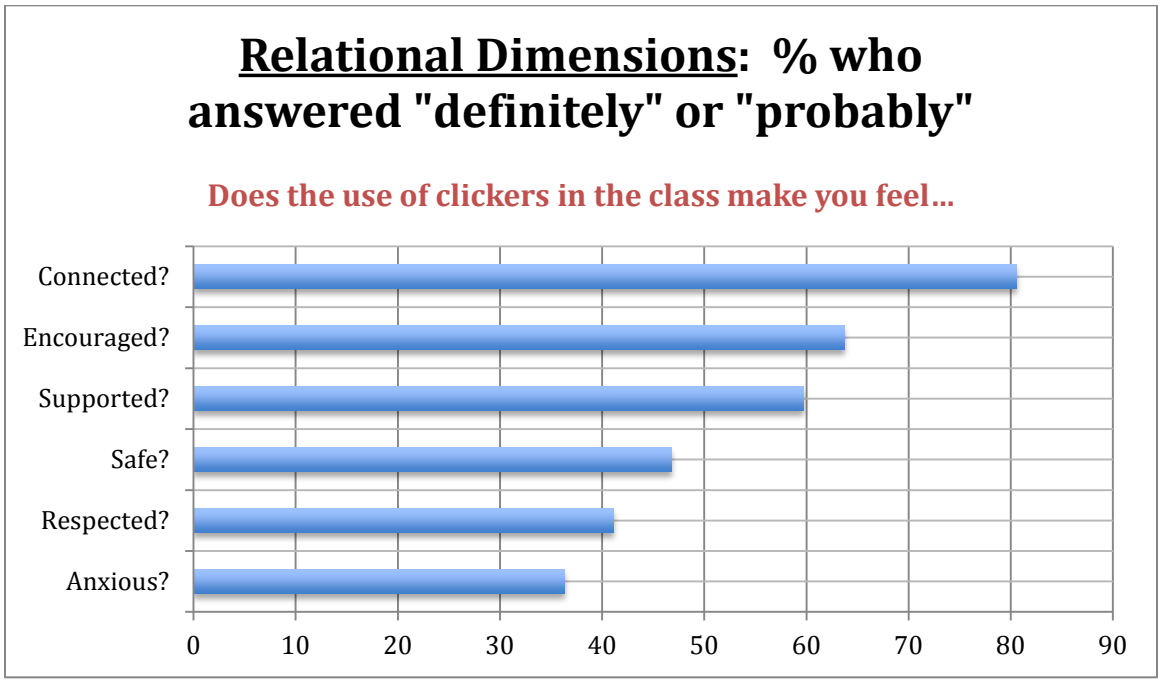

Figure 3. Relational Dimension Results.

The perception of clicker use as related to dimensions of the student-teacher relationship offers interesting results. Of the participants, 80.6% reported that the use of clickers in the classroom helped them feel "connected." The word "connect," from Latin meaning to join or bind together, has multiple meanings. In can mean to "get in touch with" someone, to "establish rapport," "to awaken meaningful emotions," and to "establish a relationship" (Online Etymology Dictionary, n.d.). The word "connect" also has technological connotations. We connect computers, we are connected to the Internet, and to be connected is to be "online" (as to be disconnected is to be offline). One online dictionary includes "join by means of communication equipment" in their list of definitions (The Free Dictionary, n.d.). The fact that participants reported that they felt "connected" in the classroom suggests that they view clickers as a tool for linking them with their teacher. The association of clicker use to connection in the classroom received the highest relative result in this category.

Two items in this category, clickers helping students feel encouraged and supported, received 63.7% and 59.7%, respectively. While the split between responses of "definitely" and "probably" were roughly the same for feeling supported, the split for feeling "definitely" or "probably" encouraged was broader. Twenty-one percent of participants indicated that they "definitely" felt encouraged while 42.7% said they "probably" felt encouraged. While this indicates that more than half of participants associated feeling supported and encouraged with clicker use, these associations are weaker than with feeling connected. Finally, less than half of participants associate

clickers with feeling safe and respected. The item on anxiousness was a reverse coded item, and indicates that just over a third of students associate clicker use with anxiety.

These results tell me that clickers appear to facilitate connection, which shows promise for contributing to the pedagogical relationship. However, fewer than half of participants related clickers with feeling safe and respected. This finding indicates that there is a dynamic at play here because clickers appear to facilitate some aspects of a student-teacher relationship while not supporting other aspects. This deserves additional research attention. In addition, approximately a third of participants associated clicker use with anxiety, and I believe this deserves interrogation as well. What is it about using clickers that makes some students anxious? Is it clicker use in general, or only when clickers are used in particular ways, like for quizzes? The results in this category offer insight into which relational dimensions may be associated with clickers.

E. Clickers as Communication

The second category I created based on my literature review of dimensions of student-teacher relationships and findings related to clicker use in the classroom is "Clickers as Communication." These items reflect the perception that clickers are associated with aspects of student-teacher communication:

- Would you say that using *clickers* is an important way you communicate with the teacher?
- Do you think the use of *clickers* helps the teacher know what information you need to understand the course material?
- Do you think the teacher pays careful attention to clicker responses?

- Does the teacher *respond* to the information provided by the clicker answers?
- Would you say that clicker questions and answers promote *dialogue* between you and the teacher?

Figure 4 shows the percentage of participants who answered “definitely” or “probably” to the survey items related to the communication dimensions of clickers.

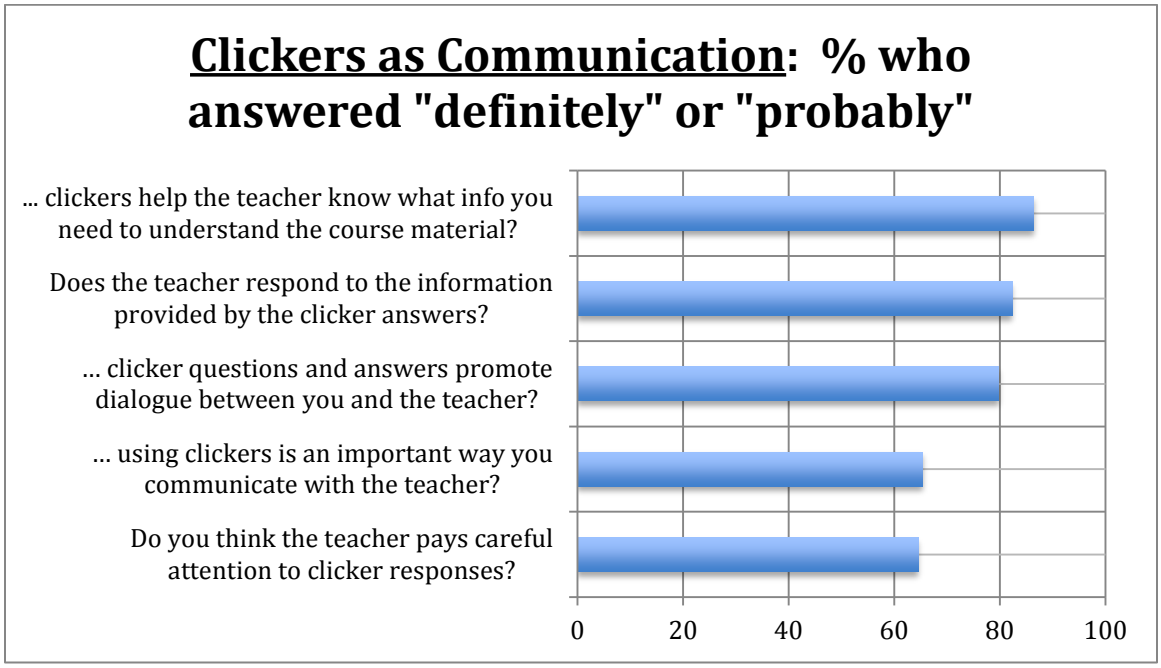

Figure 4. Clickers as Communication Results.

These results indicate that at approximately two-thirds of participants perceive clickers as a communication tool—something that facilitates communication between students and teachers. Over 85% of participants said that clickers serve as important feedback tools by helping teachers to know what information students need. In addition, approximately 80% said that teachers respond to clicker answers (61.3% said “definitely” and 21% said “probably”), and that clickers promote dialogue between students and

teachers. The other items, referencing clickers as an important form of student-teacher communication and teachers attending carefully to clicker answers, were associated with clickers by approximately 65% of participants.

These results support the literature that clickers function as an effective tool for student-teacher communication in the classroom. In addition, the finding that 80% of participants see clickers as promoting dialogue with the teacher may also contribute to a student-teacher relationship.

F. Clickers and Teacher Relational Qualities

The third category partitioning the data into meaningful groups for analysis purposes is "Clickers and Teacher Relational Qualities." These items reflect teacher qualities that students associate with positive student-teacher relationships. The items on the survey reflecting teacher qualities are:

- Does the use of *clickers* in the class make the *teacher* seem . . . Nurturing?
- Does the use of *clickers* in the class make the *teacher* seem . . . Trustworthy?
- Does the use of *clickers* in the class make the *teacher* seem . . . Professional?
- Does the use of *clickers* in the class make the *teacher* seem . . . Fair?
- Does the use of *clickers* in the class make the *teacher* seem . . . Manipulative
- Does the use of *clickers* in the class make the *teacher* seem . . . Open-minded?
- Does the use of *clickers* in the class make the *teacher* seem . . . Approachable?

Figure 5 shows the percentage of participants who answered "definitely" or "probably" to the survey items related to relational qualities of teachers as identified in the literature.

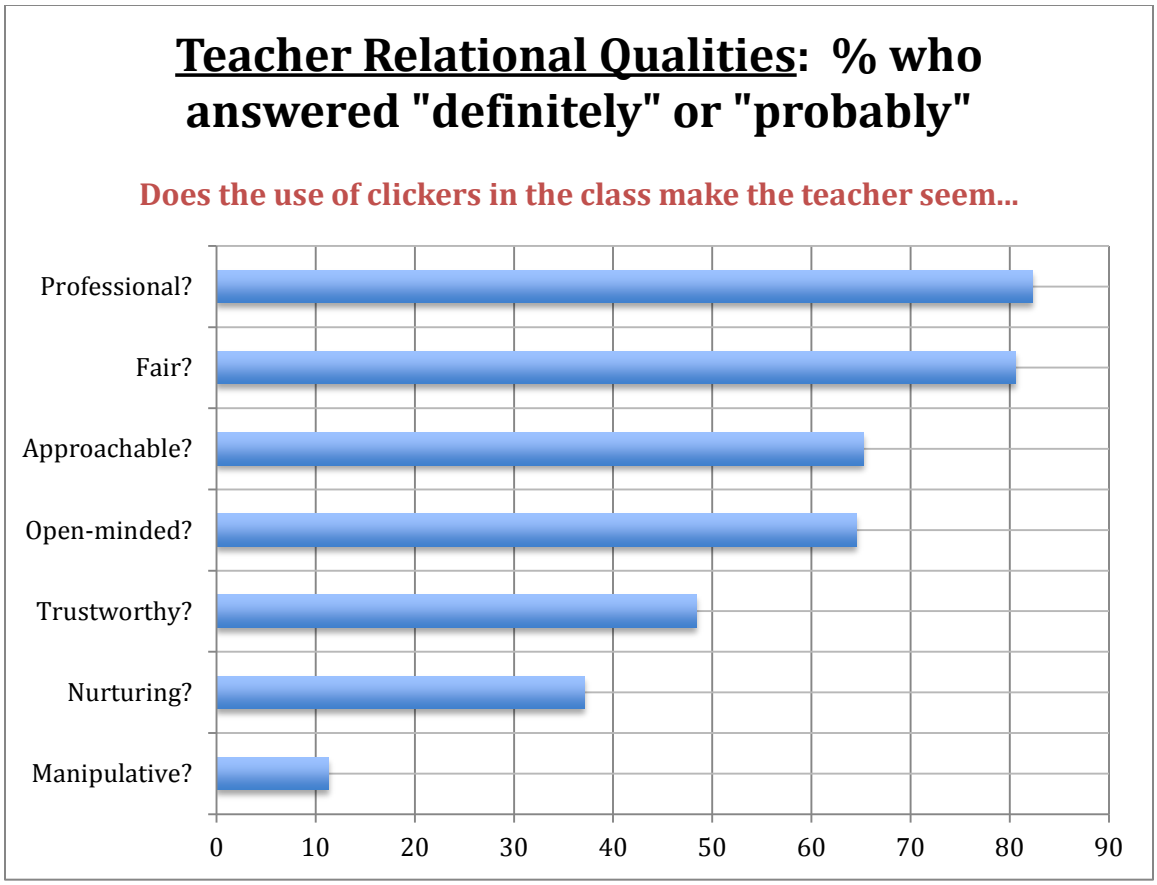

Figure 5. Teacher Relational Qualities Results.

The survey items relating to the relational qualities of teachers associated with clicker use are interesting because of the differences in the percentage of positive responses. Results indicate that over 80% of participants associate clicker use and perceptions of the teacher as professional and fair. Perceptions of clickers and teacher approachability and open-mindedness were supported, but with approximately 65% of participants making the association. It is interesting to note that fewer than half of the participants associated clicker use with trustworthiness or nurturing (12.9% said "definitely" and 24.2% said "probably"), which may be important aspects as the student-

teacher relationship. This is worth a follow-up study to explore these aspects of perceived teacher qualities for the pedagogical relationship and the use of clickers.

G. Other Survey Items

The final category of survey items consists of questions that do not directly relate to clicker use *and* student perceptions of the student-teacher relationship, but relate to either the use of clickers or the student-teacher relationship. The first 2 items ask about clicker use and engagement and learning, which are the two primary benefits of clicker use according to the literature.

- Do you think the use of *clickers* in this class helps you feel more *engaged* in the course? (*engaged* = involved, interested, motivated)
- Do you think using *clickers* in this class has helped you learn course content?

The third item asks about student perception of teacher care, but is not specifically related to clicker use.

- Do you think your teacher *cares* about you and your success in this class?

Figure 6 shows the percentage of participants who answered "definitely" or "probably" to the three survey items not directly related to clicker use and the student-teacher relationship. These findings support the literature on the major benefits of clicker use in the classroom: increased student engagement and learning. Over 85% of participants reported that clickers helped them to feel more engaged in the class, and 71% said that clickers helped them to learn course content. While not directly related to the student-teacher relationship, these findings indicate perceived values from the use of clickers.

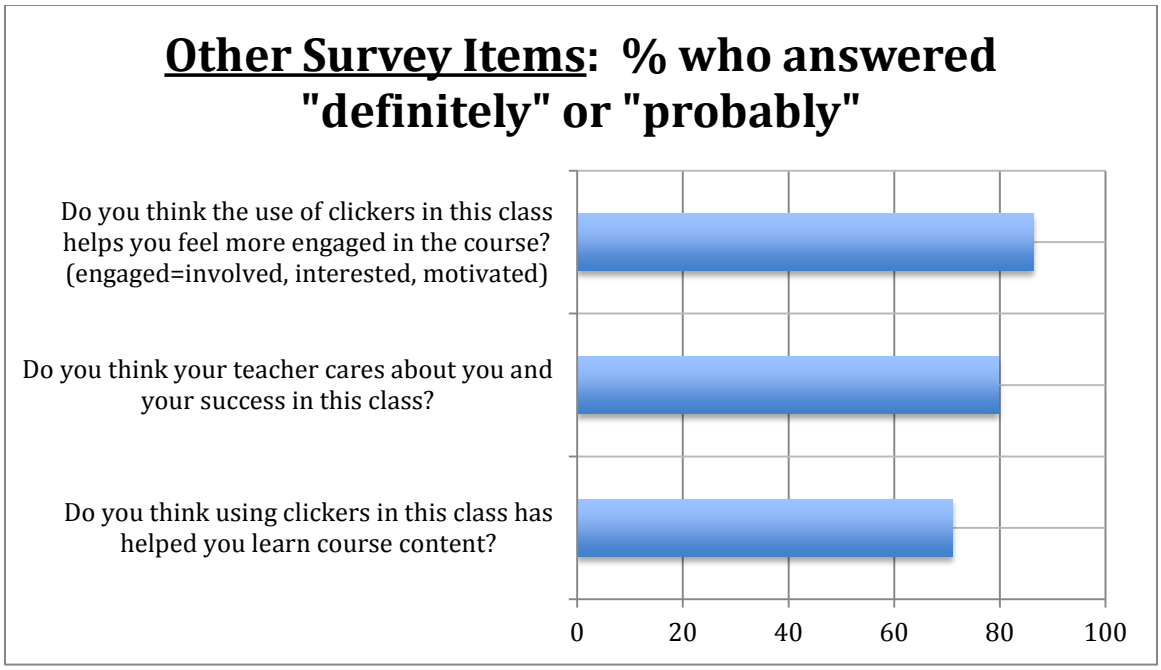

Figure 6. Other Survey Item Results.

Although almost 80% of participants said they either definitely or probably think their teacher cares about them and their success in the class, and "care" is certainly an important dimension of the student-teacher relationship, the survey item did not ask about this perception as it relates to clicker use. However, it is interesting to note that almost 80% of participants felt that the teacher either definitely or probably cares about them, which I think is a positive result to see.

H. Gender, Age, and Classification

In addition to examining the relative frequencies of the items on the survey, I also conducted one-way ANOVAS to compare students' responses on each of the survey items based on the demographic information I collected: age, classification, gender, ethnicity, and major, as well as by the class section the student was enrolled in. There

were no statistically significant differences in average responses by classification (freshman, sophomore, etc.), ethnicity, or major. However, there were survey items with statistically significant variance for class section enrollment, age, and gender. These results are included as Appendices D, E and F. Though some of these results are interesting to note, these findings are not directly related to the research question: How might the use of clickers in the classroom contribute to the student-teacher relationship? However, the results may be useful for future research, so they are appended.

Summary of Survey Results

The frequency distributions from the survey data indicate that a majority of participants see the use of clickers in the classroom as helping them feel "connected" to the teacher. The association of clicker use to connection in the classroom received the highest relative result in the "relational dimensions" category. Certainly, a feeling of "connection" is a part of a pedagogical relationship (see Komarraju et al., 2010), thus I believe this is an important finding. There were other relational dimensions associated with clickers as well, including helping students feel encouraged and supported.

These results also indicate that a majority of participants perceive clickers as a communication tool—something that facilitates communication between students and teachers. The aspects of student-teacher communication that received the highest relative percentages of agreement were clickers as important feedback tools to the teacher, teacher response to the clicker communication, and the perception that clickers promote dialogue between students and teachers. These findings indicate that participants see

clickers as a tool for communication, which also contributes to a student-teacher relationship.

Finally, the results indicate that a majority of participants associate clicker use with perceptions of the teacher as professional, fair, approachable, and open-minded. These qualities are associated with a positive student-teacher relationship, so this indicates that clicker use may be associated with a number of desirable qualities in teachers who use them, and may contribute to the student-teacher relationship.

There were three items which were not directly related to the perception of clicker use and the student-teacher relationship, and the results support the literature on the major benefits of clicker use in the classroom: increased student engagement and learning. In addition, almost 80% of participants said they either definitely or probably think their teacher cares about them and their success in the class. While the item did not ask participants about their association of clicker use and care, "care" is certainly an important dimension of the student-teacher relationship.

Some of my results are interesting because what I did *not* find. Less than half of participants associated clickers with feeling safe or respected, or with perception of the teacher as trustworthy or nurturing. In addition, over one-third of participants associated clicker use with feeling anxious. These results warrant future exploration.

In sum, my results tell me that my participants associated clickers with some aspects of the student-teacher pedagogical relationship.

The Interview Process

The third research method I used as a part of methodological triangulation was to interview a small number of students enrolled in the three classes, 18 students total, six from each class, to explore the results further. All interviews were conducted in the 15- to 30-minute time period before and after class meetings, either in the hallway outside the classroom or inside the classroom, over a three-week period of time. This type of interview is known as informal and unstructured. "Informal interviews, like unstructured interviews, are an essential part of gaining an understanding of a setting and its members' ways of seeing" (Cohen & Crabtree, 2006, n.p.).

Participants were selected by convenience sampling. Specifically, I talked to students who were available and who consented to be interviewed for the purposes of this study. This type of sampling allows for limited generalization since it is not random, but it suits the purpose of the interviews for this study since the intent was to solicit assistance in interpreting results.

For one of the classes, the daytime Nutrition class, I spoke with all six students individually in the hallway before class because the classroom was in use both before and after class. It is common for the foyer of the building to be full of students waiting to enter the auditorium between classes, and offered a convenient time to talk informally with students. For the Accounting class, I also approached the interviewed students before class, but the students were already seated in the auditorium because there was no class in the room prior to the class I observed. The room emptied quickly after class because this teacher tended to keep class slightly past the end time, and there were a

hundred students waiting (noisily) to enter the room. For the evening Nutrition class, I spoke with students both before and after class. The room was empty before class, and many students lingered in the classroom after class (8:50 pm) to finish up notes or check their phone so I was able to approach students after class as well. In all cases, I approached students randomly, with some attempt to talk with both males and females of visibly different ethnicities.

I began the interviews by re-introducing myself as the graduate student conducting a study of clicker use in their class, and asking for their consent to be interviewed for the study. Everyone I approached agreed to be interviewed. I began each interview by presenting a finding from the survey and asking for their help with interpretation. The following are examples of my initial questions:

> The results of the survey indicated that students felt like clickers helped them feel connected . . . can you explain that?
>
> Eighty-two percent of the students in this class who took the survey said that clickers helped them feel connected . . . is this true for you? Can you explain that?
>
> Why do you think your teacher uses clickers in this class?
>
> Would you say that using clickers in this class has helped you form a relationship with this teacher?
>
> Eighty-seven percent of the students in this class who took the online survey said that clicker questions and answers promote dialogue between students and the teacher. Do you agree? Why or why not?

After my initial question, I followed their comments with follow-up questions to try to encourage them to continue their explanation and to clarify their ideas. I took

shorthand notes while conducting the interviews, and I typed more extensive notes immediately following each interview. I was able to capture exact phrases in some cases, and capture the participants' ideas in others.

Interview Data Analysis and Results

I reviewed my typed notes from each of the 18 interviews. Then, I listed phrases to try to capture the content of what was said, based on guidelines offered in the Coding Manual for Qualitative Researchers (Saldana, 2012). For example, as I reviewed my notes from my interview with Elise, a black female I interviewed on April 14, 2015 in the hallway before the daytime Nutrition class, my phrases, or codes, were as follows:

- Not connected because not personal
- Group answers, not individual
- Not really a relationship
- Likes group work/peer interaction
- Clickers promote discussion/class and peers

I used these codes to examine how the interviewees' perspectives helped expand my participant observations and survey results. For example, I used one of Elise's ideas to clarify the finding that not all participants perceived a connection with clicker use.

> Elise: I don't feel really connected because it's not personalized. In a large class . . . it's only group answers, not individual.

Her response offers an explanation for why some participants might not see clickers as connecting them with the teacher: group communication is not seen as personal as one-

on-one communication, and individualized communication is what makes her feel connected.

Finally, I examined my codes independent of my previous findings to look for patterns across the interviews. I developed these patterns into themes, which I present below. For each theme, I first describe it then offer numerous examples from the student interviews to illustrate each theme. Then, I consider how the theme might inform my understanding of clicker use and the student-teacher relationship.

For the purposes of reporting, I assigned each interview participant a pseudonym, which I use to distinguish participants in the summaries below. The text in italics represents the participants' words, bearing in mind that I did not tape the interviews, so they represent what I captured based upon the notes I recorded after each interview. The regular text indicates that I prompted the student in some way, and the prompt is included for context.

Theme #1—Multiple Clicker Uses/Pedagogical Functions

Each of the 18 students interviewed offered one or more explanations for why their teacher used clickers in the class. These responses support my findings from participant observations that clickers are used to support multiple pedagogical functions. For example:

Clickers initiate dialogue/build rapport.

Flynn: Clickers are interactive. It does promote dialogue . . . there is a lot more talking in this class than in my other classes. Clickers help discussion. Other large classes are mostly lecture; this one is interactive because of clickers.

Cara: You get to voice your opinion. And clickers start discussions.

Clickers frame peer interaction/peer learning.

Laura: It's a conversation because she asks us the true/false questions, and then we (in small groups) talk about how to make them true. It helps me to learn.

Elise: I like the think/pair/share. It really promotes discussion with other students.

Clickers assess student understanding.

Anna: She uses clickers as feedback, so she knows what you understand and what you don't. They help her know what students know.

Owen: The #1 benefit is that teachers know what students know. For me, clickers are useful for feedback.

Clickers allow students to self-assess.

Roger: With clickers . . . I know that I'm behind or if I'm on point. It's a way to check myself.

Anna: I like using clickers . . . it helps me to know what I know and what I don't.

Clickers initiate dialogue/encourage deep thinking.

Grant: We discuss answers and she allows people to justify their answers . . . there's more than one right answer . . . it promotes discussion.

Neil: Because the questions are open, we can compare answers, and get feedback, from the teacher and classmates, and there's lots of interaction.

Evaluate students for a grade. Only one of the 18 students talked about the use of clickers for grade-related evaluation. This may be the case because only one of the three teachers used clickers for this purpose.

> Danielle: She uses it (clickers) for quizzes and as a form of feedback.

One student talked about feeling "safe" in the class because clickers were *not* used for evaluation.

> Ian: Clickers are stress-free because they're anonymous, just for practice, not a grade. It's very safe because she does not know if I get it wrong.

It was evident in the student interviews that clickers were used for multiple purposes. Participants appeared able to define multiple uses of and outcomes from clicker technology based on their own experiences in a classroom. This indicates that potentially, students see clickers as tool that can be used for various purposes, specifically in this study, to facilitate student-teacher communication and student engagement. Some students even hinted at the potential effect of clickers as a *mediator* of the communication between themselves and the teacher. For example, Bradley said that clickers promote conversation and interaction, and added that the ideal classroom situation is a small class that is more personal. He said that non-verbal communication is better in small classes, but that clickers make the best of the large-class situation. The fact that Bradley recognized a clicker limitation, or a frame of clickers as limited to an alpha-numeric/linguistic representation of verbal communication (rather than non-verbal communication), tells me that the mediating effect of educational technology is

discernable, at least to some students. While some of the literature about "digital natives" indicates that students who have grown up in this digital age may not "see" technology the same way that "digital immigrants" do, Bradley's response and the collective responses of other participants tell me that for some "digital natives," technology is visible.

Theme #2—Clickers as Communication and Connection

Most interviewees clearly state that clickers helped them to feel "connected" in the class. When I asked them to explain, many students referred to a *communication* function of clickers. For example:

> Owen: Clickers help teachers feel more connected because it helps them to know if students are getting it. Most teachers are oblivious. They ask, "is everyone good?" Then they nod and move on.
>
> Paula: Yes, clickers make me feel connected to the teacher. They know what you need help on. He asks for our reasons for our answers. And it helps keep my attention.

But not everyone associated clicker use with connection. Two of the 18 students said that clickers did *not* help them feel connected in the class.

> Elise: I don't feel really connected with clickers because it's not personalized. In a large class . . . it's only group answers, not individual answers. (So to feel connected, you would need one-on-one communication?) Yeah, it would have to be one-on-one, personal-like.
>
> Maureen: Not for me—clickers don't make me feel connected. Pressing a button is not connection. Electronics don't help me connect with people. Maybe people are so used to technology that that the clicker makes them feel connected. Clickers are a bridge to communication, but are not communication themselves.

These two responses indicate that the experience of connection with clicker use may not be a universal experience, or it may be the case that these students have a different definition of the term connection. More in-depth interviews might have clarified these definitional distinctions, and is certainly an area for future inquiry.

Theme #3—Clickers Not Generally Experienced as Relational

Since a primary focus of this study was the student-teacher relationship, I typically asked interviewees if they thought that that using clickers in the class helped them to form a relationship with the teacher. Most of the students said that using clickers did not promote a relationship. For example:

Quan: Clickers do help me feel connected to the teacher because I answer questions. A relationship is different.

Ian: Clickers help me to connect with the teacher because it encourages participation . . . and I know where I stand. (Would you say clickers promote a relationship between you and the teacher?) No, it's not a relationship.

Danielle: Clickers are a form of communication. But not really a relationship.

Juanita: I do connect, because the teacher gets feedback . . . and it's better than other classes but it's not really a relationship. It's fun, though.

Bradley: Clickers promote conversation and interaction between the teacher and students, but it's not as personal as in small classes. Clickers make the best of the situation (referring to a large class).

However, some students made further distinctions about the type of relationship clickers do or do not facilitate, and introduced the possibility that clickers could be used relationally. For example:

Grant: Clickers invite participation, which is better than the traditional one-way communicating (in a lecture class). (Would you say clickers promote a relationship between you and the teacher?) Well, a relationship, yes, but just during class.

Helena: Yes, I feel connected to the teacher because he gets feedback and students can see how others are answering the questions. I don't know about a relationship, but it does offer the opportunity to create one.

Kenny: I feel connected. (Clickers) help keep you engaged . . . interested. Clickers could help a relationship, like a tool. Could help. It's a tool to gauge where we are at . . . what we know.

Only one student defined clicker use as constituting a student-teacher relationship, based on communication between the student and teacher. He said:

Flynn: It is a relationship because there is interaction and discussion.

As I reflect on these responses, I wish I had asked students to talk more about their definition of a "relationship," particularly as it relates to the idea of "connection." I did not realize that the students' distinctions between the two would be central to my understanding of how they view clicker use. While it does appear clear that they associate clicker use with "connection," primarily because of the "communication" functions of clickers, I am less clear about how they view connection as distinct from a relationship.

My only clues for understanding distinctions between connection and a relationship, based on the interview responses, is that a "relationship" requires one-on-one communication where the student is identified as a unique person. Clickers, on the other hand, offer collective class responses, thus are not individual and personal. It may

be that clickers connect a class with the teacher, but that a "relationship" requires one-on-one communication.

Summary of Interview Results

My goal for these interviews was to solicit student explanations to assist me in interpreting the results of my participant observations and the survey data. I designed them to serve as a feedback loop of sorts—to validate what I observed and help me understand the survey responses. Thus, my interview approach was informal and unstructured to allow participants to comment on my "prompt" without much direction from me.

After processing all the data for this study, I believe I might have been better served by positioning the interviews as another source of data rather than as validation of previous data. This would have been more of a layering approach, beginning with my perspective as participant observer—to a collective perspective with the survey—to individual student perspectives, rather than a validation approach. I believe that richer interviews would have helped me to make finer distinctions between clicker functions, notions of connection, and the student-teacher relationship.

However, the interviews served their initial purpose, which was to see if my participant observations could be supported and for assistance in interpreting the survey results. My analysis of the interview responses resulted in three recurring patterns, or themes: Multiple Clicker Uses/Pedagogical Functions, Clickers as Communication and Connection, and Clickers Not Generally Experienced as Relational.

The first theme, Multiple Clicker Uses/Pedagogical Functions, corroborates my categorization of clicker questions by function based on my classroom observations. Each student interviewed talked about how, or why, they perceived the teacher using clickers. The second theme, Clickers as Communication and Connection, validates the responses received on the survey. Over 80% of survey respondents said that clicker use in the classroom either definitely or probably made them feel connected, and 16 of the 18 interviewees said that clickers helped them feel connected because they aided communication in the classroom. The third theme, Clickers Not Generally Experienced as Relational, also appears to validate the survey results. Survey results indicate that while students see clickers as facilitators of connection (an aspect of the student-teacher relationship), other characteristics of the student-teacher relationship identified in the literature were not as strongly supported. In the interviews, most students said that clickers did not promote a student-teacher relationship. More research is needed to clarify how students define a pedagogical relationship, and if qualities like feeling encouraged and supported are important to their definition.

In the final chapter, I provide a synthesis of the observation, survey and interview results, and discuss the findings of this study as they relate to both the research question and larger discussions of educational technology and the relational nature of education.

CHAPTER VI

TECHNOLOGY AND THE PEDAGOGICAL RELATIONSHIP BETWEEN STUDENTS AND TEACHERS

Technology is changing how we relate with others, and education is not immune to this cultural shift. Since large classrooms are more impersonal than small classrooms and limit student-teacher interaction and relationship potential, clickers are commonly used to facilitate student-teacher communication and student engagement. But do students consider clickers relational? How might the use of clickers in the classroom contribute to a student-teacher relationship?

In this final chapter, I synthesize the findings from this study in answering my research question, and situate these findings within the larger discussions of educational technology and the relational nature of education. I conclude with a discussion of the implications of my findings for future research in this area, an assessment of the strengths and weaknesses of this study, directions for future research, and a personal reflection on this process.

Synthesis of Observation, Survey, and Interview Results: What Did I Find?

The research question that guided this study is: How might the use of clickers in the classroom contribute to the student-teacher relationship? I developed this question because I am curious about how the increasing use of technology in education might redefine the relational nature of teaching and learning. Specifically, how might the use of clicker technology mediate the student-teacher relationship? Might clickers be perceived

as relational tools? In this study, I created and analyzed three data sets to respond to my research question utilizing a mixed methods research design. My primary findings fall into four general areas: (a) types of clicker questions, (b) clickers as facilitating aspects of the student-teacher relationship, (c) but not constitutive of a "relationship," and (d) clickers as facilitating collective rather than individual communication informing feelings of "connection."

Based on my observations of 37 class meetings and hundreds of clicker questions in the Spring 2015 semester, I identified patterns in the types of questions employed—questions with different functions and outcomes. The five types of clicker questions I identified are: Initiate Dialogue/Build Rapport, Frame Peer Interaction for Peer Instruction, Assess Student Understanding/Allow Students to Self-assess (Formative Assessment), Initiate Dialogue/Encourage Deep Thinking, and Evaluate Students for a Grade (Summative Assessment). While there may be some overlap, I believe these categories are identifiably distinct even if not mutually exclusive. The interview responses supported the use of these categories because students referenced these functions as they described how, and why, they believed their teacher used clickers in the classroom. This finding is important both because it is consistent with the literature on the different types of questions and outcomes, thus it offers additional support for previous findings, and because it speaks to the nature of clickers as a technological tool with multiple affordances.

Second, results indicate that clickers may have some potential for facilitating aspects of the student-teacher relationship. More than 80% of participants reported that

the use of clickers in the classroom helped them feel "connected." Certainly a feeling of connection is an aspect of, and maybe a pre-requisite for, a student-teacher relationship. In addition, a majority of participants said that clicker use was also associated with feeling encouraged and supported. Regarding perceptions of teacher relational qualities, over 80% of participants associated clicker use and perceptions of the teacher as professional and fair, and two-thirds of participants associated clicker use with teacher approachability and open-mindedness. All of these results indicate that clicker use has potential for contributing to the pedagogical relationship. Conversely, some aspects of a pedagogical relationship, according to the literature, were not supported by the results of this study. Fewer than half of participants associated clickers with feeling safe or respected, or with perceptions of the teacher as trustworthy or nurturing.

Third, while most participants reported that they associate clicker use with certain aspects of the student-teacher relationship, the interviewees were clear that clicker communication did not comprise a "relationship." This finding has implications for the relational nature of teaching and learning as articulated by Vygotsky and others. If education is *relational*, occurring in the encounter between teachers and students where they collaborate to create common meaning, then how are we to understand what is happening in these large classrooms? How might students define a pedagogical relationship? In addition, this finding is significant to the discussion about the role of digital technology as a tool for communication and relationship development in the classroom.

Finally, survey results indicate that approximately two-thirds of the participants perceived clickers as a communication tool—something that facilitates communication between students and teachers and potentially promotes dialogue. In addition, through the interview process, students further defined the type of communication that clickers typically facilitate: namely, collective communication rather than individual, or one-on-one communication. Further, students who were interviewed coupled the idea of "clicker communication" with the idea of "connection." These findings are important because they indicate that students perceive the technology as a tool that facilitates some types of communication but not others.

So, how might the use of clickers in the classroom contribute to the student-teacher relationship? The findings from this study tell me that participants did not view clicker communication as constituting a student-teacher relationship, but they did associate clickers with some aspects of the student-teacher pedagogical relationship including facilitating student-teacher communication in the form of feedback and dialogue; feeling encouraged, supported, and connected; and perceiving the teacher as professional and fair, approachable and open-minded. These findings indicate that clicker use in the classroom may contribute to the student-teacher relationship, thus may have value as a relational tool. The model in Figure 7 is a visual representation of my findings.

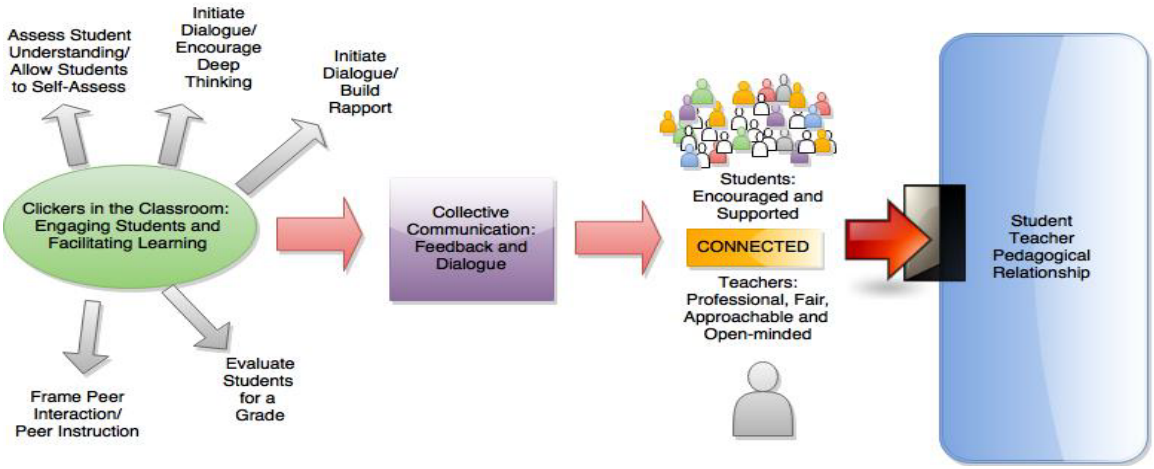

Figure 7. Clickers and the Student-Teacher Relationship.

The Student-Teacher Relationship and Pedagogy of Relation

I framed this study with a relational approach to education, based on Vygotsky's social and relational theory of learning and development. I believe the relational nature of education is important to highlight, particularly at the present time, because many colleges and universities are being managed using market-based and product-focused models rather than value-based and process-focused models for making decisions. A relational approach to education is a counter-narrative to the focus on students as quantifiable products rather than developing human beings. A theoretical approach to education as relational highlights the moral, ethical, social, and cultural nature of this unique practice.

The results of this study allow me to extend the discussion to include the possibility of a technology-mediated pedagogy of relation. My results indicate that clickers may facilitate some aspects of the student-teacher relationship, for example, student-teacher dialogue, building rapport, and facilitating feelings of connection,

encouragement, and support. And, the use of clickers may contribute to positive perceptions of the teacher as professional, fair, approachable, and open-minded. However, my results also indicate that clickers may not facilitate other aspects of the student-teacher relationship: like feeling respected, safe, or nurtured, or the perception of teachers as trustworthy.

This study offers data to support the idea that clickers may facilitate some aspects of the student-teacher relationship, thus opens new avenues for inquiry into classroom technologies and the student-teacher relationship.

Educational Technology and Mediation

A second theoretical lens I used to design, conduct, and interpret the results of this study is the idea of technology as a tool of mediation. All human interaction is mediated—by both language and cultural norms for interpreting the verbal and non-verbal behaviors of others, and by technology. Clickers are tools known as classroom-mediated discourse technologies, which are technologies that mediate communication in the classroom (Wankel & Blessinger, 2013).

An important question is how technology in general, and clickers specifically, might influence the experience of human interaction in the classroom. Numerous philosophers, including Friesen, Ide, Hudak, and Verbeek argue that digital technologies shape human experience in a particular way by foregrounding certain aspects of experience, and backgrounding others. Vygotsky is also concerned with the concept of mediation. He says that tools (including technology) mediate thought and mental processes, and also mediate the relationships between and among teachers, students, and

context. The idea that technology influences the construction of knowledge and experience means that we need to examine how digital classroom mediated discourse technology influences the student-teacher relationship.

If it is the case that technology foregrounds some aspects of experience and backgrounds others, it makes sense some aspects of the student-teacher relationship would be facilitated by clickers, and others would be out of focus. The nut-graf here is the question of frame, or epistemology of the technology. One the one hand, I observed clickers being used in different ways, performing different pedagogical functions. Further, the pedagogical functions I observed with clicker technology are all pedagogies that are presently utilized in classrooms—like assessing student understanding, building rapport, encouraging deep thinking, etc. This means that that the clickers themselves did not *create* the pedagogical function, but instead facilitate existing pedagogies. These findings appear to indicate that clickers are a relatively neutral tool.

Yet, question-based teaching is itself pedagogy, so it is also the case that clicker use limits teachers to question/answer-based pedagogies. This constitutes a "frame," or an "epistemology" of the technology itself.

The idea that clickers may have an epistemology does not negate their benefits. Clicker use, according to this study and the literature, helps keep students engaged in large classrooms, helps students learn course material, provides the teacher with important information about student understanding, promotes dialogue between students and teachers, helps students feel supported and encouraged, and facilitates a feeling of connection in a large, impersonal lecture hall. These are meaningful benefits achieved

with the use of clicker technology. Understanding the frame, or epistemology of a technology simply offers us a way to understand what specific technologies can and cannot facilitate, which I believe is important in the discussion of educational technology and the student-teacher relationship.

In some ways, the results of this study may contribute to the accounting of technology in human communication and the limits of clickers in the classroom for student-teacher relationship. While clickers may facilitate *some aspects* of the student-teacher relationship, they do not appear to facilitate what participants defined as a relationship. The limits of the technology may help us to understand why. Vygotsky says that tools allow us to function in specific ways…that tools make a difference by adding a layer of mediation. If technologies shape the character of human-world relation, then clickers may shape the relation of students and teachers in the classroom.

It is likely clear that I am concerned about the influence of the technological mediation of educational practices. But this does not mean that I cannot appreciate the benefits of technological tools as well as the limitations. And, though I believe my results speak to the frame of technology as a mediating force, I am not saying that clickers 'control' the classroom—just that they facilitate, or foreground, particular aspects of student-teacher communication in the same way the physical environment, with its arrangement of chairs and aesthetics, also foregrounds particular types of student-teacher interactions.

In addition to the function of foregrounding types of experiences, the technologies we use may frame human action, but they do not determine the outcome. As my findings

suggest, clickers can be used in multiple ways for a variety of purposes. Villaverde and Carter (2009) summarize this idea well: "To educate using technology does not mean the technology educates. The agent is ever present" (p. 187).

It may be that the inclusion of certain digital technologies in the physical classroom "hybridizes" the classroom environment to include both the physical *and* the digital, allowing each to offer a unique experience given their distinct affordances and limitations.

Digital Natives and the Student-Teacher Relationship

Another influence on this study, albeit a minor one, is the literature that suggests that current, traditionally aged students were born in the "digital age" and can be considered "digital natives" who see technology in a different way than previous generations (Prensky, 2010). I have been concerned that "digital natives," with their continual immersion with digital technology and the potential for this group to understand technology differently than "digital immigrants" like myself, may be redefining the teacher-student relationship—or even redefining the *need* for the student-teacher relationship.

The fact that some participants in this study stated that clickers helped them feel connected in the classroom, but that this connection did not constitute a relationship is significant for me. This indicates that "digital natives" may not view technology so differently after all. If many, or even some, of this group are able to distinguish between communication as connection and a one-on-one relationship, then I do not need to be as concerned that student/teacher relationality might be reduced to digital impulses.

Implications for Educational Practice/Recommendations

The findings of this study confirm the literature that clickers offer numerous benefits for teachers and students in the large lecture classroom. Clickers facilitate student engagement and learning, student-teacher communication, and may also contribute to some aspects of the student-teacher relationship. Certainly, the use of clickers facilitates an improved educational environment over traditional lecture classes. Thus, I offer the following recommendations:

1. The University Teaching and Learning Center should initiate an effort to offer training and support for clicker implementation to teachers across campus, particularly those who teach high-enrolled course sections. Since clickers are used currently employed primarily across the STEM disciplines, my findings suggest that clickers might be advantageous for large classrooms in other disciplines as well. One of the three classrooms I observed for this study was an Accounting class—outside the College of Arts and Sciences. This professor was the first in his department to use them, and he participated in the grant to learn how to best implement clickers without the typical support from his department. In addition, I met with a history professor who is interested in learning about clickers too, as he anticipates increasing class sizes in the near future. As budgets continue to tighten, and as classroom sizes increase across campus, clicker technology might be useful across campus.

2. We need to create opportunities for students to have one-on-one access to faculty outside the classroom to promote relational development. Options might include faculty-involved learning communities; small lab, recitation, or discussion sections; and other informal, outside-of-class activities. Departments could prioritize joint student-teacher lunches, study halls, etc. and encourage faculty to get involved with students. While increasing student engagement in large classrooms is a step in the right direction, "engaging" is distinct from "relating." Teaching and learning is a social, relational phenomenon. Education happens *between* people—in the encounter between teachers and students, when they collaborate to create common meaning. The results of this study indicate that the increased connection students perceive with clicker use does not meet their criteria for a "relationship" with the teacher.
3. Results of this study indicate that an ethic of pedagogical care can guide the state of being in-relation in large classrooms utilizing technology mediated communication systems. This is an important finding that warrants continued investigation. Nodding's theory of the pedagogical relation of care informed this study, and should be utilized as a theoretical frame for future investigations into the use of educational technology and the student-teacher relationship. Noddings argues that pedagogy is more a matter of caring disposition and emotional presence than technique, and requires three things: the engrossment and motivational displacement of the one-caring and

recognition by the cared-for. While this study did not focus on Noddings's definitions and conditions for caring, almost 80% of participants reported that they thought the teacher either definitely or probably cared about them and their success. Though not related to clicker use, I found this both hopeful and promising, and I believe it warrants additional research.

Strengths and Weaknesses of this Study/Directions for Future Research

Every study is partial and incomplete, and can only offer a drop in the bucket of our understanding of a particular phenomenon. That said, every single drop contributes and can influence our interpretation of the literature and the direction of future research. I believe the results of this study contribute to our understanding of clickers as an educational technology as well as the dynamic student-teacher relationship.

The results of this study are descriptive, which means that the findings provide a snapshot of some students' associations between clicker use and the student-teacher relationship in the context of three classrooms at a particular university at a particular time. While I believe this snapshot is useful and can inform future inquiry, my findings might have offered a richer understanding these associations had I conducted more in-depth interviews. In particular, I think that in-depth, semi-structured interviews would yield useful information about how students distinguish between a feeling of "connection" in the classroom and a "relationship" with a teacher. I also could have found out more about their perceptions of learning in general and learning in large classrooms specifically.

I also believe that additional research is needed to better understand how students might define a student-teacher relationship, and the need for a relationship in the context of a large university classroom in general, and how clickers and other technology might facilitate the kind of relationship students want.

Also, additional research is needed to better understand the role of clickers in facilitating the student-teacher relationship, and to confirm the findings of this study. For example, are there certain conditions under which clickers are more relational than others? Might this be related to *how* clickers are used? Are there teacher factors that influence this relationship? How might these findings extend to other forms of classroom-based technologies?

I find the notion of student engagement to be almost too broad to be useful, and believe that a more focused approach to understanding engagement is necessary in the pedagogical literature. How do clickers facilitate student engagement in the classroom? And what does it mean for a student to feel "engaged?" Is this a cognitive state? Is it a social position? How might relationality inform "engagement?"

The results of this study lead to a number of interesting questions that might inform future research. Certainly, further inquiry is needed as we endeavor to understand the role of educational technology and the student-teacher relationship.

Reflection

Completing this dissertation has been a three-year odyssey—a true intellectual wandering marked by changes in fortune, philosophy, and focus. My initial intention in 2012 was to write a philosophical treatise on the import of the material body to knowing

and being, and to the practices of teaching and learning. I poured over Merleau-Ponty's (1962, 1968) writings on intercorporeality, and considered Freudian analyses of the role of the unconscious in learning and development (Britzman, 2006, 2009; Lear, 2005; Roustang, 1996). When paired with my interest in technology, I delved into posthumanism (transmuted human experience in the 'electropoilis') and Heidegger's (1977, 1996) notion of technological enframing.

While this study is a departure from my initial plan, it still centers on the same fundamental concern—the material body, technology, and the practice of education—just from another angle. Instead of addressing the inquiry deductively, and creating a philosophical premise based on past scholarship, this study represents an inductive approach—the conduct of research to inform a philosophical position. I believe both approaches are necessary as they both inform and are informed by each other as we engage the theoretical and practical for reasoned action.

During this process, one of the most personally and professionally challenging of my life, I have learned to appreciate the collaborative nature of research and the value of the pedagogical relationship. I have also learned that resolve and a little courage can transcend limitations and resistance. While I am pleased to have finished this dissertation, the true value has been in the quest.

Conclusion

Education is a unique activity that is fundamentally, and necessarily, *relational*. High-enrollment classes, now common in higher education, represent a significant threat to quality teaching and learning because they limit one-on-one student-teacher interaction

and the opportunity for student-teacher relationship development. Teachers have incorporated new digital technologies into the classroom to attempt to mitigate the impersonal nature of these mega-classes, but there has been almost no research attention to how these technologies might facilitate a student-teacher relationship. This study addressed this gap.

This study finds that clickers facilitate greater student engagement in large classrooms, serve multiple functions, facilitate communication and connection among teachers and students in large classrooms, and may promote some aspects of the student-teacher relationship. However, despite the numerous associations between clicker use and aspects of the student-teacher relationship, clickers appear to fall short of facilitating what students define as a "relationship." Since the relational nature of education places the student-teacher relationship at the core of student learning, the use of clickers may not be adequate for a pedagogical relationship between students and teachers. We need to continue to explore how clickers and other technologies might facilitate the very human interaction that *constitutes* education, and how they also might hinder that which they were designed to support.

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APPENDIX A

IRB APPROVAL

To: Stephanie Carrino
Educational Leadership and Cultural Foundations
5512 Richland Street, Unit D Greensboro, NC 27409

From: UNCG IRB

Date: 1/29/2015

RE: Notice of IRB Exemption
Exemption Category: 2.Survey, interview, public observation
Study #: 15-0017
Study Title: Clickers and the Student-Teacher Relationship. (Technology-mediated Care in High-enrollment classrooms? A Mixed-method Study of 'Clickers' in the Classroom and the Pedagogical Relation of Care

This submission has been reviewed by the IRB and was determined to be exempt from further review according to the regulatory category cited above under 45 CFR 46.101(b).

Study Description:

Shrinking university budgets are resulting in large classroom on college campuses, which limit student-teacher interaction and may threaten the quality of student-teacher relationships. Classroom Response Systems (clickers) are common features in these large classrooms, and were designed to facilitate student-teacher communication. However, there has been little research on the potential relational function of these clicker systems. It is not clear if clickers facilitate student-teacher relationships, or if they are even perceived as relational tools.

This problem is significant because the importance of student-teacher relationality has been theoretically grounded and supported by research. Since class sizes are increasing, it is important that we understand how the 'impersonal' nature of high-enrollment classes is impacting this relationship, and how the use of technology might function to mediate the negative effects.

The purpose of this study is to investigate students' perceptions of classroom clicker use and the student-teacher relationship in high-enrollment classrooms.

Regulatory and other findings:

- This research meets criteria for waiver of a signed consent form according to 45 CFR 46.117(c)(2).

Investigator's Responsibilities

Please be aware that any changes to your protocol must be reviewed by the IRB prior to being implemented. Please utilize the most recent and approved version of your consent form/information sheet when enrolling participants. The IRB will maintain records for this study for three years from the date of the original determination of exempt status.

Signed letters, along with stamped copies of consent forms and other recruitment materials will be scanned to you in a separate email. **Stamped consent forms must be used unless the IRB has given you approval to waive this requirement.** Please notify the ORI office immediately if you have an issue with the stamped consents forms.

Please be aware that valid human subjects training and signed statements of confidentiality for all members of research team need to be kept on file with the lead investigator. Please note that you will also need to remain in compliance with the university "Access To and Retention of Research Data" Policy which can be found at http://policy.uncg.edu/research_data/.

CC:
Kathryn Hytten, Educational Leadership and Cultural Foundations

APPENDIX B

CLASSROOM OBSERVATION GUIDE/FIELD NOTES

Clickers and the Student-Teacher Relationship

Date:
Time:
Instructor:
Classroom Location:
Topic/Class Plan:

Observations Reflections

APPENDIX C

RESEARCH SURVEY

This survey is part of a study of clicker use in large classes. As you answer these questions, please consider only this class and this teacher. This survey will ask your opinions about your teacher and the use of clickers in this class. *Your responses are anonymous!* Thank you for participating.

Part 1 Instructions: Choose the answer that best reflects your opinion.

1. Do you think the use of *clickers* in this class helps you feel more *engaged* in the course? (*engaged*=involved, interested, motivated)

Definitely	Probably	Not Sure	Probably Not	Definitely Not
5	4	3	2	1

2. Do you think using *clickers* in this class has helped you learn course content?

Definitely	Probably	Not Sure	Probably Not	Definitely Not
5	4	3	2	1

3. Would you say that using *clickers* is an important way you communicate with the teacher?

Definitely	Probably	Not Sure	Probably Not	Definitely Not
5	4	3	2	1

4. Do you think the use of *clickers* helps the teacher know what information you need to understand the course material?

Definitely	Probably	Not Sure	Probably Not	Definitely Not
5	4	3	2	1

5. Do you think the teacher pays careful attention to clicker responses?

Always	Sometimes	Not Sure	Rarely	Never
5	4	3	2	1

6. Does the teacher *respond* to the information provided by the clicker answers?

Always	Sometimes	Not Sure	Rarely	Never
5	4	3	2	1

7. Would you say that clicker questions and answers promote *dialogue* between you and the teacher?

Always	Sometimes	Not Sure	Rarely	Never
5	4	3	2	1

8. Do you think your teacher *cares* about you and your success in this class?

Definitely	Probably	Not Sure	Probably Not	Definitely Not
5	4	3	2	1

9. Does the use of *clickers* in the class make *you* feel…

	Definitely	Probably	Not Sure	Probably Not	Definitely Not
Supported ?	5	4	3	2	1
Respected?	5	4	3	2	1
Anxious?	5	4	3	2	1
Encouraged?	5	4	3	2	1
Connected?	5	4	3	2	1
Safe?	5	4	3	2	1

10. Does the use of *clickers* in the class make the *teacher* seem…

	Definitely	Probably	Not Sure	Probably Not	Definitely Not
Nurturing ?	5	4	3	2	1
Trustworthy?	5	4	3	2	1
Professional?	5	4	3	2	1
Fair?	5	4	3	2	1
Manipulative?	5	4	3	2	1
Open-minded?	5	4	3	2	1
Approachable?	5	4	3	2	1

Part 2 Instructions: Please choose the best answer from the choices offered.

11. Which of the following classes are you enrolled in this semester? (This survey is being distributed to 3 different classes this semester, and I may want to look at the results by class).

    f. ACC 202: Managerial Accounting, TTH 2-3:15
    g. NTR 213: Introduction to Nutrition, TTH 12:30-1:45
    h. NTR 213: Introduction to Nutrition, Tuesdays 6:00-8:50pm
    i. More than one of the above
    j. None of the above

12. How old are you?
    a. 18-22
    b. 23-30
    c. 31-50
    d. 51 or older

13. What is your academic classification?
    a. Freshman
    b. Sophomore
    c. Junior
    d. Senior
    e. Other

14. What is your gender?
    a. Female
    b. Male
    c. Other

15. Which of the following best describes your Ethnicity or Race?
    a. Latino (a)
    b. Black or African American
    c. White
    d. Native American
    e. Asian / Pacific Islander
    f. Mixed Ethnicity/Race
    e. Other

16. Which of the following best describes your major?
    a. Humanities/Arts
    b. Education
    c. Social Sciences
    d. Health/Human Services
    e. Business
    f. Science/Technology/Engineering/Math
    g. Other

Thank you for your responses!

APPENDIX D

STATISTICALLY SIGNIFICANT RESULTS FOR "CLASS SECTION"

In addition to analyzing the survey results as a whole, I also looked at the results by class section. For this study, I observed three class sections: Introduction to Managerial Accounting with Dr. Davis; Introduction to Nutrition with Dr. Nelson; and Introduction to Nutrition with Ms. Miller, a night class. I conducted one-way ANOVAS to compare students' responses to each of the survey items based on the class enrollment.

An ANOVA (analysis of variance) calculates the differences between, or the variance, between and within groups. I chose to analyze the survey items by class to see if students' responses were distinct by class—that is, to see if the teacher and the way they used clickers had an effect on students' responses. Then, for those items that showed a statistically significant variance ($p < .05$), I ran Tukey's post hoc comparisons to see where the variance was.

There are six (6) items shown to be significantly different by class: clicker use and learning, clickers as communication, clickers and feeling encouraged, perceiving the teacher as professional, and perceiving the teacher as approachable. And, all the variance involved Dr. Davis's accounting class and one of the nutrition classes, Ms. Miller's class. The two nutrition classes did not show a significant difference on any item. This tells me that there was something about the use of clickers in the accounting class and the evening nutrition class that resulted in significantly different ratings on these items.

Figure 8 shows the six survey items that were statistically significantly distinct at the $p < .05$ level, and the percentage of students who answered positively for each of the items. Following the figure is a discussion of each item.

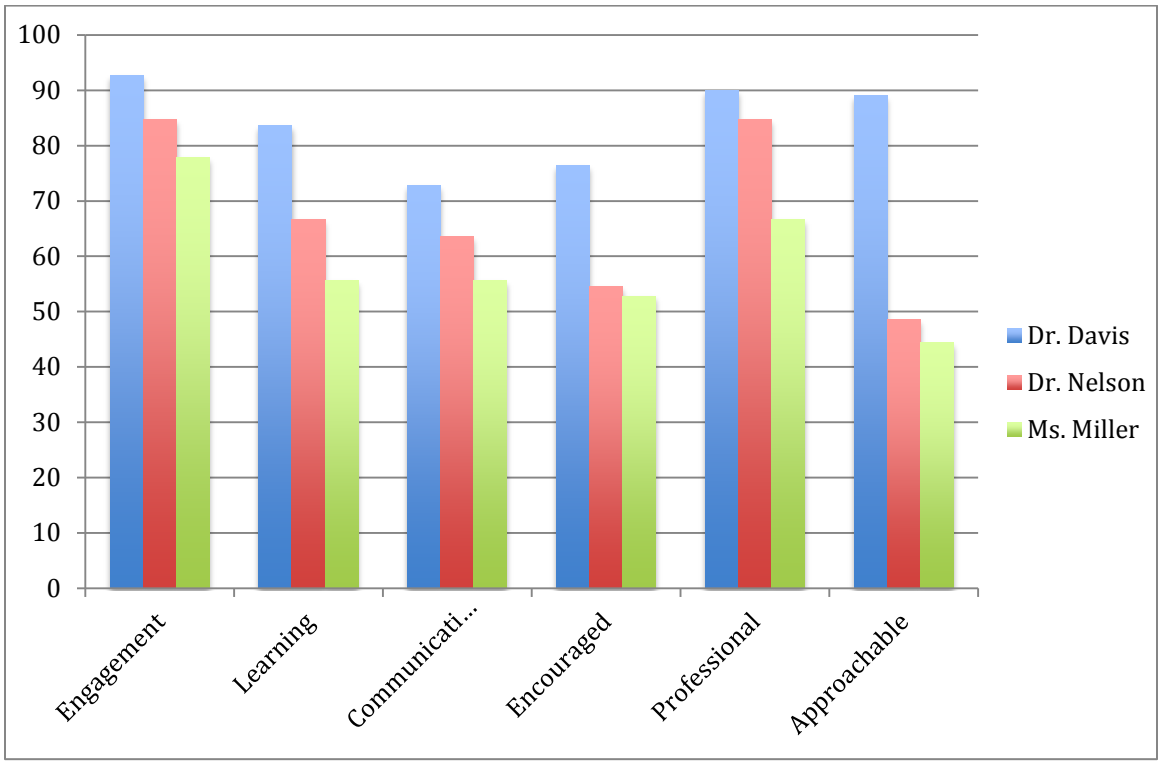

Figure 8. Statistically Significant Results by Class Section.

Engagement

Survey Item: Do you think the use of *clickers* in this class helps you feel more *engaged* in the course? (*engaged=involved, interested, motivated*). A one-way ANOVA was conducted to compare the effect of class enrollment on participants' ratings of clicker use and their *engagement* in the accounting class, the daytime nutrition class, and the evening nutrition class. There was a significant effect of class enrollment on ratings

of engagement at the $p < .05$ level for the three conditions [$F(2, 121) = 3.720$, $p = .027$]. Post hoc comparisons using the Tukey HSD test indicated that the average ratings between the accounting class and the evening nutrition class was significantly different ($p = .032$). There was no significant difference between the accounting class and the daytime nutrition class or between the two nutrition classes. These results may suggest that the teacher and their use of clickers may have an effect on students' perceptions of clicker use and their engagement in the class, or that there was another difference in the enrolled students by class that can account for the variance.

Learning

Survey Item: Do you think using *clickers* in this class has helped you learn course content? A one-way ANOVA was conducted to compare the effect of class enrollment on participants' ratings of *learning* in the accounting class, the daytime nutrition class, and the evening nutrition class. There was a significant effect of class enrollment on ratings of engagement at the $p < .05$ level for the three conditions [$F(2, 121) = 5.391$, $p = .006$]. Post hoc comparisons using the Tukey HSD test indicated that the average ratings between the accounting class and the evening nutrition class was significantly different ($p = .004$). There was no significant difference between the accounting class and the daytime nutrition class or between the two nutrition classes. These results may suggest that the teacher and their use of clickers may have an effect on students' perceptions of clicker use and their perception of their learning, or that there was another difference in the enrolled students that can account for the variance.

Communication

Survey Item: Would you say that using *clickers* is an important way you communicate with the teacher? A one-way ANOVA was conducted to compare the effect of class enrollment on participants' ratings of *clickers as communication* in the accounting class, the daytime nutrition class, and the evening nutrition class. There was no significant effect of class enrollment on ratings of engagement at the $p < .05$ level for the three conditions. However, it was close [$F(2, 121) = 2.859$, $p = .061$]. Post hoc comparisons using the Tukey HSD test indicated that the average ratings between the accounting class and the evening nutrition class was significantly different ($p = .049$). There was no significant difference between the accounting class and the daytime nutrition class or between the two nutrition classes. These results may suggest that the teacher and their use of clickers may have an effect on students' perceptions of clickers as a communication tool, or that there was another difference in the enrolled students by class that can account for the variance.

Encouraged

Survey Item: Does the use of *clickers* in the class make *you* feel…Encouraged? A one-way ANOVA was conducted to compare the effect of class enrollment on participants' ratings of *feeling encouraged* in the accounting class, the daytime nutrition class, and the evening nutrition class. There was a significant effect of class enrollment on ratings of engagement at the $p < .05$ level for the three conditions [$F(2, 121) = 4.971$, $p = .008$]. Post hoc comparisons using the Tukey HSD test indicated that the average ratings between the accounting class and the evening nutrition class was significantly

different (p = .015). The variance between the accounting class and the daytime nutrition was class was close at p < .051. There was no significant difference between the two nutrition classes. These results suggest that the teacher and their use of clickers may have an effect on students' perceptions of clicker use and feeling encouraged, or that there was another difference in the enrolled students by class that can account for the variance.

Professional

Survey Item: Does the use of *clickers* in the class make the *teacher* seem . . . Professional? A one-way ANOVA was conducted to compare the effect of class enrollment on participants' ratings of *teacher professionalism* in the accounting class, the daytime nutrition class, and the evening nutrition class. There was a significant effect of class enrollment on ratings of professionalism at the p < .05 level for the three conditions [F(2, 121) = 5.938, p = .003]. Post hoc comparisons using the Tukey HSD test indicated that the average ratings between the accounting class and the evening nutrition class was significantly different (p = .003). There was no significant difference between the accounting class and the daytime nutrition class or between the two nutrition classes. These results suggest that the teacher and their use of clickers may have an effect on students' perceptions of clicker use and teacher professionalism, or that there was another difference in the enrolled students by class that can account for the variance.

Approachable

Survey Item: Does the use of *clickers* in the class make the *teacher* seem . . . Approachable? A one-way ANOVA was conducted to compare the effect of class enrollment on participants' ratings of clicker use and *teacher approachability* in the

accounting class, the daytime nutrition class, and the evening nutrition class. There was a significant effect of class enrollment on ratings of professionalism at the $p < .05$ level for the three conditions [$F(2, 121) = 7.798$, $p = .001$]. Post hoc comparisons using the Tukey HSD test indicated that the average ratings between the accounting class and the evening nutrition class was significantly different ($p = .002$) and between the accounting class and the daytime nutrition class ($p < .008$). There was no significant difference between the two nutrition classes. These results suggest that the teacher and their use of clickers may have an effect on students' perceptions of clicker use and teacher approachability, or that there was another difference in the enrolled students by class that can account for the variance.

For all the other survey items, there was no significant difference in student ratings across classes: providing information, teacher paying attention to clicker responses, teacher responding to clicker answers, promoting dialogue, teacher caring, clickers making students feel supported, respected, anxious, connected, safe, or making the teacher seem nurturing, trustworthy, fair, manipulative, or open-minded. These non-results tell me that on a number of items, the average student rating was similar across classes, indicating that some perceptions about clickers were similar regardless of the class the student was enrolled in and teacher who used them.

APPENDIX E

STATISTICALLY SIGNIFICANT RESULTS BY "GENDER"

I conducted one-way ANOVAS to compare students' responses to each of the survey items based on their reported sex/gender: male, female, other. Then, for those items that showed a statistically significant variance ($p < .05$), I ran Tukey's post hoc comparisons to see where the variance was. I have not included the statistically significant results pertaining to the category "other" because only 3 of the 124 respondents, or .024%, self-identified as other. This response category was included not a variable for study, but to offer participants who identify as non-traditionally gendered an alternative choice.

Results revealed six survey items that show statistically significant results.

Information

Survey Item: Do you think the use of *clickers* helps the teacher know what information you need to understand the course material? A one-way ANOVA was conducted to compare the effect of sex/gender on participants' ratings of clickers as informational. There was a significant effect of sex/gender on ratings of information at the $p < .05$ level for the three conditions [$F(2, 121) = 10.768$, $p = .000$]. Post hoc comparisons using the Tukey HSD test indicated that the *average ratings between males and females was significantly different* ($p = .011$).

Teacher Pays Attention

Survey Item: Do you think the teacher pays careful attention to clicker responses? A one-way ANOVA was conducted to compare the effect of sex/gender on participants'

ratings of the teacher's attentiveness to clicker responses. There was a significant effect of sex/gender on ratings of information at the $p < .05$ level for the three conditions [$F(2, 121) = 4.132$, $p = .018$]. Post hoc comparisons using the Tukey HSD test indicated that the *average ratings between males and females was significantly different* ($p = .041$).

Anxiousness

Survey Item: Does the use of *clickers* in the class make *you* feel…anxious?

A one-way ANOVA was conducted to compare the effect of sex/gender on participants' ratings on clickers and anxiousness. There was a significant effect of sex/gender on ratings of information at the $p < .05$ level for the three conditions [$F(2, 121) = 6.240$, $p = .003$]. Post hoc comparisons using the Tukey HSD test indicated that the *average ratings between males and females was significantly different* ($p = .002$).

Trustworthy

Survey Item: Does the use of *clickers* in the class make the *teacher* seem…trustworthy? A one-way ANOVA was conducted to compare the effect of sex/gender on participants' ratings of teacher trustworthiness. There was a significant effect of sex/gender on ratings of information at the $p < .05$ level for the three conditions [$F(2, 121) = 4.730$, $p = .011$]. Post hoc comparisons using the Tukey HSD test indicated that the *average ratings between males and females was significantly different* ($p = .037$).

Professional

Survey Item: Does the use of *clickers* in the class make the *teacher* seem…professional? A one-way ANOVA was conducted to compare the effect of sex/gender on participants' ratings of teacher professionalism. There was a significant

effect of sex/gender on ratings of information at the $p < .05$ level for the three conditions [$F(2, 121) = 6.365$, $p = .002$]. Post hoc comparisons using the Tukey HSD test indicated that the *average ratings between males and females was significantly different* ($p = .042$).

Approachable

Survey Item: Does the use of *clickers* in the class make the *teacher* seem…approachable? A one-way ANOVA was conducted to compare the effect of sex/gender on participants' ratings of teacher approachability. There was a significant effect of sex/gender on ratings of information at the $p < .05$ level for the three conditions [$F(2, 121) = 8.338$, $p = .000$]. Post hoc comparisons using the Tukey HSD test indicated that the *average ratings between males and females was significantly different* ($p = .037$).

APPENDIX F

STATISTICALLY SIGNIFICANT RESULTS BY "AGE"

I conducted one-way ANOVAS to compare students' responses to each of the survey items based on their age group: 18–22, 23–30, and 31–50. Then, for those items that showed a statistically significant variance ($p < .05$), I ran Tukey's post hoc comparisons to see where the variance was. Results revealed two items that show statistically significant results.

Anxiousness

Survey Item: Does the use of *clickers* in the class make *you* feel . . . Anxious? A one-way ANOVA was conducted to compare the effect of age on participants' ratings of clicker use and their *feeling anxious* by age group. There was a significant effect of age on ratings of anxiousness at the $p < .05$ level for the three conditions [$F(2, 121) = 4.503$, $p = .013$]. Post hoc comparisons using the Tukey HSD test indicated that the *average ratings between the 18–22 age group and the 31–50 age group was significant* at $p < .053$. These results suggest that age may have an effect on students' anxiety with clicker use.

Teacher as Manipulative

Survey Item: Does the use of *clickers* in the class make the *teacher* seem . . . Manipulative? A one-way ANOVA was conducted to compare the effect of age on participants' ratings of clicker use and their *perceptions of the teacher as manipulative* by age group. There was a significant effect of age on ratings of perceived manipulation by the teacher at the $p < .05$ level for the three conditions [$F(2, 121) = 4.175$, $p = .034$]. *Post*

hoc comparisons using the Tukey HSD test indicated that the average ratings between the 18-22 age group and the 31-50 age group was significant at $p < .030$. These results suggest that age may have an effect on students' clicker use and perception of the teacher as manipulative.