Investigating relationships between educational technology use and other instructional elements using "big data" in higher education

by

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A dissertation submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Curriculum and Instructional Technology

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Ames, Iowa

2015

DEDICATION

To my supporting and loving husband, John, and two beautiful children, Celeste and Kai, who have never known me to not work on my Ph.D., boy, will life be a changing! Bring on the fun and adventure. To my immediate family, parents Bruce and Gail Wortmann and brother, Rich, for always setting the bar so high; may you never lower your expectations. And to my in-laws, Tom and Jaye Good, for their endless love and support.

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ACKNOWLEDGEMENTS

I am ever so grateful to all of the people who have been there to support, encourage, and provide their expertise along this challenging journey. I have had many colleagues, family members, and friends who have lent an ear as well as given sage advice each and every time I have asked. Each has played a generous role in laying the groundwork for this research.

Many thanks go to my mom, husband, and best friend who have talked, listened, and cared for my mental health during hours of planning and writing to help me reach my desired educational goals. Not only am I appreciative of the time and dedication they have put forth, but I also plan to return the favor.

I also want to thank some of my past employers and supervisors. These include Hiro Iino, Allan Schmidt and the colleagues I have worked with at Iowa State University who helped me find my passion for professional and faculty development, and educational technology.

I am also thankful to Pam Christoffers, Amy Getty, and Kevin Gannon for understanding what it takes for a colleague to divide their time at work to be able to continue one's education. Your support has been endless as well as appreciated more than you will ever know. The university is lucky to have such wonderful people working so hard to build a better community for colleagues and education for all students who attend. I hope my contribution to the university in this research will provide useful direction for growth in teaching and learning equal to those aspects I have learned going through this process.

Thank you Cindy Wiley*** (triple emphasis intended) for getting me back on my feet to complete this research. Without the support group, camaraderie, and copious amounts of jellybeans, this research would not have been as much fun and its completion may not even have been possible. You are one of the happiest and most inspirational people I know.

And last, but certainly not least, thank you to my major professor and valued committee: Ana-Paula Correia, Ann Thompson, Carl Smith, Ann Marie VanDerZanden, and Holly Bender. You are some of the kindest, most intelligent, patient, and understanding people I know. Thank you for the time, expertise, professionalism, and collegiality, among many other remarkable attributes, that you have all shown and shared with me. I cannot wait to see what the future brings, as we continue to work together to better education for all!

ABSTRACT

The use of educational technology in higher education has been growing over the past few years. The focus of this research study is to understand the relationships between college students' reactions to instruction and those courses that use educational technology, together with other important instructional elements, to facilitate learning. The research took place at a small liberal arts university in the Midwestern United States between August 2012 and December 2014. The research uses *Student Ratings of Instruction and Courses* from the IDEA Center, otherwise known as student evaluations of teaching. A total of 34,480 survey responses were analyzed for the study. The intent is to draw implications from this analysis for further faculty development. Descriptive and inferential statistical analyses were conducted, including but not limited to Goodman-Kruskal's gamma correlation coefficient. Correlations were calculated between the use of educational technology and other instructional elements so as to facilitate learning, including teaching methods, progress on learning objectives, and global elements then stratified by class size and repeated the correlation calculations.

The relationships stressed in this study occur between educational technology use and various instructional elements. They are important for instructors concerned about using technology in their classes. The positive correlation between the use of educational technology and the many variables analyzed in this study demonstrate that the increase of use of educational technology corresponds to an increase in effective teaching methods and higher scores on the overall quality of the instructors and the courses offered. These results show areas of both strength and weakness.

Such analyses can lead to opportunities for offering targeted faculty development by teaching and learning centers in many universities and colleges.

CHAPTER 1 - BACKGROUND

Formal Education for College Students

A formal education system early in the twenty-first century is meant to facilitate intentional learning (Gagné, 2005) and prepare learners to be contributing members of society within a fixed time frame (Morrison, Ross, & Kemp, 2007) by focusing on specific learning objectives. Students attend college as a means of formal education or instances of intentional learning (Gagné, 2005). To start their college careers, students begin by participating in educational experiences, for example, coursework, experiential learning, and student organizations. Within a short timeframe, they choose a major and plan out the rest of their college experience. A student's plan of study determines the timeframe for completion. As they finish their coursework and continuously keep gaining knowledge and skills through a multitude of educational experiences, they are also looking ahead to employment. Many students plan to find jobs in their areas of study to make a contribution to society.

Contributing members of society in the twenty-first century, now also known as the digital age, require a very different skill set than in the past (Gagné, 2005). These students are likely to be preparing for a profession that requires a significant amount of technology use. Students also gain an introduction to profession-based technology throughout their college coursework and other educational experiences. Thus, most students' classroom efforts are informed by the design of their coursework and the educational experiences that are developed by college faculty. The faculty have expertise in specific disciplines designated by their degrees. They also must have knowledge of the field of teaching and learning in order to design quality educational experiences for their students. Gaining expertise in teaching and learning is not as directly available as gaining expertise in their specific disciplines. In addition, in the digital or information age—the technology era that followed the industrial revolution (Armstrong & Chen, 2002; Bates, 2015), students demand that technology permeate their college formal learning experiences. One may thus ask how faculty gain the knowledge they need to design appropriate learning in formal education settings.

Preparing for a Faculty Career in Higher Education in the Digital Age

Future faculty members who plan to begin a career in teaching and learning must prepare to become designers of instruction through accessing many venues. Some engage in individual activities or some combination of the following: a) do graduate work in teaching and learning, b) read research on designing educational experiences, c) conduct research or scholarship on teaching and learning, d) attend conferences that offer sessions on teaching and learning, e) gain this knowledge and skills via reflective trial and error, f) attend local, national, and international faculty development events, and much more. Others participate in studying and redesigning educational experiences based on direct feedback from students in their classrooms. There is no one right path to becoming a knowledgeable faculty member who understandings teaching and learning. It is considered lifelong learning.

Learning about instruction can go through many indistinct phases, including understanding a) professional ethics, b) classroom management, c) the basics of pedagogy, and also d) applying the basics of pedagogy through facilitation and active learning, e) preparing their students for a future in a profession by using educational technology, f) reflecting on pedagogical practices to improve student learning experiences, and g) conducting formal assessments (McKeachie & Hofer, 2002). Most instructors do not go through all these phases when they first start teaching. Experience is gained over time. With each educational experience, it is not just the students who gain more knowledge, understanding, and skills about content; their instructors also gain these same attributes while teaching the content to students. Faculty both lead and facilitate by teaching content -driven lessons while learning how to improve those same lessons.

According to Cashin (1989), the primary purpose of higher education is teaching. Teaching encompasses seven areas: 1) subject matter mastery, 2) curriculum development, 3) course design, 4) delivery of instruction, 5) assessment of instruction, 6) availability to students, and 7) administrative requirements. In order to determine an instructor's effectiveness, evaluation in all seven areas of teaching is necessary. One of the most highly respected sources for teaching evaluation is systematic student ratings (Cashin, 1989). This process, the primary source of data obtained from students, allows individual instructors to engage in their own reflective practices. Student data can be used for both individual instructors and institutional improvement. By completing such a survey, students can help evaluate course design, delivery of instruction, and availability of instructors to students via their assessment of instruction (Cashin, 1989). Student ratings of instruction, however, are only one part of the evaluation of teaching and learning. Evaluation systems for teaching are a) multidimensional, b) reliable and stable, and c) functional for any instructor who teaches a course rather than for the course being taught, d) relatively valid against a variety of effective teaching indicators, e) relatively unaffected by a variety of potential biases, and f) useful for faculty, students, and administrators (Perry & Smart, 2007, p. 372).

In addition to design and evaluation, teaching includes more than merely how to convey content in an efficient and effective manner. It includes characteristics like professional ethics, management and facilitation of learning environments, and the creation of learning experiences. Further, ethics are involved in every aspect of teaching and learning. In higher education, there are ethical decisions for the ways instructors carry on their relationships with students. Decisions such as harassment, maintaining the confidentiality of student grades—known as the Family Educational Rights and Privacy Act (FERPA), appropriately researching and presenting previous literature, content, and art—e.g. copyright laws, and using technology as a teaching strategy—are known as digital citizenship. These ethical aspects are not only expected of instructors, but should be taught to all students as well.

Management and facilitation of learning environments relies on ethical practices as well as organizational techniques and technological usage. Being prepared to manage a learning environment takes time and attention by the instructional designer, usually the instructor or faculty. This process includes developing grading schema, determining the weight an instructor gives particular activities along with the 'when' and 'how' to include educational technology use, attending to the scope and sequence of learning activities throughout the semester, and communicating with students. While implementing these management techniques, facilitation of learning activities should also ensue. Facilitation will "…help create an environment in which learning more easily could occur" (Januszewski & Molenda, 2008, p. 4). It includes such elements as showing students processes and resources not directly related to content, but relating to learning that content. Facilitation of teaching in the digital age also includes the use of technology (Weigel, 2002) and how to plan and communicate with colleagues as well as students. For example, instructors may use particular functions of software to give students feedback on their work (e.g. Track Changes in Microsoft Word or VoiceThread for audio feedback). The digital age is thus a time when "…everyone, and in particular, the students we are teaching, are using technology" (Bates, 2015, p. 1).

Many times when new technologies are used in educational activities, tutorials and practice used to moderate a learning curve is required before students can use the technology to support their learning. This process emphasizes that teaching and learning will include a vast array of knowledge, skills, and attitudes. In order for all of these elements to work together, it is important for an instructor to first, understand the interconnectedness between them; second, create learning experiences that integrate the learning technologies; and third, evaluate the process for future improvements.

Continuous Faculty Development

Faculty development provides opportunities for learning about the interconnections found in teaching and learning. These learning experience interconnections include designing and developing, integrating educational technologies, managing and facilitating, and assessing. Conversations among colleagues—via formal workshops or informal hallway or online chats—are the anecdotal preferred way to experience this development. Discovering what has worked for other faculty and discussing pedagogy and assessment techniques are ways to engage in faculty development. "It should be noted that 'improvement' (or 'development') does *not* [emphasis original] necessarily imply a deficiency" (Cashin, 1990, p. 1), but instead an opportunity for growth. The focus of faculty development should be to improve instruction or teaching skills (Diamond, 2002). Continuous professional development is important to learn new ways of developing educational experiences, implementing new teaching techniques, and improving the learning opportunities available for students.

Faculty development in and of itself is a means of combining formal education, informal education, and training. Training usually occurs within an organizational setting and only covers the information needed to perform certain tasks (Morrison et al., 2007). Training is more like a just-in-time, practical situation whereas formal education is more likely to be bounded by theory. Theory has its place at the foundation of teaching and learning; practicality is where people feel as though they can deliver the theory in actual educational experiences. For example, instructional design is based on theory, however, when it comes to designing, implementing, and teaching a course—well, one cannot get any more practical than that.

Instructional Design of Educational Experience

Designing instruction is not a series of tasks, but rather a complicated, diverse, and reflective practice that helps promote learning in a variety of educational settings and learning aimed at different audiences. Instructional design is a process in which instructional elements (instructional materials, events, and expectations) are woven together—using research and theory—to help students reach specific learning objectives (Gagné, 2005).

Design of instruction includes the analysis, design, development, implementation, and evaluation of educational experiences. Keep in mind that the focus of instructional design is always on the learner or student. However, designing learning experiences is also impacted by instructor preparedness in teaching and learning as the foundation that supports student learning. Thus, when a survey collects student ratings of instruction, one should be mindful of the processes involved, the interconnectedness, and the reflection and adaptation that is necessary after student feedback is received.

Designing Instruction Using Educational Technology

According to Januszewski and Molenda (2008), educational technology "is the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources" (p.1). Creating educational experiences using educational technology implements the "practice" aspect of this definition. Instructors use practical implementations while designing the "facilitation" of learning for improving performance and knowledge in a specific discipline. They also design educational experiences where students have the opportunity to create using technology and use technology to improve their learning. Throughout this process, the instructor manages the resources and processes whereby students can engage during their learning. There are times when instructors need additional support to reach their performance teaching goals.

Professional support, such as educational technologists, greatly influences the use of educational technology. Educational technologists have researched the latest technologies for teaching and learning and are prepared to support faculty in the implementation of the appropriate technologies needed to reach their performance teaching goals. Training faculty on the new uses of technology has greatly influenced the design of educational experiences and most importantly its impact on student learning. Therefore, faculty developers and educational technologists will model the use of educational technology. They encourage the appropriate use of technological integration methods and evaluate the instructional elements, which include the use of educational technology, in a particular organization, for example a college or university. Appropriate technology use, in this context, means the application of both technological processes and those resources that sustain and are compatible with the intended purposes (Januszewski & Molenda, 2008).

Evaluation of Instructional Elements

Evaluation of instruction has been a key aspect of teaching and learning that allows for reflection and the improvement of future courses or educational experience offerings. Evaluation uses both informal and formal methods. Whether informal or formative, such evaluations come as class discussions, soliciting student feedback via emails, and reviewing student-learning activities throughout the course effort. Many colleges and universities use a more formal, or summative, evaluation such as an end-of-course student rating of instruction, student evaluations of teaching (SET), or student and faculty exit surveys. Formal evaluations are useful at both the course level for reflecting and redesigning courses as well as at the institutional level for assessment, accreditation, and further organizational development (Gillespie & Robertson, 2010). One example of a formal evaluation is the survey instrument prepared by The IDEA Center. It is titled *Student Responses to Instruction and Courses* (Hoyt & Cashin, 1977). This student rating of instruction has been used nation-wide to improve teaching and learning in higher education. Research on teaching and learning gained from this survey was conducted continuously for more than 35 years in order to develop, maintain, and update the survey instrument for better instructional and institutional feedback (Benton & Li, 2015a; Benton, Li, Brown, Guo, & Sullivan, 2015).

Thus far, a majority of the research on *Student Responses to Instruction and Courses* survey has been conducted on elements of instructional design, such as learning objectives and teaching methods (Cashin, 1990). However, hardly any research had been conducted to analyze the relationships between educational technology use and students' reactions to different instructional elements. The feedback provided by such student ratings can help inform instructors about their teaching performance in terms of what is working well and where there are areas of potential growth (Cashin, 1989). However, based on the definition of education technology, it is not only the use of technology by instructors and students that facilitates and improves performance, but also the study of ethical practices "on creating, using and managing appropriate technological processes and resources" (Januszewski & Molenda, 2008, p. 1), which includes the technology used by researchers and the institutional systems that are supporting teaching and learning. Because there are so many people involved with educational technology at any given college or university, continual research and reflective practice is necessary to improve and support recurrent educational technology use. This research study was conducted under the assumption that educational technology facilitates learning, and therefore, can have a strong relationship with teaching and learning through formal evaluation, using instruments, such as student ratings of instruction. Facilitation includes the actual design of the learning environment, the organizing of resources, and the providing of learning tools (Januszewski & Molenda, 2008).

Significance of the Study

The use of educational technology in the digital age has become a norm in many higher education classrooms. Based on the results of research on the benefits of educational technology, there is a significant potential for facilitating learning and improving performance (Januszewski & Molenda, 2008). Understanding the relationship between educational technology and other instructional elements can become the groundwork for the increased role that educational technology plays in teaching and learning. What relationship does educational technology use have with teaching methods, progress on learning objectives, and using other instructional elements in courses and by instructors in higher education? This study aims to fill this gap in knowledge. Understanding this gap will lead higher education professionals to comprehend educational technology use and its relationships with instructional elements more fully and implement that knowledge successfully in the classroom.

This research study uses student ratings to help define the existence, strength, and direction of the relationships between educational technology use and instructional elements, i.e., teaching methods and learning objectives. As Gay and Airasian (2000) state, "correlational research involves collecting data in order to determine whether, and to what degree, a relationship exists between two or more quantifiable variables. The purpose of a correlational study is to determine relationships between variables or to use these relationships to make predictions" (p. 321–322). Once clear relationships are identified between educational technology use and instructional elements, reflecting on the results of student evaluations of instruction can lead to actions that improve student learning and support their instructors. Development opportunities, such as discussions, collaboration, consultations, programming, or mentoring, are instilled in faculty for sustaining understanding and "…managing *appropriate* [emphasis added] technological processes and resources" (Januszewski & Molenda, 2008, p. 1)

In summary, this research study is an intersection between gathering feedback on instruction from college students, collecting data on higher education design of instruction, including educational technology use, and proposing faculty development opportunities based on the results.

Research Purpose and Hypotheses

This study took place at a small liberal arts university in the Midwestern United States between August 2012 and December 2014. The data analyzed was previously collected using the *Student Reactions to Instruction and Courses* survey, aggregated and initially analyzed by the IDEA Center. Further, analysis for this study was done with the permission of the Midwestern University administration. A total of 34,480 survey responses were analyzed with the intent to accomplish the purpose of the research study and address the research hypotheses explained below.

This research study was designed to investigate the relationships between college students' reactions to instruction and courses that use educational technology and other important instructional elements to facilitate student learning. The intent was to draw from this analysis new implications for faculty development. The following hypotheses were thus developed and tested in this study:

H1: Across the university, educational technology when used to promote learning will gain a high rating.

H2: Educational technology use will demonstrate a positive correlation when related to teaching methods.

H3: Educational technology use will show a positive correlation when related to progress on learning objectives.

H4: Educational technology use will show a positive correlation with:

a. Instructor rating;
b. Overall student perception of a course rating;
c. Rating for the student putting "…forth more effort than other students on academic work;"
d. Rating for "the instructor used a variety of methods—not only tests—to evaluate student progress on the course objectives;"
e. Rating for "the instructor expected student to take their share of responsibility for learning;"
f. Rating for "the instructor had high achievement standards in this class."

H5: There are correlations between educational technology use and

a. Teaching methods;
b. Learning objectives;
c. Global elements;

that will differ with class size.

Definition of Terms

Correlational studies investigate the relationships between variables, including their measures of strength and direction (Remler & Van Ryzin, 2015).

Educational technology "is the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources" (Januszewski & Molenda, 2008, p. 1).

Educational technology use is the spectrum of activities seen as the diffusion of innovation process, including their selection, usability, utilization, and integration into educational experiences to facilitate learning (Januszewski & Molenda, 2008).

Evaluation of teaching includes the evaluation of all elements of instruction, including 1) subject matter mastery, 2) curriculum development, 3) course design, 4) delivery of instruction, 5) assessment of instruction, 6) availability to students, and 7) administrative requirements (Cashin, 1989).

Facilitating learning helps to "…create an environment in which learning more easily could occur" (Januszewski & Molenda, 2008, p. 4).

Instructional Elements are the set of instructional materials, events, and expectations that are embedded in educational experiences that facilitate learning (Gagné, 2005) as well as their teaching methods and learning objectives.

Instructional development is when course developers, often instructors, engage in course design and curriculum development that is centered around student learning (Diamond, 2002).

Learning objectives are a list of expectations for the performance desired from an educational experience (Gagné, 2005).

A **teaching method** is the way in which an instructor presents new content (Gagné, 2005) and the approaches used to reach expected or desired learning outcomes (Trowbridge, Bybee, & Carlson-Powell, 2000).

Teaching strategies are the educational approaches followed and the classroom-environment-focused tools used during an educational experience (Marzano, 2001; Trowbridge et al., 2000).

Student ratings of instruction (also known as **systematic student ratings** or **student evaluations of teaching** (SET)) include students' reactions to the different elements of teaching. Data gathered from student ratings are a part of a larger dataset that encompasses a complete evaluation of the teaching (Cashin, 1989).

CHAPTER 2 - LITERATURE REVIEW

Introduction

Two themes were recognized in the literature review for this study. The first theme identified the design of educational experiences that specialize in the use and integration of educational technology. The second theme focused on having well designed educational experiences for different audiences as well as different class sizes in higher education. Three variations of audiences were recognized. The first was traditional students from classroom experiences; the second as non-traditional students as adult learners; and the third were the faculty who engaged in professional development opportunities. Each audience and different class sizes, an additional audience variable, have a foundation in educational research and impact the methods used for teaching and learning, and in turn, the educational technology being used.

This chapter guides the reader through these themes by defining what is meant by educational technology, the difference between educational technology use and its integration, and actual educational experiences in higher education. The chapter is further organized by describing the stages of instructional design and how educational technology and educational experiences intertwine. Lastly, the chapter shows how higher education regularly provides certain support services for development of educational experiences. It includes the look and feel of different faculty development approaches and how the support services offered can use this research study to improve their own development opportunities.

Educational Technology Defined

Because educational technology is used in the multiple aspects of the design of educational experiences, it is important to define educational technology first and foremost. As mentioned previously, according to Januszewski and Molenda (2008), "educational technology is the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources" (p. 1). Therefore, the intent of this research study is to further gather and analyze information about educational technology and its use in the context of higher education, including its ethical practices. Educational technology use is the practice of implementing educational technology to facilitate or enhance learning. During the implementation of educational technology use for learning, students are likely to develop new understanding, create products, and apply processes based around course content. Instructors initially developed and managed technology implementation, but hopefully facilitated instruction so that students could later model the use of educational technology in their own professional practices when they were aimed at education and training. Throughout this review of the literature, this researcher noticed evidence of these characteristics being implemented during the different stages of the instructional design process.

Educational Technology Use and Integration

The definition here includes "using" educational technology, but it has not differentiated between educational technology use and its integration. However, having investigated the discussion between use and integration more deeply, Januszewski and Molenda (2008) suggest that "use" or utilization happens at a global level, including using document editing software and communication software such as e-mail. Another perspective of technology "use" can be seen as unplanned, purely instructional/managerial, or even used for lower-order thinking tasks (Rao, 2013). "Integration" is much more intricate a concept. It is planned and purposeful, specifically embedded into facilitated educational experiences. Integration uses facilitated engagement with content employing higher-order thinking and becomes part of the full routine and environment for learning. Integration is an essential part of such creation and new thinking processes (Rao, 2013). To further detail the difference, "use" includes having researched and found the appropriate technology based on evaluating the materials and their usability, but it may not be the critical tool necessary for promoting learning. The amount of utilization depends on the environment and the planned activities. When educational technology is fully implemented into pedagogical aspects, having been taught to and used by students, that outcome is considered integration.

Educational Experiences in Higher Education

Educational experiences in this study include the use of teaching methods in order to progress on learning objectives. Other instructional elements, such as educational technology use, instruction, quality of a course, student efforts and responsibilities are also considered. Having designed learning experiences, the instructors then pay attention to audience (Morrison et al., 2007) as well as advancing their students toward the planned learning objectives (or educational goals).

Audience

Students as learners at higher education institutions are engaged in instruction designed for a pedagogical or andragogical audience. These approaches differ based on previous student experiences and/or age. Knowles (1973) pointed out that the Greek derivation of pedagogy literally means "the leader of children" and can be defined as "the art and science of teaching children." Pedagogy is typically used for traditional students who may require more direction throughout their educational endeavors. Whereas the Greek derivation of andragogy means "the leader of men" and is currently defined as "the art and science of helping adults learn" (Knowles, 1980), andragogy is typically used for non-traditional students who are likely to have a specific end goal. Note as well that both of these definitions are written from the instructor's perspective. Unlike the definitions of the terms, Knowles's andragogical theory is based on characteristics of adult learners rather than those of the teachers (Holmes & Abington-Cooper, 2000). Adult learners have different motivations than do traditional students in class. Knowles (1980) outlined the needs of these adult learners as including:

- The need to learn;
- An environment of trust, respect, and acceptance of differences;
- Teachers' goals must match the learners' goals;
- A heightened sense of an expectation to share responsibility for learning;
- Active participation;
- Inclusion of learners' experiences; and
- Feedback on learners' progress toward their goals.

Understanding the audience or learners in a particular course or educational experience should drive all future decision-making when designing that course. College students between 17 and 22 years of age are taught as non-professionals; therefore they need someone who can give them more direction, facilitate their motivation, engage them with the content, include reflective and recursive practice with the content, and give timely feedback as additional motivation. Adult learners differ from traditional students by exhibiting an internal motivation, preferring guidance from instructors, showing mutual respect for like and unlike viewpoints, and desiring to share the responsibility of learning with the instructor and their fellow students. When teaching these different audiences, the learning objectives can remain the same; however, teaching methods and teaching strategies may differ greatly. In addition, there are differing expectations for both the role of the instructor and the students.

Design of Educational Experiences in Higher Education

Designers and researchers have used Instructional Systems Design (ISD) for more than a century and more readily over the last four decades. ISD is an informed and reflective practice of learning, instructional implementation, and evaluation of progress on outcomes (Gagné & Briggs, 1974) based on various instructional design theories. Reigeluth and Carr-Chellman (2009) suggest that there are six major kinds of instructional design theory. These six major theories define the stages of ISD that closely matched one of the most common ISD processes. It is known as Analysis-Design-Development-Implementation-Evaluation (ADDIE) (Gagné, 2005).

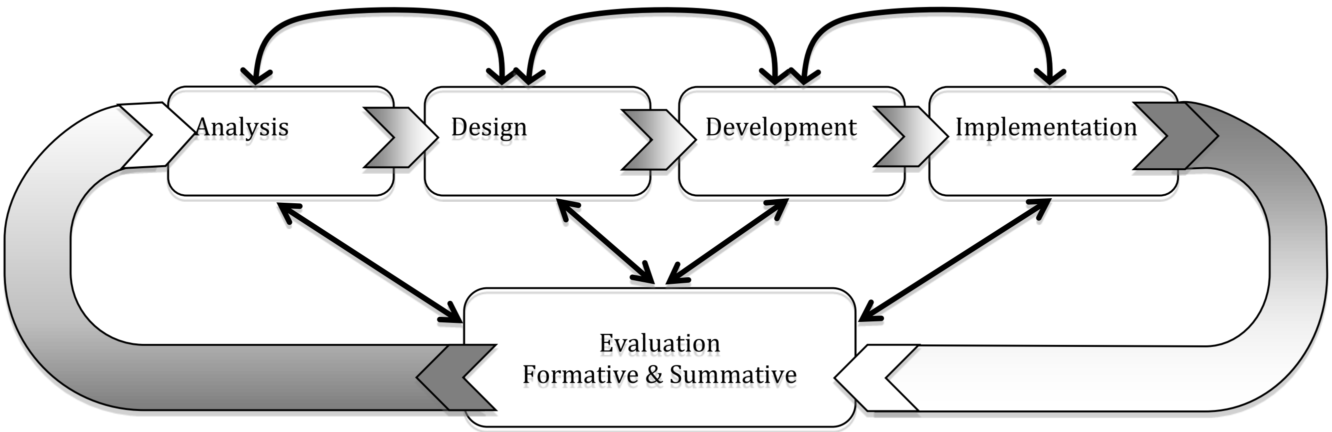

Figure 2-1: The ADDIE Model for Instructional Design

Gagné et al. (2005) highlighted the fact that learning conditions and classroom environments (such as class size and teaching methods) play a major role in student learning. The 5th edition of the text, *Principles of Instructional Design*, originally written by Robert Gagné (Gagné & Briggs, 1974), included two additional sections on the considerations for designing and using technology and online learning (Gagné, 2005). It is important to note that the impression of "technology and its use should not be an end in itself, but a means to an end" (Russell, 2005, p. 45) was supported by Gagné. In other words, educational technology use is a vetted strategy that helps students reach the goals described by learning objectives, not a method of teaching in and of itself.

The systematic approach ADDIE, like many other instructional design processes could appear to be linear. However, the process did not have to be such, as each phase has its own feedback loop and may interact with other phases by employing formative evaluations along the way. Figure 2-1 implies this by illustrating feedback loops as arrows between the phases. Instructional development did not have to be as formal as the ISD process (for example, the ADDIE model). As a matter of fact, most instructors did not employ either when designing educational experiences due to the fact that the levels of detail used in the processes were too exhaustive for the amount of time allotted to teachers for teaching preparation (Morrison et al., 2007). Many instructors took a look at the gist of instructional design or the heuristics of it and employed what they could (Reigeluth, 2009). They may have used any number of processes, but for the sake of this review, backwards design is used as an example (See Figure 2-2).

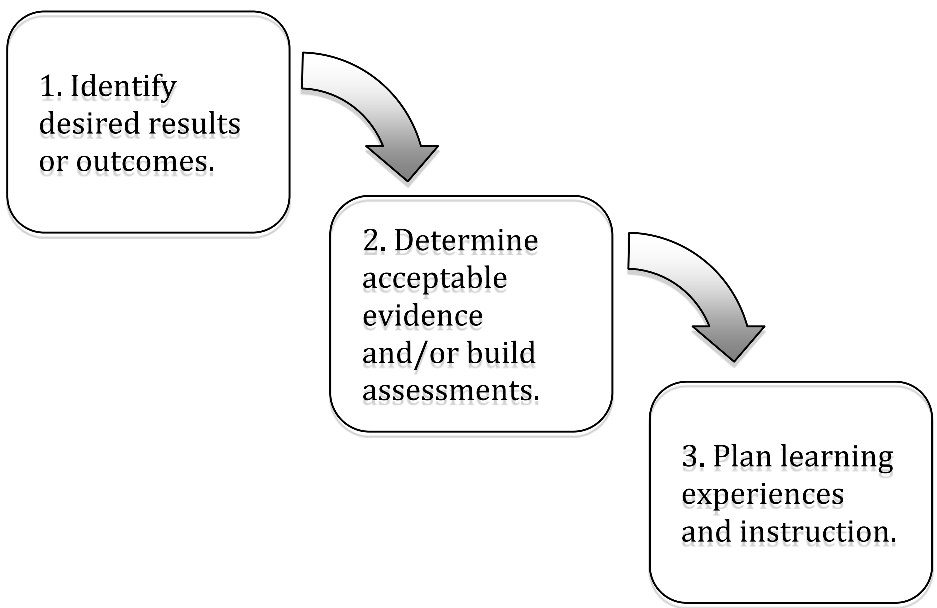

Figure 2-2: Backward Design as a Method of Instructional Design (Wiggins & McTighe, 2005)

Any design, including backward design, is assumed as though one actually went through the process, and the audience and classroom environment, such as class-size, is kept in mind (McKeachie & Hofer, 2002), if only anecdotally. The backward design process starts by creating goals and learning objectives (the desired results), then informal and formal assessments of progress on these learning objectives is added to determine acceptable evidence, followed by the actual teaching methods and activities needed to reach those goals, culminating in the implementation of the planned learning experiences and its instruction (Wiggins & McTighe, 2005). Instructors who invest time in designing their courses around learning objectives are likely to help students gain a deeper understanding of the material. These students know what they are expected to learn, the level and detail of the assessment upon which they will be graded, and are able to practice, revise, and revisit their work as they progress through the educational experience process. The prevailing idea was that instruction is "teaching for understanding" (Wiggins & McTighe, 2005).

Expectations of Instructors

Instructors are the cultivators of the art, science, and/or craft of teaching. Instructors are designers (Morrison et al., 2007). The art of teaching included the ability to engage in teaching, reflect on those practices, and report back to the larger teaching community (Crawford, 2014). The science of teaching is based on teaching theories and implementation in practice (Crawford, 2014; Reigeluth, 2009). The craft of teaching is based on grounded theory where the design and delivery of teaching is semi-scripted with reflective practices' informing any changes or refinements for future instruction (Crawford, 2014). The combination of an instructor's use of the art, science or craft of teaching is known as that person's teaching philosophy.

Instructors are highly likely to design, implement, and react to educational experiences based on their personal teaching philosophy and the tools in their toolbox. Those tools include an instructor's knowledge of the subject matter, an understanding of pedagogy and/or andragogy, and knowledge of educational technology use and implementation—including facilitating learning and improving performance and the time allocated to teaching learning.

Adjusting Educational Experiences for Today's Student

College students in the digital age expect and even demand use of technology to facilitate their learning. Bates (2015) compared the differences in students of the digital age against their peers of the past. He said a more diverse population is attending university now than ever in the past. It was no longer the financially well off, but a gambit and full range of students who look for quality education to prepare themselves to be competitive in the job market and pursue their dreams. Students are likely to have more than one train of thinking on what their education should look like. Learners will build their own educational adventure—by piecing together a two-year education with a transfer to four-year institutions and additional online coursework, possibly Massive Open Online Courses (MOOCs), to fill any gaps. These students may be what are called traditional full-time students, or they perhaps part-time students who have already entered the job market and are now looking for a change in career, a promotion, or a leadership position. These students may not attend school for traditional four-year time period, but only as time and money allow. They also schedule their studies around other commitments. Due to changes in student needs and expectations as a part of the digital age, the widely used definition of a traditional student thus needs to be redefined. Therefore, since academic knowledge based on evidence and research has been not the only significant body of knowledge in current societal developments (Bates, 2015) teaching in a digital age does differ from instruction in earlier times. It would be problematic to teach this new type of students by using the same teaching resources as employed during previous eras.

Teaching in the Digital Age

Educational research has led us to believe that no one way of teaching has been proven as "the best practice." As in the past, the traditional epistemologies of behaviorism, cognitivism, pragmatism, and constructivism are still used today for informing teaching philosophies. However, due to current digital influences, the research has discovered additional complex and still controversial learning and teaching epistemology called connectivism (Siemens, 2004). Connectivism is described as a learning process that can happen outside of the individual and between "nodes" or other informational sources– leaving the instructor out of the picture altogether (Bates, 2015). The teacher is a designer, initiator, and facilitator of the learning experience while yet under the influence of their own teaching philosophy and thus likely to use educational technology as part of the more recent connectivist approach.

Educational technology can be used to enhance the educational experience, regardless of the epistemology and teaching philosophy. The benefits and preferred practices of the five main epistemologies and educational practices have been discussed and disseminated through ongoing research. Nevertheless, each does have its own benefits to contribute to an ever-growing knowledge base of educational research. These epistemologies further call for variety in the types of learning objectives, instructional philosophies, designs for educational experiences, and teaching methods to be used throughout the teaching and learning process.

Technology is a growing and evolving societal reality, and thus it has its unique connections to student practices and their educational experiences. Students' expectations for technology and its educational uses have evolved as well. Like aiming at a moving target, designing learning experiences to match the expectations of students requires their input. Instructors can gather this student input via formative or summative evaluations, then reflect upon the results, and implement the findings as part of redesigning instruction in an expanding technology environment.

Guiding Teaching and Learning Using Learning Objectives

Goals and learning objectives should be broad in nature and help students focus on what is important (Wiggins & McTighe, 2005). Students should partake in personalizing these learning objectives by creating criteria, such as sub-goals for self-direction and motivation (Marzano, 2001). No matter what course design process is used, when designing learning experiences there are many ways to build goals and learning objectives. Two widely used models are those of Bloom's revised taxonomy of educational objectives that include the cognitive, affective, and psychomotor domains (See Figure 2-3) (Anderson & Krathwohl, 2001; Bloom, Krathwohl, & Masia, 1984),

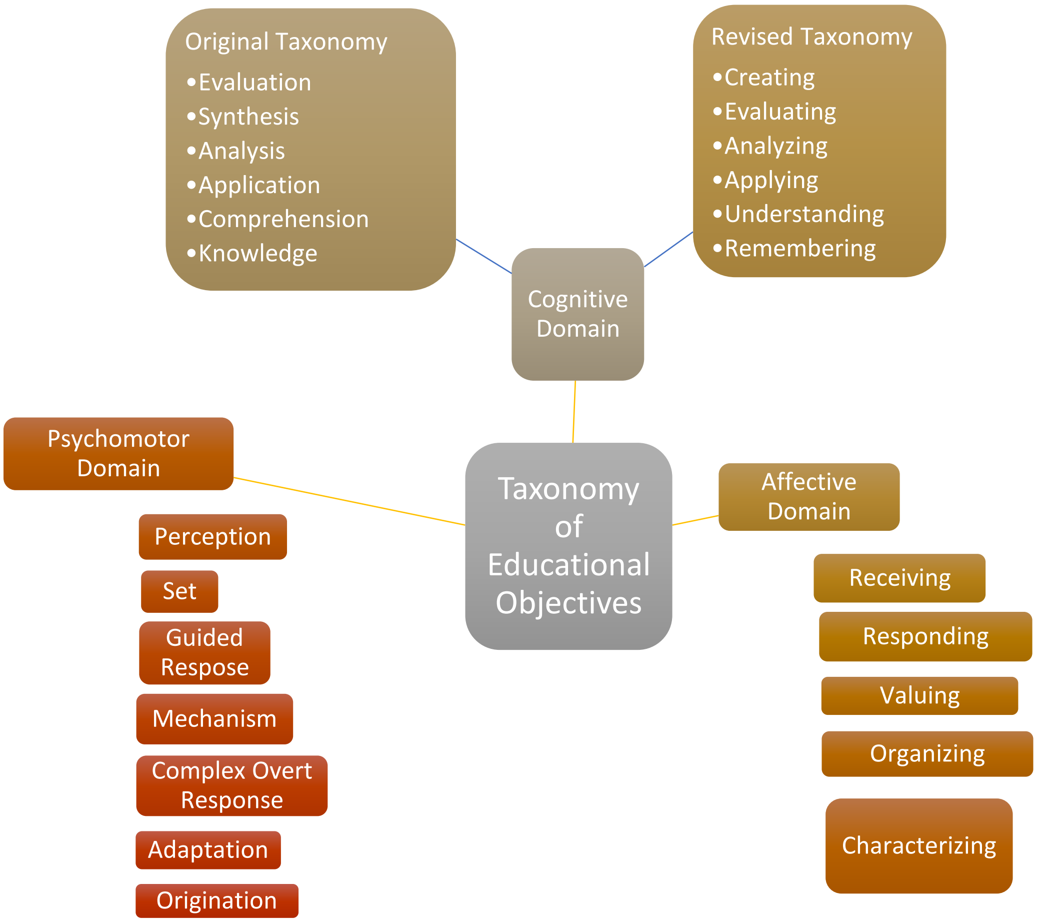

Figure 2-3: Bloom's Taxonomy of Educational Objectives (Anderson & Krathwohl, 2001; Bloom et al., 1984)

and Fink's taxonomy of significant learning include: 1) foundational knowledge, 2) application, 3) integration, 4) human dimension, 5) caring, and 6) learning how to learn (See Figure 2-4) (Fink, 2013). Instructors use models like these to direct the development of the special goals and learning objectives for their courses.

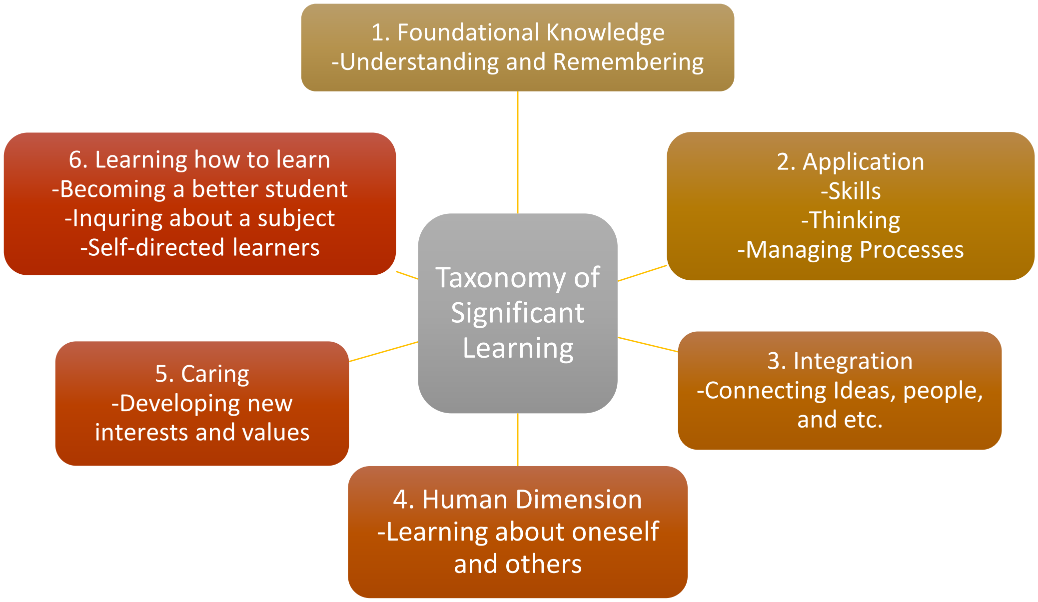

Figure 2-4: Fink's Taxonomy of Significant Learning (Fink, 2013)

Once learning objectives are developed, it is likely that instructors will develop both informal and formal assessments to be able to identify student progress on learning objectives (Wiggins & McTighe, 2005). Assessments are conducted in many arrangements and gather evidence from many different types of learning activities: daily homework, regular low-stakes quizzes, written assignments, research papers, portfolios, presentations, community engagements, examinations, and many more. These assessments are a means of gathering evidence and also a vehicle to provide feedback to the students on their progress toward the learning objectives. McKeachie and Hofer (2002) mention that developing and responding to feedback is one of the richest ways to notify students of progress on the learning objectives. There are also a few themes that should be addressed when providing feedback: 1) feedback should be corrective in nature; 2) feedback should be timely; 3) feedback should be specific to a single criterion; and the 4) participant should provide some of his or her own feedback (Marzano, 2001).

The Relationships between Educational Technology Use and Learning Objectives

Learning objectives are the basis for what the instructor perceives to be the most important outcomes a student should obtain from a course or educational experience (Bates, 2015). Gagné states:

> "The notion of *learning* [emphasis original] with technology implies the development of an intellectual partnership where the student and computer work together to achieve learning outcomes; the *effects* [emphasis original] of technology refers to the knowledge or skills acquired by the student as a result of learning from the computer (Steketee, 2002) [citation part of quote] (Gagné, 2005, p. 232)."

Therefore, educational technology should be used as a means of supporting student learning by helping to track the use of learning objectives as well as accomplish them. In recent years, learning management systems have had a goal or outcome tracking available. These can be used at the course level as well as at the institutional level for further feedback on reaching learning objectives. For students, it has been a common and best practice to identify the learning objectives periodically throughout a course and give feedback to get information on student progress toward those learning objectives. Another feature of many learning management systems is the availability to assess student progress by using electronic rubrics. These technologies help instructors work efficiently as well as provide the capability for timely feedback for students. Rubrics are also a means of gathering program and institutional data as a part of an evaluation processes on institutional learning objectives.

Guiding Teaching and Learning Using Teaching Methods

Teaching methods can be focused on classroom activities and aimed at achievement of previously determined learning objectives (Trowbridge et al., 2000). Teaching strategies are classroom-environment-focused tools used during teaching (Marzano, 2001; Trowbridge et al., 2000). This distinction between teaching methods and teaching strategies is important in any description of the instructional design process and the evaluation of educational experiences.

The Relationships between Educational Technology Use and Teaching Methods

The approaches for reaching learning objectives come in a multitude of forms including lecturing, discussing, working in groups, creating products based on new understanding, and many more (Trowbridge et al., 2000). Each of these different teaching methods use a variety of teaching strategies. They employ guest speakers, offer on-site visits, and have students' teaching other students, or use educational technology or technology integration, just to name a few. While facilitating learning through teaching activities, instructors manage the appropriate technology by providing useful processes for building skills and resources for students to learn more than just the content delivered during implementation (Januszewski & Molenda, 2008).

Educational Technology Used As a Strategy for Different Teaching Methods

Nearly all teaching methods are independent of educational technology use or integration (Bates, 2015). However, current teaching trends have been focused on teaching with technology (Correia, 2012). Below are examples of some of the most popular teaching methods both with and without use if educational technology. The first is the most popular teaching method in higher education, the traditional lecture—the conveyance of subject matter through direct oral delivery by the instructor (Morrison et al., 2007). The traditional lecture has evolved from simple oral delivery of material to include the use of integrated visuals and additional multi-media (Reigeluth, 2009). Early technology use included providing notes to students at the front of the classroom. First there were slate chalkboards, followed by overhead projectors, white boards with dry erase markers, more sophisticated computer-based projections with presentation software, such as Apple's Keynote or Microsoft's PowerPoint via single or double projection screens, and then interactive whiteboards. Interactions in lectures include using audience response systems, or clickers, to answer timely questions in response to information that has been recently introduced during a lecture (Good, 2013). Lectures can include techniques such as "backchat" conversations between students during the lecture (Bates, 2015). "Flipped" classrooms are a more flexible manner of lecturing that uses podcasts or recorded videos that can be viewed outside of class or during face-to-face class time (Bergmann & Sams, 2012). Although technology has greatly enhanced the lecture and student understanding of the content, it is not a requirement to teach that content in that format.

Another example is class discussion. Discussions are interactions with the content through verbal communication among students or between the students and their instructor. Interactive discussions are regularly facilitated rather than being conveyed like lectures. Discussions have been viewed through a lens' using educational technology to facilitate learning. During classroom interactions that include discussions, it may be useful to employ a student or teaching assistant as a "Google jockey" to help search for terms or the concepts being discussed. A "Google jockey" is "…a student who surfs the World Wide Web for material related to a discussion or lecture and displays the results to the class"

(Pence, Greene, & Pence, 2010, p. 1). However, with the abundance of Smartphones and web accessibility in the classroom today, Google jockeys may now have had a less prominent place, and yet, the role has created individual students who gained the power to discover (Kolb, 2011). In addition, either inside the classroom or out of it, discussions could still occur on electronic discussion boards, through instant messaging, texting, or via chat features (Bonk, 2009).

Other teaching methods have also been effective both with and in absence of educational technology use. Learning-by-doing, sometimes called experiential or active learning, problem-based learning, case-based studies, project-based learning, or team-based learning can all appear in the face-to-face classroom without technology or in a face-to-face classroom with some technology. It is called web-enhanced learning and occurs in blended learning environments, and also in fully online classrooms (Bates, 2015). Each modality, although still follows the process of designing the instruction, employs a very different set of teaching tools. As with any educational technology, research, practicality or appropriateness, usability must inform classroom use (Januszewski & Molenda, 2008).

<u>Guiding Teaching and Learning in Response to Class Size</u>

The studies on class sizes in higher education have been fairly consistent. Class size influences the success of certain teaching methods. However, there is little statistical proof that class size influences student achievement in higher education (Kokkelenberg, Dillon, & Christy, 2008). On the other hand, the teaching and learning literature mention that class size is one of the major influencers for choosing teaching methods to achieve learning objectives (Gagné, 2005; McKeachie & Hofer, 2002). Evidence suggests that small class sizes support improvement of student performance (Kokkelenberg et al., 2008) and large class sizes have an abundance of studies suggesting best practices for this environment. Therefore, large class sizes can be as effective as small class sizes when the teaching methods and the student characteristics align well with teaching best practices for that environment.

What differentiates small from medium and large class sizes? Definitions for class sizes differ throughout the literature. Kokkelenberg et al. (2008) suggest that small class sizes are less than 30 students, medium class sizes can range between 31 and 90 students, and large class sizes are those over 90. This set of ranges are likely to be for large research-intensive universities, but are unlikely to match the definitions of classes in small liberal arts universities. Research congruent to this study defines class sizes more conservatively. Small classes contain less than 15 students, medium class sizes contain 15 to 34 students, large class sizes are 35 to 49 students, and extra-large classes are those with 50 or more students enrolled (Cashin, 1989). These differences in definitions suggest that class sizes should be determined by discipline, institutional environments, and pedagogy rather than simply designated numerical standards (Hornsby & Osman, 2014).

Educational Technology Use and Differences in Class Size

Earlier in this review of the literature, audiences were examined in regard to student expectations of educational experiences. As a part of those experiences, it was seen that classroom environments influenced student learning. In other words, environmental factors, such as class size, impacts the design of the course, teaching methods and strategies used (McKeachie & Hofer, 2002). If teachers of small classes called for the use of technology, such as having laptops available for students, it is pretty feasible for most higher education institutions. If large class instructors require the use of laptops for learning, the task calls for something more like a one-to-one grant funded computer initiative to make it a reality. "A higher education institution with limited access to teaching technology may have a different experience from one with ample technological resources when it comes to what constitutes a large class" (Hornsby & Osman, 2014, p. 715). Therefore, accessibility to educational technology resources has a sizable impact on the design of instructional activities. Having the expertise to differentiate between the appropriate technologies based on class size, level of work, developing the skills to create learning activities conducive to the learning goals, and making resources available greatly impacts the success of the educational technology implementation (Januszewski & Molenda, 2008).

Bates (2015) indicated there is a current trend with more time being dedicated to lecture style teaching and less on small group work due to differences in class sizes. Lately, due to budget constraints in higher education, class sizes have tended to increase. With more students, it is likely that small group work is used less as the use of lectures increased. This affected instructor use of a less flexible assessment of students' progress toward achieving learning objectives to meet the reduced time per student allowed for grading and feedback. With less feedback comes less interaction between students and faculty. Bates (2015) also mentioned that increasing class sizes without adjusting teaching methods could be quite taxing on instructors. Instructors in situations such as these should seek assistance for instructional efficiency and alternate teaching methods to facilitate the learning process so students thus carry more of the responsibility of learning (Jackson, 2009).

Implementation of Educational Experiences in Higher Education

Implementation occurs when the instructional plan is put into action. Although implementation is still very much a part of the instructional design process, it is at a stage where teaching methods, strategies and other support and resources for teaching and learning are presented to students through learning activities (Morrison et al., 2007). It is during the implementation stage that instructors leave an impression (positive or negative) upon students. Beyond teaching and facilitating classes, it is important to gather feedback from the students to inform future iterations of their educational experiences. These formative evaluations, in turn, help determine the success of reaching learning outcomes (Gagné, 2005). Summative evaluations are just as important and are usually gathered during end-of-course student evaluations or SET surveys.

Global Elements of Educational Experiences

Teaching includes an array of factors that did not fit within the realms of generalized audiences, learning objectives, or teaching methods. In addition to elements that are independent of learning objectives and teaching methods, other instructional elements are taken into account. These arise during the implementation of instructional activities where aspects, such as the characteristics of individual students, are likely to impact their learning. Global elements include attitudes, behaviors, and judgments made by the students regarding their own learning, learning environment, and comparisons with other courses they had taken (Hoyt & Cashin, 1977). Student attitudes and behaviors impact courses during implementation as much as instructional design. Instructors address these elements of teaching in addition to designing the delivery and interactions with learning during the educational experience.

In 1987, Chickering and Gamson's (1987) list of seven principles for teaching undergraduates made its debut. Among these principles were creating rapport between faculty and students, developing a community to engage learners, using active learning strategies, giving timely and good quality feedback to students, encouraging students to accept responsibility for engaging with content, adhering to high-expectations when it comes to learning, and being respectful of the many ways of learning (Chickering & Gamson, 1987). These are the types of global elements that impact student learning and involve the management of learning environments.

The Relationships between Educational Technology Use and Global Elements of Teaching

Managing learning environments means effectively engaging and leading people, processes, infrastructure, and resources to reach learning objectives (Januszewski & Molenda, 2008). Instructors held students to certain learning expectations and act as their leader, facilitator, coach, and director of change. This technique includes the instructor's ability to communicate with students both clearly and concisely (Hoyt & Cashin, 1977; Morrison et al., 2007). Management of students and learning resources alike requires an alignment between the needs of the student and the learning objectives, which must also be clearly defined and evaluated (Januszewski & Molenda, 2008). Educational technology becomes a means of supporting instructors in their managerial expectations. Communication technologies are used to ensure regular interactions with students, including getting to know them, supporting them, giving them direction, and leading them to use educational resources. Supporting students in such a manner is a very effective use of educational technology, and it ensures student success. For managerial purposes, educational technologies need to be used "…to direct, to align, and to inspire" (Januszewski

& Molenda, 2008, p. 191). Technology should also be used to help manage regular formative and summative evaluations. Evaluations of learning experiences are then reflected upon to inform changes and updates to the instructional design process during the current offering as well as for future offerings of that learning experience.

Evaluation of Educational Experiences in Higher Education

Following the instructional design process, evaluation takes place on every aspect of teaching and learning at one point in time or another during the educational experience (Gagné, 2005). There are five different types of evaluation used during the instructional design process: 1) evaluating instructional materials for their support in reaching learning outcomes, 2) evaluating the instructional design process used for developing the learning experience, 3) assessing student perceptions of effective delivery, 4) assessing student progress on learning outcomes, and 5) determining transferability of what was learned to improve or inform specific organizations or the larger community (Gagné, 2005). Having employed evaluation processes or instruments, instructors now gather both formative and summative feedback on a regular basis through coursework, conversations with their students or end-of-course ratings of instruction. Assessments on learning experiences include many, if not all, of the types of evaluation at some point in time throughout the entire learning experience. If each of these evaluation types are used, large quantities of data are generated, reflected upon, and then informed instructional changes, the very goal of evaluation.

Each type of evaluation generates feedback and/or changes based on the decision type—whether formative or summative. For example, if instructional materials are not producing the desired results for learning outcomes, changes/improvements in the instructional materials or teaching methods and strategies are then appropriate. If the instructor is not satisfied with the process of instructional design used, he or she may choose to use a different method of design for future instructional endeavors.

No single stakeholder (universities, instructors, or students) has more invested in the educational experience than any other. Therefore, evaluations from all stakeholders involved in the experience are equally important (Cashin, 1990). Fink (2013), Cashin (1990), and Cashin and Hoyt (1977) all mentioned that there should be multiple levels of evaluation of educational experiences. Gathering the student perspective is just one level, but it is a critical one. Students hold an important place in providing feedback as a part of the evaluation. During an educational experience, students are likely to have diagnosed difficulties, self-reported on their progress toward learning objectives, and evaluated instructional effectiveness (Gagné, 2005; Morrison et al., 2007; Seels, 1998). However, to get quality feedback from students, they should be informed about how their responses on the formative evaluations as well as end-of-course or SET ratings would impact the learning environment (Cashin, 1989). Formative and summative evaluations should follow the same guidelines as the feedback to students on their progress toward the learning objectives. Because evaluation can be complex, no one type of evaluation should be used exclusively. For example, formative evaluation data should be used to "supplement end-of-course ratings" (McKeachie & Hofer, 2002) directing instructors about what to reflect upon and where changes would be necessary during implementation to improve their teaching. Student ratings of instruction are one of the most direct and reliable routes for gathering student feedback about educational experiences (Benton & Cashin, 2011). To increase the reliability of student ratings, there needs to be more than ten students from a single class.

If that threshold is not reached, then multiple sections comprised of the same course characteristics should be included to increase reliability and generalizability (Benton & Cashin, 2011). "Student ratings are significantly and consistently related to student achievement, teacher self-ratings, administrator and colleague ratings, ratings by trained observers, and student written comments" (Benton & Cashin, 2011, p. 5). Therefore, student feedback is just as important as gathering information from instructors, as both are involved in the entire learning process.

Seels and Glasgow (1998) mentioned at least four areas of learning that could be measured using evaluations: cognitive learning, attitudes, performance, and organizational impact of learning effectiveness. The relationship between learning objectives and evaluation are derived by matching measures of evaluation directly to learning objectives (Morrison et al., 2007). Teaching methods and other global elements can be evaluated in a similar manner. Mapping instructional design elements to the evaluation instruments or methods is also an important step when planning evaluation to close the loop during the instructional design process (Morrison et al., 2007).

Evaluation data gathered at any point in time during students' learning can also help in assessing a student program or major in a university setting. Looking at the same evaluation data over time can inform higher education leaders of the transferability of student learning from a particular learning experience to a larger organizational goal or community. In other words, in a university setting, the influences of evaluation data at the course level can press changes on support services and/or organizational goals. Support services for instructors in educational technology and pedagogical matters can be greatly influenced by evaluative data collected at the course or institutional level.

Development of Support Services for Instructors

Faculty development efforts can encompass three main goals: organizational development (program, departmental, and institution-wide efforts), "personal development (self-reflection, vitality, and growth), and instructional development (course and student-based initiatives)" (Gillespie & Robertson, 2010, p. 26). Focusing on development centers as part of the larger, institutional picture is a way to present sound faculty development efforts for re-accreditation, present quality enhancement planning, support a strategic plan/institutional mission, and model a strong agent of change (Gillespie & Robertson, 2010). Strong institutions depend on strong organizational development. Fink (2013) even stated that "… effective instructional development was linked to and depends on effective organizational development" (Fink, 2013, p. 199). For better organizational support when teaching learning, Fink (2013) suggested six critical conditions; 1) awareness, 2) encouragement, 3) time, 4) resources, 5) cooperative students, and 6) recognition and reward. Yet, specified action items for improvement should also include:

- Change procedures for faculty work and faculty evaluations;
- Improve procedures for evaluation of teaching;
- Establish teaching and learning centers; and
- Coordinate student development with instructional development.

Organizational administrators and managers alike have to find out if they are offering the programs and services needed by instructors, students, and staff (Januszewski & Molenda, 2008; Miller, 2007). There would be little need to generate more evaluation data if the existing data could inform current programming. Gathering data electronically is the key to efficient evaluation practices. Institutional researchers can be key players, assisting in planning, implementing, and analysis. They are generally skilled in areas of big data and research techniques (Miller, 2007). Findings from these data help define strategic plans and future endeavors. Data also help support accreditation goals and are used for conversations on institutional improvement, a core function of faculty development centers or centers for teaching and learning. Many research-intensive institutions typically have an office where institutional research is their sole purpose to support these endeavors. This scenario is not always the case in small or liberal arts institutions, however. Each department or unit within any organization, such as faculty development centers, can be charged with doing their own analysis and offering program recommendations.

Why Was Faculty Development Important?

Reeves (2010) offered evidence that the "assessment of adult learning processes is directly related to improved student learning" (p. 96). Over time, the need arose to prepare faculty to be more knowledgeable in teaching and learning as well as good researchers in their prospective disciplines. "As a *scholarly* [emphasis original] enterprise, teaching begins with what the teacher knows. Those who teach must, above all, be well informed, and steeped in the knowledge of their fields" (Boyer, 1990, p. 23). At one point in time, faculty's main goals were improving scholarly endeavors, but then began a transition that focused on teaching and learning and employing a more pedagogically based approach (Sorcinelli, 2006). It became apparent that being an expert in one's discipline may not be enough to help students succeed at reaching their learning objectives. As a result, the scope of preparing for an academic career is changing. It now means having a foundation in teaching and learning theory as well as sound knowledge of one's field.

In response to professional needs, faculty support programs began to adapt, change, and innovate. They began to include the needs of graduate students (also considered future faculty members) as they prepare for their careers in academia and place a stronger emphasis on teaching. Changes include formally developing help guides for graduate students who are teaching assistants, becoming a part of a mentoring partnership, attending faculty development offerings, or taking coursework on teaching and learning. In addition, teaching and learning centers are regularly staffed with specialists in teaching and learning or technology, or local faculty. Learning how to teach is a necessary development for new faculty; learning how to teach using educational technology is another, as it is for all faculty. Staffing a professional development center to match the needs of faculty is also advantageous because the diffusion of educational innovations are better supported when that diffusion is done by an educator (Correia, 2012).

Faculty Development for Course Design and Educational Technology Use

The idea of diffusion brings us back to the use of instructional design to develop courses. Centers have provided development at many levels in this arena as well. Centers for teaching and learning are employing different types of programming, informing practices of instructional design that include writing learning objectives, integrating teaching methods and strategies, assessing, and evaluating. For example, whole processes, such as backward design, can be the content for a weeklong institute. Without prior training or exposure, faculty use other professional development opportunities and networks to learn more about using educational technology to support attaining their designated learning objectives.

In addition, workshops, institutes, or one-on-one consultations address instructors' needs for knowing how and which educational technology tools should be implemented to reach desired learning objectives. It is then up to the instructor to finalize the course design by including educational technology use and implementing educational technology as a teaching strategy or tool during learning activities. Instructors should always be learning something new to improve the student experience and thus truly become lifelong learners.

Faculty members are also regularly understood to be self-directed learners. There are, however, instances when this is not the case, and then these faculty are highly encouraged to seek assistance for improving their teaching or interactions with students. Centers for teaching and learning are likely to provide programming for both self-directed learners and the highly encouraged. Either way the faculty are adult learners. It should also be mentioned that not all adult learners are alike. At the time of any faculty development opportunity, faculty members are professionals' working within a specific discipline buy having some background in teaching and learning; they are not learning a new discipline. Professional developers should not follow the rules of andragogy, but rather those of heutagogy when teaching faculty. Heutagogy is just-in-time learning for professionals within their field (Hase & Kenyon, 2001). As such, a teaching event should make very apparent the need to change as a motivation to learn more.

Perspectives on Designing Teaching and Learning

Teaching and learning are complex processes to say the least. There are many learning theories with multitudes of research backing each application of an instructional design process; different learning theories have also been used in different teaching and learning situations. The learning theory needed depends on the chosen learning objectives, the manner in which these learning objectives are attained, the content taught, the instructor's teaching philosophy, and any other educational experience environmental factors, such as class size, student audience and its motivation, and technology access.

Throughout this review of the literature, several learning theories have been discussed. Examples of these theories include pedagogy, andragogy, heutagogy, cognitivism, constructivism, connectivism, as well as the learning theories behind Bloom's taxonomies of educational objectives and Fink's taxonomy of significant learning. However, the most important distinction is that although instructional design is a way of systematically developing instruction, it is only a process that moves from design theory to practice. It does not specifically follow any learning theory per se. The learning theories used during the process of instructional design should align with the content, learning objectives, and teaching philosophies, not a derivative from the process wherein they were designed. Therefore, instructional design, much like teaching, should be seen as an art, a craft, and a science. Instructional design should be and can be used with all epistemologies and most learning theories. Yet, the history of instructional design still does stem from behaviorist principles and practices.

CHAPTER 3 - METHODS

This chapter outlines the details of the quantitative approach used for this particular research study. It explains the setting in which the study was conducted, the research design, the data collection methods, and the data analyses. The interpretation of the data is based on the perspective of the educational researcher, and thus, that interpretation frames the research (Merriam, 2009). Therefore, a brief description of the positionality is included. Although it was unusual to include positionality with a quantitative study, this research study was conducted because the researcher's experiences drove the origination of the research questions; these questions were not derived from a literature review. The researcher indeed hoped to inspire future quantitative research on educational technology use and student ratings of instruction.

Context of the Study and Its Participants

The small liberal arts university where this study took place employs approximately 100 full-time faculty members, 200 adjunct instructors, and serves 1,800 full-time students annually. These students focus on academics; yet have the flexibility to also be engaged with student organizations, athletics, and the larger community through classroom activities, degree requirements, and service learning projects.

The Setting

During the time period of this research study, August 2012 through December 2014, 45 undergraduate and 5 graduate programs were being offered. There were 10,433 student enrollments at the university and 192 were at graduate level (see Table 3-1).

Table 3-1

Student Enrollment in Courses per Term between August 2012 and December 2014

Term	Enrollment
Fall 2012	2,232
Spring 2013	2,057
Fall 2013	2,129
Spring 2014	1,951
Fall 2014	2,064
Total	10,433

Technology Available At the University

Technology hardware and software available at this university throughout the study remained relatively the same in classrooms, computer labs, and instructors' offices. Although technological consistency was not controlled in this study, there were classrooms without technology that were upgraded in order to have the same technology available and to function similarly during the time period of the study.

The Typical Classroom

A typical classroom at this university holds approximately 22 students. Marker boards were available in each classroom. Almost all classrooms were fitted with basic technology available at an instructor station. Those with a full technology setup offered a computer, a hook-up for a laptop, a projector, a document camera, an interactive whiteboard, and a DVD/VCR player. A switcher box on the instructor's desk controlled the display for each piece of the technology. As with any university, not all classrooms were exactly the same; however, this description did fit almost every classroom on campus.

Class Size

During the timeline of this research, class sizes ranged from 1 to 52 students. The average class size was approximately 16 students with a median class size of 16 and a modal class size of 20.

Study Participants

The participants in the study included the entire student body, as they all responded to the *Student Reactions to Instruction and Courses* survey at the conclusion of each course between August 2012 and December 2014. Participants in this study included the student body for every course offered for credit during the five semesters of the study. There were a total of 10,433 enrollments in university courses during these five semesters and a total of 34,480 survey responses were collected from an unknown number of different students due to survey anonymity and the possibility of multiple course enrollments. To explain further, students were likely enrolled over multiple semesters. It is accurate to say, however, that a total of 34,480 survey responses were analyzed in this study. The students at the university are described by the data presented in Table 3-2 (gender by semester), Table 3-3 (age by semester), Table 3-4 (ethnicity by semester), and Table 3-5 (residency by semester).

Table 3-2

Institutional Gender Demographics by Semester

	Semester				
Gender	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014
Females	59%	58%	58%	56%	54%
Males	41%	42%	42%	44%	46%

Table 3-3

Institutional Age Demographics by Semester

Student Age	Semester				
	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014
Up to 24	70.8%	70.5%	72.5%	71.8%	72.50%
25-30	12.9%	12.4%	11.6%	12.6%	11.60%
31-40	9.5%	9.8%	9.1%	9.2%	9.10%
Over 40	6.8%	7.3%	6.8%	6.4%	6.80%

Table 3-4

Institutional Ethnicity Demographics by Semester Based on Those Who Designated Ethnicity

Ethnicity	Semester				
	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014
White	81.5%	74.5%	80.5%	73.5%	79.9%
Black/African American	8.3%	7.6%	8.5%	7.6%	8.8%
American/Alaskan Native	0.5%	0.3%	0.5%	0.4%	0.3%
Asian	2.9%	2.8%	3.5%	3.2%	3.2%
Hispanic	3.1%	3.6%	3.2%	3.5%	4.3%
Hawaiian/Pacific Islander	0.3%	0.2%	0.2%	0.1%	0.1%
2 or more ethnicities	3.4%	3.5%	3.6%	3.1%	3.4%

Table 3-5

Institutional Residency Demographics by Semester

	Semester				
Residency	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014
International students	1.5%	1.3%	1.5%	1.3%	1.7%
In-state students	85.8%	87.1%	86.1%	85.8%	84.5%
Out-of-state students	12.7%	11.6%	12.4%	12.9%	13.8%

In sum, this university has a higher percentage of females enrolled than males (Table 3-2). The majority of students enrolled in courses were between the ages of 18 and 24 (Table 3-3). Diversity in ethnicity had Caucasians as the highest percentage and Black/African American as the next highest group (Table 3-4). Not all of the students were from the local state. Some international and out-of-state students attended due to opportunities in different academic majors, heritage, leadership programs, and sports (Table 3-5).

Research Design

Educational research has become increasingly important as a contributor when cultivating evidence-based research on teaching and learning (Crawford, 2014) including educational technology use. Correlational studies are used in educational research because they can determine if a relationship exists and "the strength and direction of the relationship between two variables" (Remler & Van Ryzin, 2015, p. 262). Two variables can be very different, and yet the correlation permits comparisons as a unit-free measure. Relationships were presented as a positive relationship (an agreement or dependence between the variables), no relationship (an independence between variables), or a negative relationship (a disagreement between variables); but did not address causation of the relationship (Remler & Van Ryzin, 2015). In other words, correlational studies can suggest a relationship exists, but cannot prove one variable causes a change in another.

Data Collection Methods

Data was gathered from the spring through the fall semesters, from August 2012 through December 2014 (a total of five semesters) using the IDEA Center's diagnostic survey instrument titled *Student Reactions to Instruction and Courses* (see Appendix A), referred to here forward as the Survey. During these five semesters, the Survey instrument did not change.

Students were given the Survey near the end of their courses in a paper and pencil format. Once the Survey was distributed, the instructors excused themselves from the classroom. Upon completion, either a student or a proctor sealed the surveys in an envelope and signed the seal. The signed envelope was returned to the institutional data collector, a staff member. Surveys were organized as instructed by the IDEA Center and then mailed to the IDEA Center for processing. Each semester the data was returned in a summary format per each section of a course as well as original student surveys to the institutional data collector. The institutional data collector re-packaged the results and the original surveys and forwarded these packages to the instructors as feedback. Because the IDEA Center analyzed the data for the institution and the instructors, they kept copies of the raw data in digital form. The university was able to purchase the raw data by semester for a nominal fee of $25 per semester.

In this study, the survey scores were unadjusted and were not viewed through the perspective of any particular course. All five semesters of data were compiled en masse, and all identifiable information was removed to protect the students and instructors from any possibility of being identified.

The Data Collection Instrument

The Survey was used as the major data collection instrument in this study. It included 47 standard items grouped into seven different sections (as presented in Appendix A). In the first section, students rated the instructor's teaching methods. The second section consisted of student ratings on their progress toward learning objectives. The third, fourth, and fifth sections referred to additional instructional elements of the course, referred herein as "global elements" since they were the *overall aspects* of a particular course (e.g. "Overall, I rate this course as excellent;" and "The instructor expected students to take their share of responsibility for learning"). There was a sixth section that allowed instructors to add additional items. Lastly, the seventh section gave students room to make open-ended comments. Because both the sixth and seventh sections were not standardized across the university, they were not a part of this research study.

All of the sections in the Survey used rating scales known as Likert-type items, not Likert scales. Likert scales were originally developed as a technique to measure attitudes more precisely (Likert, 1932) and behaviors. A Likert scale is a multi-item scale, not a single item. The Likert scale was created to be a series of eight or more items that used the same rating scale for statistical analysis as a group using parametric analysis (Boone & Boone, 2012; Jamieson, 2004). On the other hand, a Likert-type item is a single item that consists of two parts: 1) a statement of an attitude and 2) a scale on which participants express their agreement with that statement. Over time, this measurement technique gained in popularity. Then, use of non-parametric statistical analysis for individual Likert-type items was researched, disputed, and researched further, and it built its own foundation in the literature (Boone & Boone, 2012; Jamieson, 2004).

The 5-point rating scales for the Survey for the current study were ordinal since there was a clear order, and the ratings were not equidistant as the numerical identifiers were arbitrary. Each respondent, when completing the Survey, used the numerical identifiers for easy recognition of the response. This research study also used these numerical identifiers for statistical analysis; otherwise, the arbitrational value had no metrical value. This was the case for each of the sections used for this research study. Each section of the Survey instrument is described in detail below.

Teaching Methods

The first section of the Survey, teaching methods, included Items 1 to 20 (see Table 3.6), and had been known to encompass Items 44, 45, 46, and 47 according to Hoyt and Lee (2002). However, this study did not include these last four items as part of the teaching methods because their rating scales do not precisely correspond. In addition, statements such as Item 44 "The instructor used a variety of methods–not only tests–to evaluate student progress on course objectives;" Item 45 "The instructor expected students to take their share of responsibility for learning;" Item 46 "The instructor had high achievement standards in this class;" and Item 47 "The instructor used educational technology (e.g. internet, e-mail, computer exercises, multi-media presentations, etc.) to promote learning," related to teaching strategies, not teaching methods.

Teaching strategies, in the context of this study, were those educational tools used by the instructor, and in the learning environment where the educational experience took place (Marzano, 2001; Trowbridge et al., 2000). Teaching methods, on the other hand, were the different ways instructors presented new content (Gagné, 2005) and the approaches they used to achieve the learning objectives (Trowbridge et al., 2000).

Therefore, for the purpose of this study, "teaching methods" only referred to survey Items 1 to 20. The five ordered response levels for these items were each assigned the numerical value of 1 for "Hardly Ever," 2 for "Occasionally," 3 for "Sometimes," 4 for "Frequently," and 5 for "Almost Always."

Table 3-6

Survey Items 1 to 20—Teaching Methods

Teaching Methods
1. Displayed a personal interest in students and their learning
2. Found ways to help students answer their own questions
3. Scheduled course work (class activities, tests, projects) in ways which encouraged students to stay up to date on their work
4. Demonstrated the importance and significance of the subject matter
5. Formed "teams" or "discussion groups" to facilitate learning
6. Made it clear how each topic fit into the course
7. Explained the reasons for criticisms of students' academic performance
8. Stimulated students to intellectual effort beyond that required by most courses
9. Encouraged students to use multiple resources (e.g. data banks, library holdings, outside experts) to improve understanding
10. Explained course material clearly and concisely
11. Related course material to real life situations
12. Gave tests, projects, etc. that covered the most important points of the course
13. Introduced stimulating ideas about the subject

Teaching Methods cont'd
14. Involved students in "hands on" projects such as research, case studies, or "real life" activities
15. Inspired students to set and achieve goals which really challenged them
16. Asked students to share ideas and experiences with others whose backgrounds and viewpoints differ from their own
17. Provided timely and frequent feedback on tests, reports, projects, etc. to help students improve
18. Asked students to help each other understand ideas or concepts
19. Gave projects, tests, or assignments that required original or creative thinking
20. Encouraged student-faculty interaction outside of class (office visits, phone calls, e-mail, etc.)

Learning Objectives

The student ratings on their progress toward learning objectives, the second section, and encompassed survey Items 21 to 32 (See Table 3.7). The five ordered response levels for these items were each assigned numerical values of 1 for “No apparent progress,” 2 for “Slight progress; I made small gains on the objective,” 3 for “Moderate progress; I made some gains on the objective,” 4 for “Substantial progress; I made large gains on the objective,” and 5 for “Exceptional progress; I made outstanding gains on the objective.”

Table 3-7

Survey Items 21 to 32—Learning Objectives

Learning Objectives
21. Gaining factual knowledge (terminology, classifications, methods, trends)
22. Learning fundamental principles, generalizations, and theories
23. Learning to apply course material (to improve thinking, problem solving and decisions)
24. Developing specific skills, competencies, and points of view needed by professionals in the field most closely related to this course
25. Acquiring skills in working with others as a member of a team
26. Developing creative capacities (writing, inventing, designing, performing in art, music, drama, etc.)
27. Gaining a broader understanding and appreciation of intellectual/cultural activity (music, science, literature, etc.)
28. Developing skill in expressing myself orally or in writing
29. Learning how to find and use resources for answering questions or solving problems
30. Developing a clearer understanding of, and commitment to, personal values
31. Learning to analyze and critically evaluate ideas, arguments, and points of view
32. Acquiring an interest in learning more by asking my own questions and seeking answers

Global Elements

The global instructional elements included sections three, four, and five of the Survey (See Tables 3-8 and 3-9). Section three actually covered the student ratings of course characteristics against other courses the students may have taken at this same university. This section included Items 33, 34, and 35; however, these were not used in this study because they did not explicitly relate to educational technology use.

Section four described students' perceptions of their own "attitudes and behaviors" in the course and were survey Items 36 to 42 (see Table 3.8). For the same reason mentioned earlier, only Items 41 and 42 were used from the section. The five ordered response levels for these items were each assigned numerical values of 1 for "Definitely False," 2 for "More False than True," 3 for "In Between," 4 for "More True than False," and 5 for "Definitely True."

Table 3-8

Survey Items 36 to 42—Global Elements (Attitudes and Behaviors)

Global Elements
36. I had a strong desire to take this course.
37. I worked harder on this course than on most courses I have taken.
38. I really wanted to take a course from this instructor.
39. I really wanted to take this course regardless of who taught it.
40. As a result of taking this course, I have more positive feelings towards this field of study.
41. Overall, I rate this instructor an excellent teacher.
42. Overall, I rate this course as excellent.

Section five refers to the global ratings of outcomes, and students were instructed to mark the response that "…best corresponds to [their] judgment." This section included Items 43 to 47 (See Table 3.9). The five ordered response levels for these items were assigned numerical values of, 1 for "Definitely False," 2 for "More False than True," 3 for "In Between," 4 for "More True than False," and 5 for "Definitely True." All of the items in this section were included in the study.

Table 3-9

Survey Items 43 to 47—Global Elements (Student Judgment)

Global Elements
43. As a rule, I put forth more effort than other students on academic work.
44. The instructor used a variety of methods—not only tests—to evaluate student progress on course objectives.
45. The instructor expected students to take their share of responsibility for learning.
46. The instructor had high achievement standards in this class.
47. The instructor used educational technology (e.g. Internet, e-mail, computer exercises, multi-media presentations, etc.) to promote learning.

In conclusion, this research study analyzed 39 different Likert-type items from the Survey as ordinal data.

<u>Validity and Reliability</u>

The IDEA Center conducted several validity and reliability studies on the scores generated by the *Student Reactions to Instruction and Courses* between 2002 and 2011 (Benton & Li, 2015a; Benton et al., 2015). Validity evidence was gathered by looking at the relations of student ratings to different variables. Other studies offered validity evidence by analyzing the internal structure of the Survey. For example, the relationships between teaching methods and learning objectives were confirmed to be indeed multi-dimensional and interconnected. Such results confirm the assumption that "students are capable of distinguishing how much progress they made on the 12 learning objectives and how frequently the instructor applied each of the 20 teaching methods" (Benton et al., 2015, p.32). Additionally, expert judgments were used to support the validity of the scores generated by the Survey (Benton et al., 2015).

As a result of the IDEA Center's efforts to establish the validity of the scores by the *Diagnostic Form, an* extensive analysis was conducted. Reliability was checked both at the course level and the instructor level (Hoyt & Lee, 2002). At the course level, reliability was studied among four class sizes ranging in sizes between 10 to 14 students, 15 to 34, 35 to 49, and 50+. They used Cronbach's Alpha to establish internal consistency and the Spearman-Brown formula to calculate reliability for the different class sizes. Adequate reliability of student ratings at the class level was demonstrated (Benton et al., 2015).

Once adequate reliability was established at the class level (consistent among students in the same class), reliability was investigated at the instructor level (consistent for an instructor across different classes). From this study, the IDEA Center concluded it needed to change a few items on the *Diagnostic Form* (the specific survey instrument used in this study) going forward (Benton et al., 2015). The reliability studies showed the importance of verifying whether the "aggregated student ratings are consistent enough to be used for making administrative decisions about teaching effectiveness. If average ratings changed dramatically from one class to the next for a given instructor, then summative decisions would be suspect" (Benton et al., 2015, p. 56).

Obtaining validity and reliability established for the Survey allowed for further investigation of inter-correlations of educational technology use with teaching methods, student ratings of progress on learning objectives, self-ratings on other instructional elements, such as attitude and behavior, and global ratings of outcomes.

<u>Summary of Data Collected</u>

A total of 617 course sections were surveyed between August 2012 and December 2014, resulting in over 34,480 individual student responses from a sample size of 10,433 student enrollments. In order to put these numbers into proper perspective, one needs to think about enrollments and institutional systems. For example, students are likely to enroll in multiple courses per semester and may be included in institutional data for multiple years until they graduate or leave the institution. Therefore, the data collected was not by participant, but rather by instance when the Survey was filled out. Each instance was defined as a single response to the Survey.

Of those surveyed, 744 responses did not answer Item 47, "The instructor used educational technology (e.g., Internet, e-mail, computer exercises, multi-media presentations, etc.) to promote learning." This sub-set of the data was retained and used in the descriptive statistical analysis and was not included in the correlational analysis.

Analysis of Data

Analyses were conducted in two ways: 1) descriptive statistical analysis and 2) inferential analysis, including a correlational statistical analysis. The descriptive statistical analyses presented as graphs, pivot tables, and summary statistics, (e.g. proportions and ranges), using Microsoft Excel. The inferential analyses began with the proportion of responses for each rank category (1 for "Definitely False," 2 for "More False than True," 3 for "In Between," 4 for "More True than False," and 5 for "Definitely True") on Item 47 and were compared using Chi-square testing. Next, Goodman-Kruskal's gamma (γ), a measure of rank correlation, was used to investigate whether there was an association between educational technology use (Item 47) and other instructional elements (the other 38 survey items studied). The inferential, including the correlational, statistics were conducted using Minitab 16 statistical software. The final analysis examined the same relationships investigated in the correlational analysis; however, the responses were stratified based on three different class-sizes, namely, small (<15 students); medium (15-34 students); and large (34-49 students).

Descriptive Statistical Analysis

Microsoft Excel formulas and pivot tables were created to summarize the data for each of the Likert-type item answers for all of the 39 survey items reviewed. The tables show the frequency for each rating and the row percentages. Because ordinal rating scales varied on the five survey sections (e.g. teaching methods, learning objectives, and global elements), the data were grouped by survey section.

Inferential Statistical Analysis

To test the first hypothesis, "across the university, educational technology used to promote learning had a high rating," a Chi-square Goodness-of-fit Test was performed to test if the proportions were significantly different for the 5 categories. It was assumed that all five ratings should have the same frequency.

Correlational Statistical Analysis

Hypotheses 2 through 4 examine the relationships using correlational statistics. Goodman-Kruskal's gamma (γ) was used to measure the relationship between the variables. Because the data used for this study was ordinal, contained ties, and was non-parametric (Likert-type items), gamma was the most appropriate correlation coefficient (Sheskin, 2004). Gamma is a cross-tabulation of bivariate analysis used for deciphering relationships of ordinal data gathered from Likert-type items (Wagner, 2015). It is a symmetrical measure of association and a rank correlation coefficient where many instances in the data have the same value or ties, taking them into consideration as a ranking system implies (Sheskin, 2004). This statistical analysis removes many of those ties by assuming they are errors. Due to the removal of these ties, γ also is described as part of a group of statistics known as the proportional reduction in error (Wagner, 2015).

Gamma (γ) ranges from -1 to 1. If there is perfect agreement between the variables, γ will equal 1. If there is perfect disagreement between the variables, γ will equal -1. If the variables are independent in their relationship γ was closer to 0 (Kianifard & Chen, 1999; Wagner, 2015). In other words, a value near -1 indicates a strong negative association, while values close to +1 indicate a strong positive association. If the value is 0 then there is no association and the variables are independent. Since γ has shown the probability that the two variables agree or disagree, it can be interpreted as such. For example, if $\gamma = .60$, then 60% of the "variation in the dependent variable can be explained by the variation in the independent variable" (Wagner, 2015, p. 1161) having shown the relationship between the two variables. Therefore, Item 47 was the independent variable, and the other item being correlated with Item 47 was the dependent variable.

Due the fact this sample size was so large, a total of 34,480 responses, γ was normally distributed (Goodman & Kruskal, 1963); therefore, the correlation coefficient analysis was also followed up on with a test of significance (*z* transform).

Subgroup Analysis—Class Size Rationale

In general, pedagogy differs due to class sizes though most of the literature discusses large class sizes, as if they were an anomaly and needed their own set of best practices (Kokkelenberg et al., 2008; McKeachie & Hofer, 2002). Therefore, specific pedagogical aspects of educational technology use may differ based on class size. Previous IDEA Center research has been undertaken using different class sizes (Hoyt & Lee, 2002), so to keep this study consistent, the same class size categorizes used in previous IDEA

Center studies are used in this study. Therefore, the representation of the data was completed as a single entity (e.g. all responses) and grouped into four class sizes: small (<15 students per class), medium (15 to 34 students per class), large (35 to 49 students per class), and very large (>50 students per class). The small class size dataset included n=7,975 student responses. The medium class size dataset included n=25,175 student responses. The large class size dataset included n=468 student responses. Classes with more than 50 students were not represented in the data analysis because the number of responses (n=119) was too small and likely represented only one very large course offered over multiple semesters. Consequently, only small, medium, and large class sizes were included in this study. They were also the most frequent class sizes found at the university where the study took place over the five semesters analyzed.

Any differences in the relationship between the ratings selected for educational technology use (Item 47) and class size were analyzed using a chi-squared two-way test of homogeneity. The results were then examined for each of the ratings and the three class sizes. This procedure was followed up with a test of two portions to see if there were differences between the class sizes when choosing the more positive rating of "In Between," "More True than False," or "Definitely True." These three ratings had the highest frequency for Item 47. It was important to know if the respondents were selecting the ratings equally or if there was a difference in the selection and thus a difference in their meaning. Finally, Goodman-Kruskal's gamma correlation coefficients were calculated for each of the Survey items for each of the class sizes.

Positionality Statement

Merriam (2009) suggests the researcher should divulge her personal perspective to air any possible biases and help the reader place the study in context and also establish credibility for the educational research and researcher. Even though this study was quantitative it remained important to understand the researcher's lens, known as positionality (Jones, 2006).

The researcher is a woman, a teacher, a mother, and an instructional designer who embraced constructivism and connectivism as her teaching philosophies conducted this research study. She is a licensed Secondary Science Educator in three states, has taught science and faculty development courses in face-to-face, blended, and online formats and has designed many different types of instruction. Continuing her education, she was a graduate student who held graduate assistantships in faculty development centers and worked at integrating educational technology at a research-intensive higher education institution. She is a current professional in the field at a small liberal arts university in the Midwestern United States, the President of the local state chapter of the Distance Learning Association, a speaker at local, national and international conferences, and an active member in many professional associations, including, but not limited to, being a member of the Professional and Organizational Development (POD) Network. As a part of the POD Network, she has engaged in many conversations about student ratings of instruction. Additionally, she has provided expert advice on using 1) educational technology to improve the process of administrating IDEA and 2) the use of IDEA results to improve instruction.

The researcher in this study believes that teaching is a means to expose students to new fields of study, critical thinking, and problem-solving approaches employed in those and related fields. She also believes a liberal arts education affords students experiences outside of their major fields of study as well as the exploration of different interests and passions. It prepares well-rounded students who are prepared to become strong and contributing members in society.

Institutional Review Board

The institutional review boards at both of the higher education institutions where this study took place have reviewed and approved it (See Appendix B). The researcher also completed the Human Participants Protection Education for Research Teams conducted by the National Institute of Health on January 18, 2015.

CHAPTER 4 - RESULTS

The results of the descriptive, inferential and correlational analyses of this study are described below for all the responses in the dataset. Later, the data was stratified by class size and the correlational analyses were repeated and then reported.

Descriptive Statistical Analysis

For each item in the Survey, the frequency and proportion of actual respondents were calculated. Because rating scales varied for the different survey sections, the Survey section grouped the Survey items (e.g. teaching methods, learning objectives, and global elements).

Teaching Methods

Table 4-1 shows that of 34,480 responses, there were over 33,600 answered for each item in the teaching methods section. "Almost Always" was selected more than 55% of the time with the range of percentages being between 55% and 69%. More than 77% of the responses were either "Frequently" or "Almost Always" with the range of frequencies combined between 77% and 90%. Whereas, "Sometimes" had a range of 6% to 12%; "Hardly Ever" and "Occasionally" were combined with a range between 1% and 10%.

Respondents reported the four teaching methods used most often in their coursework included (in order from most often) as Item 17 "Provided timely and frequent feedback on tests, reports, projects etc. to help students improve"; Item 1 "Displayed a personal interest in students and their learning"; Item 4 "Demonstrated the importance and significance of the subject matter"; and Item 12 "Gave tests, projects, etc. that covered the most important points of the course."

The item with the lowest frequency of "Almost Always" and the highest frequency of the "Sometimes" rating was Item 15 "Inspired students to set and achieve goals which really challenged them." The item with the highest frequency in the response categories "Hardly Ever" and "Occasionally" was survey Item 5 "Formed 'teams' or 'discussion groups' to facilitate learning." Students recognized and reported teamwork was addressed least often in more than one section of the Survey instrument. In summary, the respondents indicated they had not *felt inspired* or that the *teams facilitated learning*. Overall, this descriptive data demonstrated variety in teaching methods used throughout the university.

Table 4-1

Cross-tabulation (Count and Row Percentages) of Teaching Methods

Teaching Methods	Ratings 1	2	3	4	5	Total Responses
1. Displayed a personal interest in students and their learning	356 1.06%	720 2.14%	2320 6.88%	7010 20.80%	23291 69.12%	33697 100%
2. Found ways to help students answer their own questions	449 1.33%	1031 3.06%	3129 9.29%	8336 24.74%	20751 61.58%	33696 100%
3. Scheduled course work (class activities, tests, projects) in ways which encouraged students to stay up to date on their work	478 1.42%	907 2.70%	2687 7.99%	7738 23.00%	21830 64.89%	33640 100%
4. Demonstrated the importance and significance of the subject matter	300 0.89%	689 2.05%	2385 7.10%	7371 21.93%	22868 68.03%	33613 100%
5. Formed "teams" or "discussion groups" to facilitate learning	1694 5.04%	1713 5.09%	4068 12.10%	6787 20.18%	19371 57.60%	33633 100%

Teaching Methods Cont'd	Ratings 1	2	3	4	5	Total Responses
6. Made it clear how each topic fit into the course	461	905	2677	7563	22023	33629
	1.37%	2.69%	7.96%	22.49%	65.49%	100%
7. Explained the reasons for criticisms of students' academic performance	832	1270	4079	8226	19202	33609
	2.48%	3.78%	12.14%	24.48%	57.13%	100%
8. Stimulated students to intellectual effort beyond that required by most courses	650	1183	4009	8673	19123	33638
	1.93%	3.52%	11.92%	25.78%	56.85%	100%
9. Encouraged students to use multiple resources (e.g. data banks, library holdings, outside experts) to improve understanding	762	1446	4046	8031	19357	33642
	2.27%	4.30%	12.03%	23.87%	57.54%	100%
10. Explained course material clearly and concisely	785	1278	3222	7547	20796	33628
	2.33%	3.80%	9.58%	22.44%	61.84%	100%
11. Related course material to real life situations	487	880	2712	6758	22787	33624
	1.45%	2.62%	8.07%	20.10%	67.77%	100%
12. Gave tests, projects, etc. that covered the most important points of the course	463	802	2635	7465	22286	33651
	1.38%	2.38%	7.83%	22.18%	66.23%	100%
13. Introduced stimulating ideas about the subject	520	1037	3466	8128	20497	33648
	1.55%	3.08%	10.30%	24.16%	60.92%	100%
14. Involved students in "hands on" projects such as research, case studies, or "real life" activities	1112	1456	3823	7308	19937	33636
	3.31%	4.33%	11.37%	21.73%	59.27%	100%
15. Inspired students to set and achieve goals which really challenged them	914	1487	4187	8347	18683	33618
	2.72%	4.42%	12.45%	24.83%	55.57%	100%

Teaching Methods Cont'd	Ratings 1	2	3	4	5	Total Responses
16. Asked students to share ideas and experiences with others whose backgrounds and viewpoints differ from their own	1168 3.47%	1523 4.53%	3973 11.82%	7331 21.81%	19618 58.36%	33613 100%
17. Provided timely and frequent feedback on tests, reports, projects, etc. to help students improve	830 2.47%	1197 3.56%	3097 9.21%	7304 21.72%	21203 63.05%	33631 100%
18. Asked students to help each other understand ideas or concepts	757 2.25%	1307 3.89%	3921 11.66%	8243 24.52%	19392 57.68%	33620 100%
19. Gave projects, tests, or assignments that required original or creative thinking	683 2.03%	1160 3.45%	3339 9.93%	7573 22.51%	20885 62.08%	33640 100%
20. Encouraged student-faculty interaction outside of class (office visits, phone calls, e-mail, etc.)	1078 3.21%	1461 4.34%	3852 11.45%	7116 21.16%	20125 59.84%	33632 100%

Note. The ratings for these items were as follows: 1–Hardly Ever; 2–Occasionally; 3–Sometimes; 4–Frequently; 5–Almost Always.

Progress on Learning Objectives

Table 4-2 represents the data for the student perceptions of their progress on learning objectives. Each item had over 33,500 out of 34,480 total responses. More than 45% of the responses were "Exceptional progress" for each of the Survey items with a range of 45% to 54%. More than 70% of the responses were either "Substantial progress" or "Exceptional progress" with a frequency ranging between 70% and 82%. "Moderate progress" had a frequency range between 12% and 16%. "No apparent progress" and "Slight progress" were combined for a range between 1% and 8%.

It was understood as well that variety was highly recommended for teaching methods used throughout any course, but it would be unlikely that students showed progress for each of the 12 learning objective's related items. It would have made sense—as the data showed—that some learning objectives would not have been addressed in some courses. Or more simply, students were not able to accomplish certain objectives while taking particular courses. The frequencies of the ratings of the learning objectives were more equally distributed than for the teaching method or global element sections. The combined results of "Substantial progress" and "Exceptional progress" were 70% to 82%, whereas the upper ratings for teaching methods ("Frequently" and "Almost Always") were between 77% and 90%, a 7% to 8% difference in frequency. There were higher percentages for the middle rating "Moderate progress" (between 12% and 16%) for learning objectives than for the middle rating of "Sometimes" for the teaching methods (between 6% and 12%). The bottom of the rating scale recognized less progress for learning objectives ("Slight progress" and "No apparent progress"), and the use of particular teaching methods ("Occasionally" or "Hardly Ever") were less than 13% and 10%, respectively.

Examples of distributions for progress on learning objectives included Item "23. Learning to apply course material (to improve thinking, problem- solving, and decisions)" had the highest proportion for "Exceptional progress." The next two learning objectives had equal frequencies of "Exceptional progress" Item 21 "Gaining factual knowledge (terminology, classifications, methods, trends)" and Item 23 "Learning to apply course material (to improve thinking, problem solving and decisions)." Item 21 was the item with the highest frequency when combining "Exceptional progress and "Substantial progress." After combining the two lowest ratings, "No apparent progress" and "Slight progress," those learning objectives with the highest frequencies were Item 26 "Developing creative capacities (writing, inventing, designing, performing in art, music, drama, etc.)," which had 13%; Item 27 "Gaining a broader understanding and appreciation of intellectual/cultural activity (music, science, literature, etc.)," which had 12%, and Item 28 "Developing skill in expressing myself orally or in writing" which had 11%. Much like the teaching methods, Item 25 "Acquiring skills in working with others as a member of a team" was eighth out of 12 at 11%.

Table 4-2

Cross-tabulation (Count and Row Percentages) of Progress on Learning Objectives

	Ratings					
Progress on Learning Objectives	1	2	3	4	5	Total Responses
21. Gaining factual knowledge (terminology, classifications, methods, trends)	503 1.49%	1217 3.61%	4284 12.72%	9851 29.24%	17831 52.93%	33686 100%
22. Learning fundamental principles, generalizations, and theories	523 1.55%	1334 3.96%	4561 13.55%	9973 29.62%	17274 51.31%	33665 100%
23. Learning to apply course material (to improve thinking, problem solving and decisions)	556 1.66%	1230 3.66%	4304 12.81%	9241 27.51%	18262 54.36%	33593 100%

Progress on Learning Objectives Cont'd	Ratings 1	2	3	4	5	Total Reponses
24. Developing specific skills, competencies, and points of view needed by professionals in the field most closely related to this course	623 1.86%	1325 3.95%	4616 13.77%	9209 27.48%	17738 52.93%	33511 100%
25. Acquiring skills in working with others as a member of a team	1666 4.95%	2279 6.78%	5618 16.71%	8500 25.28%	15564 46.28%	33627 100%
26. Developing creative capacities (writing, inventing, designing, performing in art, music, drama, etc.)	1857 5.53%	2509 7.47%	5546 16.51%	8465 25.19%	15221 45.30%	33598 100%
27. Gaining a broader understanding and appreciation of intellectual/cultural activity (music, science, literature, etc.)	1907 5.68%	2383 7.09%	5242 15.60%	8166 24.31%	15896 47.32%	33594 100%
28. Developing skill in expressing myself orally or in writing	1598 4.75%	2434 7.24%	5402 16.07%	8433 25.09%	15742 46.84%	33609 100%
29. Learning how to find and use resources for answering questions or solving problems	938 2.79%	1961 5.83%	5401 16.06%	9118 27.11%	16212 48.21%	33630 100%
30. Developing a clearer understanding of, and commitment to, personal values	1451 4.32%	2092 6.22%	5367 15.97%	8474 25.21%	16232 48.29%	33616 100%
31. Learning to analyze and critically evaluate ideas, arguments, and points of view	1004 2.98%	1810 5.38%	5019 14.92%	8814 26.19%	17001 50.53%	33648 100%

Progress on Learning Objectives Cont'd	Ratings 1	2	3	4	5	Total Responses
32. Acquiring an interest in learning more by asking my own questions and seeking answers	995 2.96%	1770 5.26%	4996 14.85%	8626 25.65%	17248 51.28%	33635 100%

Note. The ratings for these items were as follows:
1–No Apparent Progress.
2–Slight Progress; I made small gains on this objective.
3–Moderate Progress; I made some gains on this objective.
4–Substantial Progress; I made large gains on this objective.
5–Exceptional Progress; I made outstanding gains on this objective.

Global Elements

The global elements included two sections from the Survey instrument, the global elements for attitudes and behaviors and the global elements for student judgments of the course. Because each sub-group of global elements had its own section on the Survey and differing survey instructions, the data was sectioned to match. However, the data could be combined due to the fact that the rating scales did match each of the global element sections.

"Definitely True" had a frequency range between 35% and 59%, the largest range yet. The combined ratings of "Definitely True" and "More True than False" had a range between 72% and 86%. The middle of the range, "In Between," had frequencies between 11% and 23%; these were the largest ranges and the highest frequencies for the middle of the scale from the entire survey. The combined ratings of "Definitely False" and "More False than True" had a range between 1% and 8%.

Global Elements: Attitudes and Behaviors

In Table 4-3, there were more than 33,500 responses to Items 41 and 42. As supported by evidence, there was no *survey fatigue,* as defined by (Porter, Whitcomb, & Weitzer, 2004), seen in a reduction of the responses as respondents moved through the Survey. Respondents did not leave fewer responses on later survey items than they did on earlier survey items.

The rating "Definitely True" appeared for over 48% of the responses for global elements on attitudes and behaviors. This evidence leads one to believe that respondents were more likely to rate their instructor as an *excellent teacher* (60%), than to rate the course as *excellent* (49%).

Table 4-3

Cross-tabulation (Count and Row Percentages) of Global Elements on Attitudes and Behaviors

Global Elements/ Attitudes and Behavior	Ratings 1	2	3	4	5	Total Responses
41. Overall, I rate this instructor an excellent teacher.	1031	1313	4062	7071	20160	33637
	3.07%	3.90%	12.08%	21.02%	59.93%	100%
42. Overall, I rate this course as excellent.	1247	1608	5714	8665	16307	33541
	3.72%	4.79%	17.04%	25.83%	48.62%	100%

Note. The ratings for the items were as follows: 1 = Definitely False; 2 = More False than True; 3 = In Between; 4 = More True than False; 5 = Definitely True

Global Elements: Student Judgment of the Course

Referring to Table 4-4, Item 43 "As a rule, I put forth more effort than other students on academic work," the respondents rated themselves on the level of work they put forth.

Many responses showed respondents felt as though the efforts they put forth were "In Between" the efforts that their classmates put forth at 24%. This response was very different than any other survey item. The researcher posits that such a response suggests honesty. Item 45 "The instructor expected students to take their share of responsibility for learning" was the highest rated item for this section of the Survey at 86% rating at either "More True than False" or "Definitely True." Item 47 "The instructor used educational technology (e.g., Internet, e-mail, computer exercises, multi-media presentations etc.) to promote learning" was the most highly answered item on the Survey with more than 33,700 of the total 34,480 responses.

Table 4-4

Cross-tabulation (Count and Row Percentages) of Global Elements on Student Judgment of the Course

Global Elements/ Student Judgment	Ratings 1	2	3	4	5	Total Responses
43. As a rule, I put forth more effort than other students on academic work.	310	936	8029	12282	12049	33606
	0.92%	2.79%	23.89%	36.55%	35.85%	100%
44. The instructor used a variety of methods—not only tests--to evaluate student progress on course objectives.	769	1445	5658	10537	15216	33625
	2.29%	4.30%	16.83%	31.34%	45.25%	100%
45. The instructor expected students to take their share of responsibility for learning.	196	463	3919	9771	19259	33608
	0.58%	1.38%	11.66%	29.07%	57.30%	100%
46. The instructor had high achievement standards in this class.	327	656	4765	10220	17674	33642
	0.97%	1.95%	14.16%	30.38%	52.54%	100%

Global Elements/ Student Judgment cont'd	Ratings					Total Responses
	1	2	3	4	5	
47. The instructor used educational technology (e.g., Internet, e-mail, computer exercises, multi-media presentations etc.) to promote learning.	602 1.78%	1026 3.04%	4673 13.85%	8597 25.48%	18839 55.84%	33737 100%

Note. The ratings for the items were as follows: 1 = Definitely False; 2 = More False than True; 3 = In Between; 4 = More True than False; 5 = Definitely True

An Inferential and Correlational Statistical Analysis

Inferential statistics allowed for the gathering of a sample of data to statistically support an inference about a particular group (Remler & Van Ryzin, 2015). The first sub-group, derived by stratifying the five ratings for Item 47, was analyzed. A chi-squared goodness-of-fit test was conducted to determine if the observed proportions differed across the responses to each of the five responses. Next, to determine which items on the Survey were associated with *educational technology use* (Item 47), Goodman Kruskal's gamma (γ), a correlation coefficient, was computed.

A Chi-squared Goodness-of-Fit Test for Item 47

A chi-squared goodness of fit test for *educational technology use* (Item 47) was conducted to determine if there was a difference in perception for the ratings across all five responses. This test expected the proportions of all five ratings to receive the same number of responses (or .2). The graph in Figure 4-1 represents the measure of difference between the expected and the observed proportions for five possible responses. The observed proportions for Item 47 were "Definitely False" = .17; "More False than True" =

.15; "In Between" = .02; "More True than False" = .02; and "Definitely True" = .65. The test was statistically significant (p<.01).

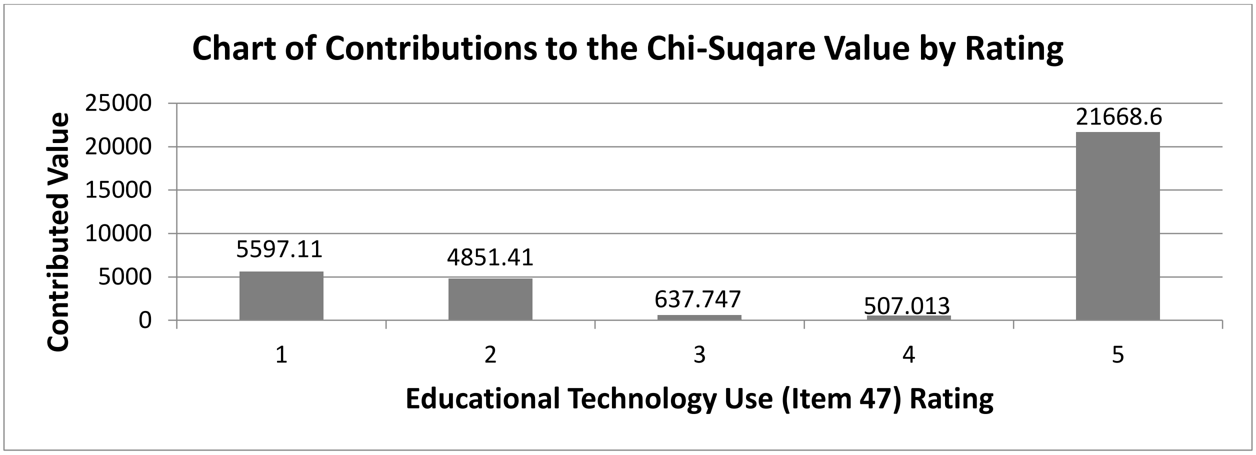

Figure [illegible] Contributions to the Chi-squared Value on Educational Technology Use Using **a** Likert-type Rating

Note. The ratings were as follows: 1 = Definitely False; 2 = More False than True; 3 = In Between; 4 = More True than False; 5 = Definitely True.

This analysis indicates there was a significant difference in the responses for "Definitely True" compared to the other four indicators; furthermore, Table 4-9 shows the frequency of responses as "Definitely True" (58.87%), was significantly larger than the frequencies of the other four ratings for Item 47. The chi-squared test indicated "In Between" and "More True than False" contributed little to the perception of educational technology use. Where Table 4-9 showed that "More True than False" had a proportion of 25%, the remaining three ratings when combined had 19%. Note that "Definitely False" and "More False than True" made up less than 5% of those responses. This scenario indicates the students did perceive a high utilization of educational technology in their courses.

A Correlational Statistical Analysis

Goodman Kruskal's gamma (γ) was computed between educational technology use (Item 47) and other instructional elements from the Survey. The results are summarized in Tables 4-6, 4-7, and 4-8, organized as the same survey sections as the descriptive statistics. The items have been listed in their order of correlational strength with corresponding descriptions of strength (Table 4-5). The strength of the correlation coefficients for γ (which are quite different than those for Pearson's *r*) was more conservative than in the current literature. For example, one resource used 0 to .19 as weak, .2 to .39 as moderate, and above .4 as strong (Gau, 2016); a different study used 0 to .2 as weak, .3 to .5 moderate, .5 to .7 strong and > .7 very strong (Babbie, Halley, & Zaino, 2007). Correlation descriptions can largely be seen as arbitrary, however, and depend upon the gathered data to define them. When study trends show higher measures of association, they are likely to use a more moderate description of strength. Based on the correlation coefficients calculated for this research study, the strength of correlation resembled a more conservative description as shown in Table 4-5.

Table 4-5

Correlation Strength Using Goodman-Kruskal's γ

Range of γ	Description
.60-1.0	Strong Relationship
.50-.59	Moderate Relationship
0-.49	No to Weak Relationship

In Table 4-6, γ was calculated for *educational technology use* (Item 47) for each of the teaching methods. This table shows the correlation using all responses in the dataset with the exception of those who did not answer Item 47 or the correlated teaching method. Results were then sorted by γ. The values of γ indicating a strong correlation (>.60) and a weak correlation (<.50) were boldfaced. The range of correlation coefficients varied between .49 and .63 for Item 47 and teaching methods with 12 having a strong correlation, seven having a moderate relationship, and only one showing as weak. The data indicated that team-based items on the Survey instrument were on the weaker end of the scale in their correlations with educational technology use (Item 47).

Table 4-6

Educational Technology Use (Item 47) and Teaching Methods (Items 1 to 20) —All Responses

Teaching Method	γ
1. Displayed a personal interest in students and their learning	**.63**
4. Demonstrated the importance and significance of the subject matter	**.62**
13. Introduced stimulating ideas about the subject	**.62**
2. Found ways to help students answer their own questions	**.61**
6. Made it clear how each topic fit into the course	**.61**
19. Gave projects, tests, or assignments that required original or creative thinking	**.61**
3. Scheduled course work (class activities, tests, projects) in ways which encouraged students to stay up to date on their work	**.60**
9. Encouraged students to use multiple resources (e.g. data banks, library holdings, outside experts) to improve understanding	**.60**
10. Explained course material clearly and concisely	**.60**
11. Related course material to real life situations	**.60**
12. Gave tests, projects, etc. that covered the most important points of the course	**.60**
20. Encouraged student-faculty interaction outside of class (office visits, phone calls, e-mail, etc.)	**.60**
15. Inspired students to set and achieve goals which really challenged them	.59
8. Stimulated students to intellectual effort beyond that required by most courses	.58
7. Explained the reasons for criticisms of students' academic performance	.57

Teaching Method cont'd	γ
14. Involved students in "hands on" projects such as research, case studies, or "real life" activities	.57
17. Provided timely and frequent feedback on tests, reports, projects, etc. to help students improve	.57
18. Asked students to help each other understand ideas or concepts	.57
16. Asked students to share ideas and experiences with others whose backgrounds and viewpoints differ from their own	.55
5. Formed "teams" or "discussion groups" to facilitate learning	**.49**

Table 4-7 displays the correlation coefficients for the Survey items' focusing on the relationship between *educational technology use* (Item 47) and student perspectives of progress on learning objectives (Items 21 to 32). Responses that were not included as answer for Items 21 to 32 or Item 47 could not be included in the calculation of γ. The results were then sorted by γ. Those with values of γ, thus indicating a strong correlation (>.60) and a weak correlation (<.50) were boldfaced. Unlike the teaching methods, the range of γ was between .51 and .60. That being said, there was only one learning objective with a strong correlation to Item 47; all others were moderate. Again, the theme revolved around the more moderate correlation between educational technology use (Item 47) and teams, such as for learning objective Item 25 "Acquiring skills in working with others as a member of a team."

Table 4-7

Educational Technology Use (Item 47) and Learning Objectives (Items 21 to 32)—All Responses

Learning Objective	γ
23. Learning to apply course material (to improve thinking, problem solving and decisions)	**.60**
24. Developing specific skills, competencies, and points of view needed by professionals in the field most closely related to this course	.59
21. Gaining factual knowledge (terminology, classifications, methods, trends)	.58
29. Learning how to find and use resources for answering questions or solving problems	.58
32. Acquiring an interest in learning more by asking my own questions and seeking answers	.58
22. Learning fundamental principles, generalizations, and theories	.57
31. Learning to analyze and critically evaluate ideas, arguments, and points of view	.57
30. Developing a clearer understanding of, and commitment to, personal values	.55
28. Developing skill in expressing myself orally or in writing	.53
26. Developing creative capacities (writing, inventing, designing, performing in art, music, drama, etc.)	.52
27. Gaining a broader understanding and appreciation of intellectual/cultural activity (music, science, literature, etc.)	.52
25. Acquiring skills in working with others as a member of a team	.51

The global elements (Items 41 to 46) had a different feel altogether in their relationships to *educational technology use* (Item 47). Because the statements were "global," students were truly being asked to rate their overall *attitudes, behaviors, and judgments* toward these survey items. The statement of each item was written so students felt they had ownership of it rather than just marking a perception of their instructors' methods or progress on learning objectives that may or may not have been identified throughout delivery of the course.

Table 4-8 offers a range of correlation coefficients between .47 and .77. All indicate either a strong or a weak correlation. There were no correlation coefficients for global elements in the moderate range. The data show respondents in courses where there was higher educational technology use perceived instructors as having higher expectations for responsibility (Item 45 "The instructor expected students to take their share of responsibility for learning"), achievement (Item 46 "The instructor had high achievement standards in this class"), and variety of assessment techniques (Item 44 "The instructor used a variety of methods—not only tests—to evaluate student progress on course objectives"). On the other hand, there was a weak relationship between the level of educational technology use and self-reported student efforts on their work (Item 43 "As a rule, I put forth more effort than other students on academic work").

Table 4-8

Educational Technology Use (Item 47) and Global Elements (Items 41 to 46)—All Responses

Global Elements	γ
45. The instructor expected students to take their share of responsibility for learning.	**.77**
46. The instructor had high achievement standards in this class.	**.77**
44. The instructor used a variety of methods—not only tests--to evaluate student progress on course objectives.	**.76**
41. Overall, I rate this instructor an excellent teacher.	**.68**
42. Overall, I rate this course as excellent.	**.62**
No Moderate	
43. As a rule, I put forth more effort than other students on academic work.	**.47**

When comparing Table 4-6—teaching methods, Table 4-7—learning objectives, and Table 4-8—global elements, a difference was noted in correlation ranges. All teaching method correlations had a range between .49 and .63. Whereas the learning objectives had a narrower range between .51 and .60, the global elements had a wide range from .47 to .77

Test of Significance

Due to the fact that this study used a large sample, γ was normally distributed, and therefore, the correlation coefficient analysis was followed by a test of significance (z). In good faith, the smallest correlation coefficient was tested for significance γ= .34, z=3.2, $p<.001$. The correlation coefficient tested, γ= .34, can be found in Table 4-12, Item 5. Because the test statistic (z) was above the critical value for a two-tailed test (z=3.2 which was larger than 2.58) $p<.01$, it was assumed that all γ were statistically significant at $p<.01$ for z.

Sub-group Analysis

In this research study, stratifying the original correlational data further by class size created the groups analyzed further. There were three class sizes included in this research study: small classes with less than 15 students; medium classes with 15 to 34 students; and large classes with 35 to 49 students. By including five semesters of data, the results helped to outline the operational definitions of the inferences discovered for the three different class sizes.

In total, four additional analyses were conducted on the sub-groups for class size. Descriptive statistics were included for *educational technology use* (Item 47) for the three class sizes. A chi-squared, two-way test of homogeneity was conducted to identify whether or not the distributions of the responses to Item 47 were the same for each class size. A test of two proportions further identified the significance of the difference in proportions between the ratings “In Between,” “More True than False,” and “Definitely True” for the three class sizes. Finally, correlation coefficients were repeated for each of the class sizes. Correlation coefficients were calculated for each survey item individually to view the correlation coefficients in all three class-sizes at once.

Descriptive Statistics (Cross-tabulation) for Educational Technology Use and Class Size

Educational technology has been known to influence classroom pedagogy. However, instructor-chosen pedagogies also can differ based on class size.

Table 4-9 is a quick overview of the counts and row percentages for each of the ratings on Item 47 for each of the three class sizes: small (<15 students per class), medium (15 to 34 students per class), and large (35 to 49 students per class). This research study continued to look at the relationships of educational technology to teaching methods, learning objectives, and global aspects, as influenced by class size.

Table 4-9 shows a decrease in frequency in "Definitely True" as one moved from small to large class size for Item 47. Directly related, there was an increase in frequency for "More True than False" from small to large. The other three ratings, when combined, did not add up to a total frequency of 25% for any of the class sizes. The proportions calculated for each of the class sizes remained quite similar to the proportions for the "Combined Class Sizes." Thus, one might infer, the use of technology may not have been dependent on class size. However, a chi-square, two-way test of homogeneity verified this inference.

Table 4-9

Cross-tabulation (Count and Row Percentages) for Item 47 and Class Sizes

Class Size	Ratings 1	2	3	4	5	All Responses
Small	109	210	938	1969	4749	7975
	1.37%	2.63%	11.76%	24.69%	59.55%	100%
Medium	482	799	3630	6467	13797	25175
	1.91%	3.17%	14.42%	25.69%	54.80%	100%
Large	7	13	84	128	236	468
	1.50%	2.78%	17.95%	27.35%	50.43%	100%
Combined Class Sizes	598	1022	4652	8564	18782	33618
	1.78%	3.04%	13.84%	25.47%	58.87%	100%

Note. The ratings for Item 47 were as follows: 1 = Definitely False; 2 = More False than True; 3 = In Between; 4 = More True than False; 5 = Definitely True. The three class sizes were defined as: small (<15 students per class), medium (15 to 34 students per class), and large (35 to 49 students per class).

Chi-squared Two-way Test of Homogeneity

The previous table (Table 4-9) implies there was no difference in the use of educational technology for the different class sizes. To be sure, this difference was in fact true, whether or not the distributions of responses to Item 47 were the same for each class size was examined. The chi-squared, two-way test of homogeneity helped decipher and determine the proper conclusion (Table 4-10). These results showed a statistical significance with p= .000. There was, therefore, an obvious difference in the distributions of the ratings compared to class size.

Table 4-10

Chi-squared Two-way Test of Homogeneity for Class Sizes

	Ratings					
Class Size	1	2	3	4	5	All Responses
Small	109	210	938	1969	4749	7975
Contribution to Chi-sq	7.612	4.341	24.840	1.928	19.328	*
Medium	482	799	3630	6467	13797	25175
Contribution to Chi-sq	2.610	1.481	6.146	0.451	5.106	*
Large	7	13	84	128	236	468
Contribution to Chi-sq	0.211	0.106	5.715	0.647	2.480	*
All	598	1022	4652	8564	18782	33618
Contributions to Chi-sq	*	*	*	*	*	*

Likelihood ratio chi-squared = 84.284, DF=8, p-value=0.000

Note. The ratings used for these items were as follows: 1=Definitely False; 2= More False than True; 3= In Between; 4= More True than False; 5 = Definitely True.

Which of the distributions of responses were different and why? A test of two proportions helped pinpoint where these differences appeared.

Test of Two Proportions

This research study further investigated the differences in proportions between the ratings "In Between," "More True than False," and "Definitely True" for the small, medium, and large class sizes. The differences found when performing these tests contributed to the differences identified between the correlation coefficients. The portions used for the tests were independent because they were from different sub-samples or class sizes. Therefore, when comparing small and medium class sizes, a significant difference was found in the proportions for "In Between" (p=.000) and "Definitely True" (p=.000). The next comparison was conducted between medium and large class sizes. There was a significant difference for the rating “In Between” (p=.048). Finally, comparisons between small and large class sizes were conducted. A significant difference was found for the rating “In Between” (p=.001) and the rating “Definitely True” (p=.000). Table 4-11 presents this data in a summarized format. However, in the table, it is not evident that the majority of difference identified in the tests of two proportions for the three tested ratings for Item 47 came between the small and the large class sizes.

Table 4-11

Summary of Tests for Two Proportions for Item 47

		Class Size	
Class Size	Rating	Small	Medium
Medium	3	Difference	X
	4	No difference	
	5	Difference	
Large	3	Difference	Difference
	4	No difference	No difference
	5	Difference	No difference

Note. 3 = “In Between”; 4 = “More True than False”; 5 = “Definitely True”.

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Educational Technology Use and Teaching Methods for Each Class Size

Goodman-Kruskal’s γ was calculated for *educational technology use* (Item 47) and each of the teaching methods (Items 1 to 20). This grouped organization allowed for comparison across a single class size for all teaching methods.

Table 4-12 displays the results according to the strength of the relationship between *educational technology use* and the teaching methods. This table shows the correlation using all responses from small classes (<15 students) in the dataset. A total of 7,975 responses were included in this small class-size analysis. All instances of γ > .60 had a strong correlation and are boldfaced. Indeed, 12 of the 20 teaching methods showed a strong correlation in small class sizes, leaving six of the teaching methods with a moderate correlation. None of the teaching methods showed a weak correlation. Note, once again, the correlation coefficient for Items 47 and 5 (*using teams)* was the lowest.

Table 4-12

Educational Technology Use (Item 47) and Teaching Methods (Items 1 to 20)—Small Class Size (<15 Students)

Teaching Methods	γ
4. Demonstrated the importance and significance of the subject matter	**.65**
1. Displayed a personal interest in students and their learning	**.64**
13. Introduced stimulating ideas about the subject	**.64**
6. Made it clear how each topic fit into the course	**.62**
9. Encouraged students to use multiple resources (e.g. data banks, library holdings, outside experts) to improve understanding	**.62**
19. Gave projects, tests, or assignments that required original or creative thinking	**.62**
3. Scheduled course work (class activities, tests, projects) in ways which encouraged students to stay up to date on their work	**.61**
11. Related course material to real life situations	**.61**
12. Gave tests, projects, etc. that covered the most important points of the course	**.61**
15. Inspired students to set and achieve goals which really challenged them	**.61**
20. Encouraged student-faculty interaction outside of class (office visits, phone calls, e-mail, etc.)	**.61**
2. Found ways to help students answer their own questions	**.60**
10. Explained course material clearly and concisely	**.60**
14. Involved students in "hands on" projects such as research, case studies, or "real life" activities	**.60**
7. Explained the reasons for criticisms of students' academic performance	.58
8. Stimulated students to intellectual effort beyond that required by most courses	.58

Teaching Methods con’td	γ
17. Provided timely and frequent feedback on tests, reports, projects, etc. to help students improve	.58
18. Asked students to help each other understand ideas or concepts	.58
16. Asked students to share ideas and experiences with others whose backgrounds and viewpoints differ from their own	.57
5. Formed "teams" or "discussion groups" to facilitate learning	.51

Table 4-13 shows the correlation between Item 47 and all responses from medium size classes (15 to 34 students) in the dataset. A total of 25,175 responses were included. The results were then sorted by γ. Those with a strong correlation (>.60) and a weak correlation (<.50) were boldfaced. Indeed, seven teaching methods showed a strong correlation with Item 47 for medium class sizes, 12 were moderate, and one was weak. Note the weakest correlation was between Item 47 and *teamwork*.

Table 4-13

Educational Technology Use (Item 47) and Teaching Methods (Items 1 to 20)—Medium Class Size (15-34 Students)

Teaching Methods	γ
1. Displayed a personal interest in students and their learning	**.62**
4. Demonstrated the importance and significance of the subject matter	**.62**
19. Gave projects, tests, or assignments that required original or creative thinking	**.62**
2. Found ways to help students answer their own questions	**.61**
6. Made it clear how each topic fit into the course	**.61**
13. Introduced stimulating ideas about the subject	**.61**
11. Related course material to real life situations	**.60**
3. Scheduled course work (class activities, tests, projects) in ways which encouraged students to stay up to date on their work	.59
9. Encouraged students to use multiple resources (e.g. data banks, library holdings, outside experts) to improve understanding	.59

Teaching Methods cont'd	γ
10. Explained course material clearly and concisely	.59
12. Gave tests, projects, etc. that covered the most important points of the course	.59
20. Encouraged student-faculty interaction outside of class (office visits, phone calls, e-mail, etc.)	.59
15. Inspired students to set and achieve goals which really challenged them	.58
8. Stimulated students to intellectual effort beyond that required by most courses	.57
17. Provided timely and frequent feedback on tests, reports, projects, etc. to help students improve	.57
7. Explained the reasons for criticisms of students' academic performance	.56
14. Involved students in "hands on" projects such as research, case studies, or "real life" activities	.56
18. Asked students to help each other understand ideas or concepts	.56
16. Asked students to share ideas and experiences with others whose backgrounds and viewpoints differ from their own	.54
5. Formed "teams" or "discussion groups" to facilitate learning	**.48**

The following is Table 4-14, which shows the correlation between Item 47 and all responses from large classes (35 to 49 students) in the dataset. A total of 468 responses are included. This table shows the correlation, using responses from large classes (35 to 49 students) in the dataset sorted by γ. Those with a strong correlation (>.60) and a weak correlation (<.50) with educational technology were boldfaced. For large class sizes, eight were teaching methods strongly correlated with Item 47, 11 moderately correlated, and one weakly correlated. The relationship between *teamwork* and *educational technology use* as the most weakly correlated was more obvious than ever in large classes.

Table 4-14

Educational Technology Use (Item 47) and Teaching Methods (Items 1 to 20)—Large Class Size (35-49 Students)

Teaching Methods	γ
13. Introduced stimulating ideas about the subject	**.64**
4. Demonstrated the importance and significance of the subject matter	**.63**
11. Related course material to real life situations	**.63**
20. Encouraged student-faculty interaction outside of class (office visits, phone calls, e-mail, etc.)	**.63**
19. Gave projects, tests, or assignments that required original or creative thinking	**.61**
3. Scheduled course work (class activities, tests, projects) in ways which encouraged students to stay up to date on their work	**.60**
6. Made it clear how each topic fit into the course	**.60**
15. Inspired students to set and achieve goals which really challenged them	**.60**
1. Displayed a personal interest in students and their learning	.59
10. Explained course material clearly and concisely	.58
12. Gave tests, projects, etc. that covered the most important points of the course	.58
17. Provided timely and frequent feedback on tests, reports, projects, etc. to help students improve	.58
2. Found ways to help students answer their own questions	.56
7. Explained the reasons for criticisms of students' academic performance	.56
8. Stimulated students to intellectual effort beyond that required by most courses	.56
9. Encouraged students to use multiple resources (e.g. data banks, library holdings, outside experts) to improve understanding	.54
18. Asked students to help each other understand ideas or concepts	.52
16. Asked students to share ideas and experiences with others whose backgrounds and viewpoints differ from their own	.51
14. Involved students in "hands on" projects such as research, case studies, or "real life" activities	.50
5. Formed "teams" or "discussion groups" to facilitate learning	**.34**

<u>Educational Technology Use for Each Teaching Method and All Class Sizes</u>

Tables 4-15 through 4-34 summarizes the results of a correlational analysis that was performed with the surveys stratified by class size. Each table displays the correlation coefficient, γ, computed for Item 47 and one of the 20 teaching methods organized by class size. This organization allows for a comparison across each teaching method in comparison to class size. The data in Table 4-15 is displayed below with descriptive text whereas Tables 4-16 to 4-34 are offered in Appendix C.

Table 4-15 displays γ for Item 47 and Item 1 for each class size. The small class sizes had a γ of .64, the medium class sizes a γ of .62, and large class sizes a γ of .59. There was a .02 difference in γ between the small and medium class sizes, a .03 difference between the medium and large class sizes, and a .05 difference between the small and large class sizes. These differences were not large differences in terms of whether or not *a personal interest in students and their learning* had been identified. A .05 difference or greater in γ would draw the attention of faculty developers to address a differentiation of teaching methods in class sizes as a topic for development. *Therefore, from this point forward, only those comparisons with a difference of .05 or more will be reported.* They are also presented in a more truncated manner where like items are grouped together based on the data review as done for Item 1.

Table 4-15

Educational Technology Use (Item 47) and Teaching Method (Item 1)—By Class Size

1. [The instructor] Displayed a personal interest in students and their learning.	
Class Size	γ
Small	**.64**
Medium	**.62**
Large	.59
All Responses	**.63**

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

To keep the results for teaching methods concise, there were no differences equal to or greater than .05 for the small to medium class sizes. There were differences in medium to large class sizes for Items 2 (Table 4-16), 5 (Table 4-19), 9 (Table 4-23), and 14 (Table 4-28). There were differences in the small to large class sizes for Items 1 (Table 4-15), 5 (Table 4-19), 9 (Table 4-23), 14 (Table 4-28), 16 (Table 4-30), and 18 (Table 4-32).

Within the teaching methods, there were several items that showed all three class-sizes having strong correlations to Item 47; these were Items 4 (Table 4-18), 6 (Table 4-20), 11 (Table 4-25), 13 (Table 4-27), and 19 (Table 4-33). Others had two class-sizes in the strong range and one in the moderate range; those items were 1 (Table 4-15), 2 (Table 4-16), 3 (Table 4-17), 15 (Table 4-29), and 20 (Table 4-34). The next group had one class size in the strong range and two in the moderate range: Items 9 (Table 4-23), 10 (Table 4-24), 12 (Table 4-26), and 14 (Table 4-28). The items that really stood out were those where all three class-sizes were moderate or less. Those where all three were moderate were Items 7 (Table 4-21), 8 (Table 4-22), 16 (Table 4-30), 17 (Table 4-31), and 18 (Table

4-32). Only one item had two class-sizes in the moderate range and one in the weak; that was Item 5, *teamwork* (Table 4-19).

Educational Technology Use and the Learning Objectives for Each Class Size

Goodman-Kruskal's γ was calculated at each class size for *educational technology use* (Item 47) using each of the learning objectives (Items 21 to 32); results were sorted by γ (Tables 4-35, 4-36, and 4-37). Table 4-35 displays the results according to the strength of the correlation for small class sizes. A total of 7,975 responses were included. Those with a strong correlation (>.60) and a weak correlation (<.50) were boldfaced. There was only one learning objective of 12 that showed a strong correlation in small class sizes. The other 11 were moderately correlated, and none were identified as weak. Indeed, Item 25 "Acquiring skills in working with others as a member of a team" found itself at the bottom of the list again.

Table 4-35

Educational Technology Use (Item 47) and Learning Objectives (Items 21 to 32)—Small Class Size (<15 Students)

Learning Objectives	γ
23. Learning to apply course material (to improve thinking, problem solving and decisions)	**.60**
24. Developing specific skills, competencies, and points of view needed by professionals in the field most closely related to this course	.59
29. Learning how to find and use resources for answering questions or solving problems	.58
32. Acquiring an interest in learning more by asking my own questions and seeking answers	.58
31. Learning to analyze and critically evaluate ideas, arguments, and points of view	.57
21. Gaining factual knowledge (terminology, classifications, methods, trends)	.56
22. Learning fundamental principles, generalizations, and theories	.56
28. Developing skill in expressing myself orally or in writing	.55

Learning Objectives cont'd	γ
30. Developing a clearer understanding of, and commitment to, personal values	.55
26. Developing creative capacities (writing, inventing, designing, performing in art, music, drama, etc.)	.54
27. Gaining a broader understanding and appreciation of intellectual/cultural activity (music, science, literature, etc.)	.54
25. Acquiring skills in working with others as a member of a team	.52

Table 4-36 shows the correlations' identifying the strength of the relationships between *educational technology use* (Item 47) and learning objectives (Items 21 to 32) for the medium class size (15 to 34 students). A total of 25,175 responses were included, and the results were sorted by γ. Those with a strong correlation (>.60) and a weak correlation (<.50) were boldfaced. Much like the small class size, only one of the 12 learning outcomes had a strong correlation. The other 11 were moderate; leaving none with a weak correlation; *working as a team member* sat at the bottom position on the list.

Table 4-36

Educational Technology Use (Item 47) and Learning Objectives (Items 21 to 32)—Medium Class Size (15-34 Students)

Learning Objectives	γ
23. Learning to apply course material (to improve thinking, problem solving and decisions)	**.60**
24. Developing specific skills, competencies, and points of view needed by professionals in the field most closely related to this course	.59
21. Gaining factual knowledge (terminology, classifications, methods, trends)	.58
29. Learning how to find and use resources for answering questions or solving problems	.58
32. Acquiring an interest in learning more by asking my own questions and seeking answers	.58
22. Learning fundamental principles, generalizations, and theories	.57

Learning Objectives cont'd	γ
31. Learning to analyze and critically evaluate ideas, arguments, and points of view	.57
30. Developing a clearer understanding of, and commitment to, personal values	.55
26. Developing creative capacities (writing, inventing, designing, performing in art, music, drama, etc.)	.52
28. Developing skill in expressing myself orally or in writing	.52
27. Gaining a broader understanding and appreciation of intellectual/cultural activity (music, science, literature, etc.)	.51
25. Acquiring skills in working with others as a member of a team	.50

Table 4-37 displays the results according to the strength of the correlation with large classes (35 to 49 students) in the dataset. A total of 468 responses were included. Those with a strong correlation (>.60) and a weak correlation (<.50) were boldfaced. There were six learning objectives that showed a strong correlation in large class sizes, and five of these were moderately correlated. One was identified as weak. This is the last example where *teamwork* demonstrated the weakest correlation.

Table 4-37

Educational Technology Use (Item 47) and Learning Objectives (Items 21 to 32)—Large Class Size (35-49 Students)

Learning Objectives	γ
21. Gaining factual knowledge (terminology, classifications, methods, trends)	**.69**
22. Learning fundamental principles, generalizations, and theories	**.67**
24. Developing specific skills, competencies, and points of view needed by professionals in the field most closely related to this course	**.63**
23. Learning to apply course material (to improve thinking, problem solving and decisions)	**.62**
31. Learning to analyze and critically evaluate ideas, arguments, and points of view	**.61**
32. Acquiring an interest in learning more by asking my own questions and seeking answers	**.61**
29. Learning how to find and use resources for answering questions or solving problems	.59

Learning Objectives cont'd	γ
28. Developing skill in expressing myself orally or in writing	.56
30. Developing a clearer understanding of, and commitment to, personal values	.55
27. Gaining a broader understanding and appreciation of intellectual/cultural activity (music, science, literature, etc.)	.53
26. Developing creative capacities (writing, inventing, designing, performing in art, music, drama, etc.)	.50
25. Acquiring skills in working with others as a member of a team	**.43**

Educational Technology Use for Each Learning Objective and All Class Sizes

Table 4-38 through 4-49 summarizes the results of the correlational analysis that was performed with the surveys stratified by class size. Each table displays the correlation coefficient, gamma, computed for Item 47 and for one of the 12 learning objectives organized by class size. This organization allows for a comparison across each learning objective based on class size. Table 4-38 is shown below in the descriptive text whereas Tables 4-39 to 4-49 are located in Appendix D.

Table 4-38 compares class sizes for Item 21 for the objective of *gaining factual knowledge* and *the use of educational technology* (Item 47) where small class sizes have a γ of .56, medium class sizes a γ of .58, and large class sizes a γ of .69. There was a .02 difference in γ between small and medium class sizes, a .11 difference between medium and large class sizes, and a .13 difference between small and large class sizes. The data suggests that large class sizes *use educational technology* regularly to help students *gain factual knowledge*. Much as for the teaching methods, a .05 difference or greater in γ will draw the attention of faculty developers to include differentiation of learning objectives in different class sizes as a development topic. *Therefore, from this point forward, only comparisons with a difference of .05 or more are reported in a truncated manner.*

Table 4-38

Educational Technology Use (Item 47) and Learning Objectives (Item 21)—By Class Size

21. [Progress on] Gaining factual knowledge (terminology, classifications, methods, trends)	
Class Size	γ
Small	.56
Medium	.58
Large	**.69**
All Responses	.58

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

To keep the results for learning objectives succinct, no differences .05 or greater for small to medium class sizes were noted. There were differences noted for medium-to-large class sizes and small-to-large class sizes for Item 21 (Table 4-38), Item 22 (Table 4-39), and Item 25 (Table 4-42).

Within the learning objectives, there was only one item that showed all three class sizes with strong correlations to educational technology use, namely, Item 23 (Table 4-40). Others had one class size in the strong range and two in the moderate range; those were Items 21 (Table 4-38), 22 (Table 4-39), 24 (Table 4-41), 31 (Table 4-48), and 32 (Table 4-49). The items that really stood out were those where all three class sizes were moderate or less. Those with all three correlations showing as moderate were Items 26 (Table 4-43), 27 (Table 4-44), 28 (Table 4-45), 29 (Table 4-46), and 30 (Table 4-47). Only one item had two class sizes in the moderate range and one in the weak range, namely, Item 25, *teamwork* (Table 4-42).

Educational Technology Use and Global Elements for Each Class Size

Due to the fact that global elements were not considered a group of similar items (e.g. teaching methods or learning objectives), these data were not included as an ordered table in terms of identifying their strength of correlation coefficients. However, each of the global elements, including all class sizes, was addressed (see Tables 4-50 to 4-55) separately.

Educational Technology for Each Global Element and All Class Sizes

The next six tables display an abridged version of the results for the stratified correlational analysis for *educational technology use* and the global elements. *Like the previous results, anything with a difference between class sizes with a correlation of .04 and under is not reported.* Because the different manner of global elements was not so easily grouped, like teaching methods or learning objectives, the detailed data for global elements were not truncated.

Table 4-50 compared class sizes for Item 41 on the element rating the *excellence of the instructor* and the relationship with *educational technology use* (Item 47) where small class sizes had a γ of .66, medium class sizes a γ of .68, and large class sizes a γ of .69. There was little change in differences between these three class sizes. All three class sizes presented very strong correlations with *educational technology use*.

Table 4-50

Educational Technology Use (Item 47) and Global Elements (Item 41)—By Class Size

41. Overall, I rate this instructor an excellent teacher.	
Class Size	γ
Small	**.66**
Medium	**.68**
Large	**.69**
All Responses	**.68**

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-51 compares the class sizes for Item 42 on the element rating of *course excellence* where small class sizes have a γ of .60, medium class sizes a γ of .62, and large class sizes a γ of .71. There was a .09 difference between the medium and large class sizes and a .11 difference between the small and large class sizes. It appears the relationship between *educational technology use* and *perceived course excellence* was affected by the size of the course and the amount of student-faculty interaction.

Table 4-16

Educational Technology Use (Item 47) and Global Element (Item 42)—By Class Size

42. Overall, I rate this course as excellent.	
Class Size	γ
Small	**.60**
Medium	**.62**
Large	**.71**
All Responses	**.62**

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-52 compares the class sizes for *educational technology use* and Item 43 for the element rating *self-reported student effort*. Here small class sizes have a γ of .45, medium class sizes a γ of .48, and large class sizes a γ of .50. There was a .05 difference between the small and large class sizes. *Self-reported student effort* had the weakest correlations of all the global elements for the range between the weak and lower moderate zones.

Table 4-17

Educational Technology Use (Item 47) and Global Element (Item 43)—By Class Size

43. As a rule, I put forth more effort than other students on academic work.	
Class Size	γ
Small	**.45**
Medium	**.48**
Large	.50
All Responses	**.47**

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-53 compares class sizes for item 44 on the element rating *variety in assessments on progress toward course objectives* with all class sizes having a γ of .76. The strength of the relationship between *assessment I'm progressing toward course objectives* and *educational technology use* was impressive.

Table 4-18

Educational Technology Use (Item 47) and Global Element (Item 44)—By Class Size

44. The instructor used a variety of methods—not only tests—to evaluate student progress on course objectives.	
Class Size	γ
Small	**.76**
Medium	**.76**
Large	**.76**
All Responses	**.76**

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-54 compares class sizes for Item 45 on the element rating *instructor expectations of student responsibility for learning* where the small and medium class sizes had a γ of .77, and large class sizes a γ of .79. The strength of the relationship between *instructor expectations of student responsibility for learning* and *educational technology use* was also strong.

Table 4-19

Educational Technology Use (Item 47) and Global Element (Item 45)—By Class Size

45. The instructor expected students to take their share of responsibility for learning.	
Class Size	γ
Small	**.77**
Medium	**.77**
Large	**.79**
All Responses	**.77**

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-55 compares class sizes for Item 46 on the element rating *instructor expectations of high student achievement* where small class sizes had a γ of .75; medium class sizes had a γ of .77; and large class sizes a γ of .80—the highest correlation for all the data. Instructors with *higher achievement standards* were also likely to *use more educational technology* in their courses.

Table 4-20

Educational Technology Use (Item 47) and Global Element (Item 46)—By Class Size

46. The instructor had high achievement standards in this class.	
Class Size	γ
Small	**.75**
Medium	**.77**
Large	**.80**
All Responses	**.77**

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

All global elements had higher correlations of educational technology of any of the teaching methods or learning objectives when either combined or stratified with the exception of Item 43 "As a rule, I put forth more effort than other students on academic work," which was fairly weak. These higher correlations were especially so for large class sizes.

It was earlier mentioned there was a difference in the ranges of γ between the three major sections of student perceptions on teaching. "All teaching method correlations had a range between .49 and .63" for all responses; small class sizes ranged from .51 to .65; medium class sizes ranged from .48 to .62; and large class sizes ranged from .34 to .64. "Where the learning objectives had a narrower range between .51 and .60" for all responses; small class sizes ranged from .52 to .60; medium class sizes ranged from .50 to .60; and large class sizes ranged from .43 to .69. The global elements had a wider range from .47 to .77 for all responses and a range of .45 to .80 when broken down into three class sizes. There were obviously influences on pedagogy in terms of teaching methods, progress on learning objectives, and the use or emphasis of other global elements for the different class sizes when variables were correlated with *educational technology use*.

CHAPTER 5 - CONCLUSION AND DISCUSSION

This research study examined the relationship of college student reactions to instruction and courses for educational technology usage and other instructional elements that facilitate learning. The relationships were analyzed using correlational studies to show a trend between the two variables and allow useful generalizations. Analyses of institutional data can support improving student learning. Analysis of institutional data can be a timely, targeted, and data-driven decision-making opportunity informs professional development in educational technology use as part of effective and successful instructional design. Here the researcher discusses the results of the statistical analyses conducted and addresses the aforementioned hypotheses.

Educational Technology Use to Facilitate Instruction

Hypothesis 1 states, “Across the university, educational technology when used to promote learning will gain a high rating.” The descriptive statistics (Table 4-4) show a higher rating whenever 80% of responses were represented by combining “More True than False” and “Definitely True” for Item 47. Having conducted the chi-squared goodness-of-fit test (Figure 4-1), it further supported the high ratings because the observed proportions were not equal to the expected proportions for these two ratings; they were much higher for “Definitely True.” The respondents self-reported a majority of their courses used educational technology to facilitate learning. Therefore, the first hypothesis is statistically supported.

As society, and specifically higher education, navigates through the digital age, technology use has become the norm for connecting, interacting, and professional interactions. Because survey Item 47 included *the Internet* (e.g. online library resources and the university learning management system), *email, computer exercises, and multi-media presentations* (such as YouTube and PowerPoint) as examples of educational technology used to promote learning, it was assumed that nearly all courses surveyed use these technologies regularly for instructional purposes. Instructors and students could easily use all these technologies in their daily activities, and respondents would have selected "More True than False" or "Definitely True" as their responses in the Survey. Could it be that the Likert-type item statement is simply too broad for detailed analysis?

Item 47, among others, was added to the Survey as an experimental item in 1998 (Hoyt, Chen, Pallett, & Gross, 1998). In the meantime, the IDEA Center conducted research focused on educational technology use in face-to-face and online courses (Benton, Webster, Gross, & Pallett, 2010). In the most recent revision of the *Student Ratings of Instruction and Courses*, the educational technology item was nominated for removal, along with the other experimental items to truncate the Survey (Benton et al., 2015). Surveys are regularly regarded as being "too long;" so once the IDEA Center finished their research on the experimental items, they deemed it was time to remove them. On the other hand, this study suggests there is much yet to learn about educational technology use in higher education in the digital age. It may indeed be time to write an updated survey that includes one or two items that are still directed at the use and integration of educational technology. Instructors, faculty development centers, and researchers could then continue to investigate educational technology use and its relationships to other instructional elements, as the digital age and technology advancements continue to change and spread over time.

Educational Technology Use Positively Correlated to Teaching Methods

Goodman-Kruskal's gamma correlation coefficient was used to test Hypothesis 2, which states, "Educational technology use will demonstrate a positive correlation when related to teaching methods." Although some of the teaching methods in this current study had a higher correlation with *educational technology use* (Item 47) than others did, all of the teaching methods had a positive correlation (Table 4-6) with this item. Therefore, γ has shown there is a probability that the two variables do agree. It can be interpreted as showing that the average variation (59%) in teaching methods can be explained by the variation in educational technology use. Using educational technology to facilitate learning was a strategy used by instructors in the design of their courses to support teaching methods. In addition, educational technology use was also a strategy employed by students to help them learn (Culatta, 2015).

Teaching methods (Items 1 to 20) had a stronger relationship with *educational technology use* (Item 47) than learning objectives because they are more closely related to the educational experience and the process of designing instruction. This point will be discussed further in this chapter after more of the evidence is reviewed. In addition, although 12 of the teaching methods had a strong correlation and seven had a moderate correlation; the one that stands out the most is the teaching method that had a weak correlation. *Forming "teams" or "discussion groups" to facilitate learning* (Item 5) is used in smaller class sizes and in face-to-face courses. Some classes can be so small that the entire class could participate as a group and team development would not have occurred as an activity or process as it would in larger classes. At a small residential liberal arts university with a vast majority of face-to-face course offerings, there is little need for working in groups while using educational technology because of an intimate classroom environment. However, as a part of the educational changes in the digital age, research-based predictions say courses are more likely to become blended (more class work completed online) and shift their use of educational technology toward teams and discussions, which will then manifest in the classroom as more collaborative and even redesigned learning spaces (*NMC Horizon Report*, 2015). Technology alone is not the driving force for such change; employers' need for future professionals to be skilled in teamwork and technology use through current educational reform are much more powerful reasons for this change.

Educational Technology Use Positively Correlated with Learning Objectives

Learning objectives are considered the goals for student success in an educational experience or course. They lead the way for learners. All teaching methods and strategies used during a learning experience have learning objectives as their guides. If backward design is used for preparing instruction, learning objectives are addressed first; there is evidence to show that students do reach those objectives second; and the teaching methods, activities, and strategies planned are third. Therefore, from the instructional designer perspective, learning objectives are slightly more removed from the actual instructional event than are teaching methods. The question thus remains, is there a positive correlation between *educational technology use* (Item 47) and progress on learning objectives (Items 21 to 32)? Is Hypothesis 3, "Educational technology use will show a positive correlation when related to progress on learning objectives" supported by the data?

Goodman-Kruskal's gamma correlation coefficient was calculated to measure the strength of relationship between self-reported student data on *educational technology use* and progress on learning objectives. Hornsby and Osman (2014) suggest "… that large classes are not learning environments conducive to establishing higher order cognitive skills" (p. 713). Some of the learning objectives can have a stronger correlation than others and generally decrease as Bloom's revised taxonomy (Anderson & Krathwohl, 2001) increases in complexity. In addition, all learning objectives showed a positive correlation, meaning γ indicated the probability that the two variables, *educational technology use* and the individual learning objectives, agreed. The single learning objective that showed the strongest relationship was the student's perceived progress on *application of course material* (Item 23). Conversely, all of the learning objectives were within a .10 range of the other correlation coefficients. Because of their close proximity, the distinctions between strong and moderate relationships become difficult to affirm when it comes to learning objectives and *educational technology use*. Statistically speaking, the variation in the correlations of the learning outcomes is less likely (on average 56%) to be explained by the variations in Item 47 than those with the teaching methods. Specifically, it can be noted the weakest relationship between the learning objectives and *educational technology use* is in *acquiring skills in working with others as a member of a team*.

Teamwork is regularly seen as a teaching strategy that is used in face-to-face learning environments or through delegated roles as a whole. Working as a team can actually be much more accessible and flexible when engaging in educational technology use. A learning curve exists for any educational technology that is used. Because educational technology that supports teamwork is no different, faculty development opportunities for learning how to implement teamwork and collaboration technologies better is a strong possibility based on the data analysis here.

Recent research shows employers expect a broad range of skills to be developed during higher education programs (Hart Research Associates, 2015). They encourage both hard and soft skills being introduced, if not developed. More employers are expecting students to have strong written and oral communication skills, be able to work successfully in teams [and at a distance (e.g. via videoconferencing)], make ethical decisions, think critically, and apply their knowledge in real-world settings (Hart Research Associates, 2015). College students need to begin learning these skills as part of their overall college experience. These are the outcomes employers expect students to obtain while they are attending university. It important to point out the interpretation of both written and oral communication skills likely includes technology use and adeptness. Being able to express oneself ethically, appropriately, and concisely through emails or chats takes a very different skill set than writing papers and reports or conversing with a team using videoconferencing. However, all three skill sets can be construed as part of "good written and oral communication." Without employing these techniques as part of the expectations in the educational experience, students may miss gaining and/or practicing these skill sets altogether.

Educational Technology Use Positively Correlated with Global Elements

The global elements, although grouped, are not a section of similar items. All but one of these global elements had the highest correlations with *educational technology use* when compared to any other survey section or single survey item. The lowest of the strong correlations, *Overall, I rate this course as excellent* (Item 42; $\gamma = .62$), was still above any of the relationships with Item 47 and learning objectives ($\gamma \leq .60$). Although these correlations cannot be directly compared without a z transform being calculated, three of the global elements were in the range of very strong ($\gamma \geq .70$). They are Item 44 "The instructor used a variety of methods—not only tests—to evaluate student progress on the course objectives"; Item 45 "The instructor expected students to take their share of responsibility for learning"; and Item 46 *the instructors high achievement standards in this class*.

For all the global elements, the data showed either a strong or a weak correlation, but not a moderate one. This finding encouraged another review of the descriptive statistics. The global elements did not have the highest frequencies for any of the items in a comparison to teaching methods and learning objectives. Yet, the global elements did have the highest correlations with Item 47. The variation in the global elements variables can be explained, in part, by the variation in educational technology use. After reviewing the global elements as a group, the hypotheses for each of the global elements are addressed individually in the following paragraphs.

Hypothesis 4a, "Educational technology use will show a positive correlation with the instructor rating" is directly related to Item 41 "Overall, I rate this instructor an excellent teacher" and Item 47. "Good teaching" does not have to be directly linked to "student learning" (Fink, 2013). How can "good teachers" continue to adjust their teaching to further enhance "student learning"? The recent literature on student evaluations of teaching discusses likely biases for survey items, such as situations where the respondent has little expertise in the area they are judging (Wieman, 2015). However, there is even more educational research that disproves such notions (Perry & Smart, 2007). In addition, research supports the idea students have had a lifetime of working with different instructors and varying levels of personal successes in learning (Benton & Li, 2015a, 2015b) and that excellent teachers do support student success. Therefore, students are stakeholders in teaching and learning and are a necessary participant in any evaluation. It has been mentioned before and bears repeating here—student ratings of instruction are only one of many sources of data that should be used to evaluate teaching and learning. Based on the evidence reported in this study, there is a strong positive correlation between student ratings of teacher excellence and the use of educational technology by teachers to promote learning ($\gamma = .68$).

Second, the rating of *course excellence* (Item 42) also had a strong positive correlation to Item 47 ($\gamma = .62$). Therefore Hypothesis 4b is supported by the data. The difference between an *excellent teacher* and an *excellent course* or educational experience is based on a lot of differing factors. The teacher may be able to deliver content in an efficient manner, but he or she may not tie all the learning objectives together in a manner that makes sense to the student. The instructor may also have deficiency in informing the students why they are learning specific content using certain teaching methods. Both are important aspects of instructional design where the instructor may be lacking in terms of proper preparation. More data and analysis is necessary to pinpoint *why*, but educational technology use to promote learning does correlate well to both excellence-related items.

Third, educational technology use (Item 47) showed a positive correlation with the rating for the student putting "…forth more effort than other students on academic work" (Item 43). Data analyzed for this study thus supports Hypothesis 4c. This is the one and only global element that did not show a strong correlation with *educational technology use* to promote learning ($\gamma = .47$). Global elements are not necessarily a series of similar items, so each item is not likely to reflect similar results to the other items.

The descriptive data (Table 4-4) shows students were honest in their judgments about their personal efforts when compared to their peers. The frequency of marking "In Between" was greater than the same rating for any other survey item studied. This was the first time in the data where "More True than False" (observed frequency = 37%) exceeded that of "Definitely True" = 36% and "In Between" surpassed the expected proportion of 20% (observed frequency = 24%). Item 43 "As a rule, I put more effort than other students on academic work" was indeed a personal perception of students' own actions versus that of their peers. There is a possibility this survey item should have been grouped with the items that were eliminated from this study (Items 33 to 39) due to a lack of clear connection with educational technology use. This regrouping was done in the most recent technical report (course ratings: Items 33, 34, and 35; and self-ratings: Items 36, 37, 38, 39, and 43) submitted by the IDEA Center (Benton et al., 2015).

The last few survey items were student perceptions of an instructor's implementations (Items 44) and expectations (Items 45 and 46). These item structures imply either an agreement or a deferral to "In Between." Few students disagreed (responding either "Definitely False" or "More False than True") with the four statements as they reflected on their classroom activities. *Educational technology use* showed a positive correlation ($\gamma = .76$) with the rating for Item 44 "The instructor used a variety of methods—not only tests—to evaluate student progress on the course objectives." Therefore, Hypothesis 4d is statistically supported. This result indicates that the more educational technology is used, the more diversity of assessment methods need to be used.

The relationships between Item 45 "The instructor expected students to take their share of responsibility for learning" and Item 47 showed a positive correlation ($\gamma = .77$) and consequently, the variation seen in educational technology use helps explain the variation for the *instructor expectations towards students' responsibility for their own learning*. Hypothesis 4e was also then statistically supported. There was a possible relationship between Items 43 and 45, and these items should probably be researched further.

Educational technology use also showed a strong positive correlation ($\gamma = .77$) with the rating *the instructors high achievement standards in this class* (Item 46). This result indicates that the higher the uses of educational technology in class, the higher the achievement standards in class. As a result, Hypothesis 4f was supported. Additional studies to compare this item with the teaching method *inspiring students to set and achieve challenging goals* (Item 15) should be undertaken in further research.

The larger range of correlations occurred when the item Likert-type statements were directed at the student rather than at the coverage of teaching methods used or the progress on learning objectives. Not all students were educated in teaching methodologies or learning objectives, and this lack could possibly have influenced their responses. Future research should be conducted on the differences in responses for student ratings of instruction for students who major in the field of education versus those with other majors.

Correlations between Educational Technology Use Differs With Class Size

The chi-squared, two-way test of homogeneity determined that class size does impact *educational technology use* (Item 47) when students responded to the Survey. The test of two proportions further indicated where the variance could be seen in terms of the significance of the difference between ratings "In Between" and "Definitely True" especially between the small and large class sizes. Based on existing research studies, it can be speculated that this difference is due to the variation of teaching methods being used

(McKeachie & Hofer, 2002) and access to technology (Hornsby & Osman, 2014) for small and large class sizes based on the size of the student learning audience. Teaching methods are discussed later in detail; however, differences in educational technology use have yet to be addressed fully in this study. Access to personal technologies during class sessions would also differ based on the class size. The university where this study took place does not have a one-to-one computer initiative; therefore, it is difficult for large class sizes to engage in technological practices and strategies during class time unless the students provide their own technological devices. Small class sizes can use technology owned by the university, such as, laptop carts, sharing of personal computers, and sometimes use of the classroom computer to engage in and lead learning activities. Both small and small medium (up to about 20 to 25 students) classes can usually fit into one of the university computer labs. Large medium (about 25 or more students) and large class sizes simply do not fit into the size of university computer labs available on campus.

Students in larger classes have a much higher expectation of completing anything requiring technology use outside of class. For example, wireless access points for the Internet can also be a limiting factor in technology use that promotes learning in larger class sizes. If the wireless access point cannot connect all of the student technology devices in one classroom, the speed of the Internet connections are slowed and some devices may never connect reliably. Therefore, students in these classroom situations will also have limited access to additional Internet-based resources. “It is interesting to consider that greater support has not been forthcoming despite a literature on large classes that generally considers them a challenge to the quality of the learning environment” (Hornsby & Osman, 2014, p. 713).

The next part of the discussion highlight the data analyses that support Hypothesis 5, "The correlations between *educational technology use* and a) teaching methods, b) learning objectives, and c) global elements that will differ with class size": small class (<15 students per class), medium class (15 to 34 students per class) and large class (35 to 49 students per class).

Teaching methods do differ between small, medium, and large class sizes. However, does the correlation between *educational technology use* and each of the teaching methods differ enough in their correlations to warrant notifying faculty developers and, thus, offering a possible opportunity for change in programming opportunities? Did learning objectives and/or global elements have the same changes in correlations for different class sizes? The literature reviewed for this study shows very little evidence that there are as many changes occurring between learning objectives and class size as there are for teaching methods (Hornsby & Osman, 2014; McKeachie & Hofer, 2002). The same could be said for the global elements (*teaching excellence, course excellence, amount of effort a student put forth, instructor expectations of student responsibility, and instructor high achievement standards*). This result means that these global elements are not as intimately identified with class size as are teaching methods.

<u>Class Size, Teaching Methods, and Educational Technology Use</u>

The data analyzed herein shows certain variations in the relationships between teaching methods (Items 1-20) for the three different class sizes (Table 5-1). For the most part, there was not enough of a difference between the correlation coefficients for an instructor's *personal interest in students and their learning* (Item 1), *sharing experiences with others who differ* (Item 16), and *students helping each other to understand* (Item 18) for the small-and-medium and medium-and-large class sizes. However, there was a difference between small and large class sizes. There was also a difference between medium and large class sizes in terms of *helping students find answers to their own questions* (Item2). In addition, a difference in correlations between medium and large as well as small and large classes for *forming teams and discussion groups to facilitate learning* (Item 5) in different classes and the *use of educational technology* to encourage teamwork, *encouraging and tutoring students and how to use multiple resources* (Item 9)*, and involving students in hands-on projects such as research, case studies, or "real life" activities* (Item 14). Therefore, taking a *personal interest in students and their learning* (Item 1), *asking students to share ideas and experiences with others* (Item 16) and having *students help each other to understand course concepts* (Item 18) should be included in future faculty development for large class sizes. The differences identified can influence faculty developers in higher education to research and offer programming that will more positively influence teaching and learning.

Table 5-1

Teaching Method Item Numbers by Class Size in Order of Correlational Strength

	Teaching Methods (Correlation Coefficient)			
Correlational Strength	Small Class Size	Medium Class Size	Large Class Size	All Responses
Strongest	**4 (.65)**	**1 (.62)**	**13 (.64)**	**1 (.63)**
	1 (.64)	**4 (.62)**	**4 (.63)**	**4 (.62)**
	13 (.64)	**19 (.62)**	**11 (.63)**	**13 (.62)**
	6 (.62)	**2 (.61)**	**20 (.63)**	**2 (.61)**
	9 (.62)	**6 (.61)**	**19 (.61)**	**6 (.61)**
	19 (.62)	**13 (.61)**	**3 (.60)**	**19 (.61)**
	3 (.61)	**11 (.60)**	**6 (.60)**	**3 (.60)**
	11 (.61)	3 (.59)	**15 (.60)**	**9 (.60)**
Correlational Strength	**12 (.61)**	9 (.59)	1 (.59)	**10 (.60)**
	15 (.61)	10 (.59)	10 (.58)	**11 (.60)**
	20 (.61)	12 (.59)	12 (.58)	**12 (.60)**
	2 (.60)	20 (.59)	17 (.58)	**20 (.60)**
	10 (.60)	15 (.58)	2 (.56)	15 (.59)
	14 (.60)	8 (.57)	7 (.56)	8 (.58)
	7 (.58)	17 (.57)	8 (.56)	7 (.57)
	8 (.58)	7 (.56)	9 (.54)	14 (.57)
	17 (.58)	14 (.56)	18 (.52)	17 (.57)
	18 (.58)	18 (.56)	16 (.51)	18 (.57)
	16 (.57)	16 (.54)	14 (.50)	16 (.55)
Weakest	5 (.51)	**5 (.48)**	**5 (.34)**	**5 (.49)**

This study recognized there are extensive differences in the use of forming teams and groups to facilitate learning. There was a .14 difference between medium and large class sizes and a .17 difference between small and large class sizes. These were the largest differences between class sizes for all the data analyzed. Because all measurements were on the border of a weak correlation or less, there was substantial room for faculty development by aiming development at *forming teams and discussion groups to facilitate learning* overall, and in different classes, including the *use of educational technology* to encourage teamwork. Employers want to hire professionals who can work in teams and, in certain instances, do so at a distance using technology.

Unlike the findings in *teamwork*, *educational technology use* had stronger correlations and needs less attention in terms of faculty development opportunities for *personal interest in students and their learning* (Item 1), *help students find answers to their own questions* (Item 2), how instructors *scheduled course work* (Item 3), *demonstrating the importance and significance of the subject matter* (Item 4), *clearly identifying how the topic fit the course* (Item 6), discussing how *course materials were related to real-life situations* (Item 11), *introducing stimulating ideas about the subject matter* (Item 13), *inspiring students to set and achieve goals that were challenging* (Item 15), and *activities and assessments that involve creative thinking* (Item 19). In addition, it was understood that both small and medium class sizes encouraged more one-on-one time with the instructor in class. It is also noted that large classes have less one-on-one time with the instructor in class and possibly more technology-mediate communication happening outside of class. The three class sizes generally had a strong correlation with the *use of educational technology* in *student-faculty interactions*. Students and instructors, regardless of class size, were likely using educational technology to communicate.

The next relationship analysis on teaching methods showed there was one class size in the strong range and two in the moderate range in terms of their correlation. The class sizes with moderate correlations can be used to identify future faculty development opportunities that can benefit student learning. Different class sizes *encourage students to use multiple resources* (Item 9) differently, and faculty development that includes differentiation in class sizes could prove useful, but is not necessary. This difference also stands true for the *use of educational technology* and *explaining course material clearly and concisely* (Item 10)*, assessments* (Item 12), and *involving students in hands-on projects, such as research, case studies, or "real life" activities* (Item 14), but differing by class size. Because the relationship is moderate it means that there is potential room for growth in the differentiation of class size when using educational technology as a teaching strategy to support certain teaching methods.

Although correlation does not imply causation, instructors could use educational technology to reach students where they are and get them the content they need to be successful by employing the convenience of technology-supported communication.

Higher education faculty development is suggested for those teaching methods where, regardless of class size, the correlation strengths were moderate or less so. Examples are expressing *reasons for criticisms of student academic performance* (Item 7), *stimulating student intellectual effort* (Item 8)*, asking students to share ideas and experiences with others* (Item 16), *providing timely and frequent feedback to students* (Item 17), and having *students help each other to understand course concepts* (Item 18). These topics may or may not need to include class size as a factor during faculty development since the data gathered did not suggest a noticeable difference.

<u>Class Size, Learning Objectives, and Educational Technology Use</u>

The learning objectives relationships to educational technology use were moderate and underwhelming due to their more distant connections to the process of designing instruction. This study accentuates the point that teaching methods are much more closely related to educational technology use, an individual teaching strategy, than the students' self-reported progress on learning objectives. However, there was a very obvious shift in the correlation when analyzing small and medium compared to large class sizes. The data analyzed suggest *educational technology* in large classes is regularly used to help students *gain factual knowledge* (Item 21) and *learn fundamental principles, generalizations, and theories* (Item 22). Small and medium class sizes may accomplish these goals efficiently without extensively using educational technology, and there may or may not be room for growth here. One suggestion is to follow a flipped classroom model where educational technology use will free up class time for in-depth discussions, and students can then *gain the factual knowledge* outside of class. One opposing notion is that large classes are now *using more educational technology* to *work with other members of the team* (Item 25) than smaller classes. Large classes at this institution seem to have less of a probability that any variation in working with other members of a team is related to variation in educational technology use. The faculty would thus benefit from professional development in this area and then employ techniques to strengthen *educational technology use* for *teamwork* in their instruction as discussed in the typically stated employer expectations (Hart Research Associates, 2015). This result matches the concern and opportunity for growth for *forming teams and discussion groups* (Item 5) as mentioned in the section on teaching methods.

The patterns of educational technology use and class size do not end there. The statistical relationships for all class sizes between learning objectives (Table 5-2) and educational technology use directly relate to the descriptions and the distances between the components for the actual process of designing instruction. Therefore, there is less of an urgency to focus additional faculty development opportunities on class size and teaching students to *apply course materials* (Item 23), *gaining factual knowledge* (Item 21), *learning fundamental principles, generalizations, and theories* (Item 22), *professional skills, competencies, and perspectives for future employment in the field* (Item 24), *analysis and evaluation techniques* (Item 31), and *acquiring interest by asking and answering their own questions* (Item 32) including *educational technology use* (Item 47) than on most other teaching methods.

These teaching methods might encourage students to engage in *creative capacities* (Item 26), a learning objective, and creative activities are expected to happen with higher frequencies in small and medium class sizes than in large classes (Hornsby & Osman, 2014) and yet there was a slight, albeit unrecognized difference in the correlation coefficients. Yet, a "…conceptual change and student focused (CCSF) approach… is more effective at challenging students to think deeply, critically, and creatively in large classes" (Hornsby & Osman, 2014, p. 716). Although the relationships between class sizes were trivial, the moderate correlations between class sizes suggest there is room for growth in the *use of educational technology* to improve *creative capacities* (Item 26), *understanding and appreciation* (Item 27), *oral and written expression* (Item 28), *finding resources to aid in answering questions and solve problems* (Item 29), and *developing personal values* (Item 30) when including no differentiation in class sizes. Finally, *using educational technology* to *work with other members of the team* continues to be a concern and indeed is expected as a competence in many professionals' fields. The data analyzed here show that this was the lowest correlation of all the learning objectives and only demonstrated a weak-to-moderate relationship between this objective and the *use of educational technology*. This weaker relationship matches the concern about *forming teams and discussion groups* mentioned here in the section about teaching methods.

Table 5-2

Learning Objective Item Numbers by Class Size in Order of Correlational Strength

	Learning Objectives (Correlation Coefficient)			
Correlational Strength	Small Class Size	Medium Class Size	Large Class Size	All Responses
Strongest	**23 (.60)**	**23 (.60)**	**21 (.69)**	**23 (.60)**
	24 (.59)	24 (.59)	**22 (.67)**	24 (.59)
	29 (.58)	21 (.58)	**24 (.63)**	21 (.58)
	32 (.58)	29 (.58)	**23 (.62)**	29 (.58)
	31 (.57)	32 (.58)	**31 (.61)**	32 (.58)
	21 (.56)	22 (.57)	**32 (.61)**	22 (.57)
	22 (.56)	31 (.57)	29 (.59)	31 (.57)
	28 (.55)	30 (.55)	28 (.56)	30 (.55)
	30 (.55)	26 (.52)	30 (.55)	28 (.53)
	26 (.54)	28 (.52)	27 (.53)	26 (.52)
	27 (.54)	27 (.51)	26 (.50)	27 (.52)
Weakest	25 (.52)	25 (.50)	**25 (.34)**	25 (.51)

<u>Class Size, Global Elements, and Educational Technology Use</u>

Finally, the sub-groups of class size and the relationships between global elements and *educational technology use* have little to add to this discussion. All but one of the global elements had an increase in correlation coefficients, as class size increased. The self-reported *student effort* (Item 43) was noticeably different for small and large class sizes. As class size increases, there is a higher probability that students will put forth more effort.

This effort can go hand-in-hand with *instructor expectations of student responsibility for learning* (Item 45) and *educational technology use*. As the class size increased, the probability of *instructor expectations* also increased in this study.

In response to the data and the areas needing faculty development, it is time to make faculty development centers better recipients of teaching and learning evaluation data. They may even benefit from a new analysis of departmental and institutional data informing faculty development needs. Currently, it is less likely for a faculty development center to focus on instructional development and the design of particular courses than it has been historically (Gillespie & Robertson, 2010) although these are still sought by faculty. Fink (2013) suggests teaching and learning centers should focus on improving teaching, redesigning courses, and changing the learning environment of an institution. Student ratings of instruction can provide the data necessary to support such development centers and make them positive change agents for their institutions.

Summary of the Contributions of the Study

The results of this study have both relevance and implications for instruction design and faculty professional development. Institutional data on teaching and learning used as formative or summative feedback, including student evaluations of teaching, can be statistically analyzed to find areas in further need of faculty professional development and improvement of the instructional design process. Student voices as a part of evaluation are important, as students are indeed directly involved with the instruction being evaluated. As a result, this research study offers a repeatable methodology to use for analyzing students' reactions to instruction and courses to inform faculty development of higher education. The focus here is on the use of educational technology and other important instructional elements to facilitate learning such as teaching methods, progress on learning objectives, and addressing the global elements as they relate to class size. These relationships can show the areas of strength and weakness that then lead to new opportunities for targeted faculty development at, for example, teaching and learning centers in universities and colleges. Concomitantly, this study informs the current and future design of instruction in higher education, for example, by informing the redesign of educational experiences to teach competencies highly sought by employers in today's society (e.g., skills in working with others as a member of a team).

The relationships stressed in this study between the use of educational technology and different instructional elements are important for those instructors who are concerned with using technology in their classes and supporting educational experiences. The positive correlation between the use of educational technology and the many variables analyzed in this study show without a doubt that the increased use of educational technology will correspond to an increase in teaching methods effectiveness and higher scores on the overall quality of the instructor and the courses offered. The large dataset of this study offered a constructive broad analysis to point out that digital age students do react positively to wide and extensive use of educational technology, in particular, accessing the Internet, computer-based exercises, and multimedia presentations that support their learning.

Limitations of the Study

This research is bound by the location and timeframe during which the data were collected, namely, between August 2012 and December 2014. Therefore, the results may differ from research previously done by the IDEA Center. All the data in this research were also self-reported by students. Student may have interpreted Item 47 differently, for example. Such limitations could have been overcome by conducting focus groups and interviews with students in addition to SET's. In addition, the previous IDEA Center research used Pearson's *r* for all correlations, as it used aggregated student data at the class level, not raw student data. Further still, this study included classes with less than 10 students and only first-year IDEA data from instructors. Most of the recent literature from IDEA excludes these two populations due to reliability issues at the course level for full statistical analyses (Benton & Li, 2015a).

Analyzing existing data from established instruments has many perks, and yet the method comes with a few limitations. The researcher would have liked to include a few more questions about educational technology use as a part of the survey instrument. Additional questions would differentiate the use of educational technology for management of instruction separately from using these uses for reaching learning objectives. As a part of the enhanced study on educational technology using SET's, however, the aforementioned additional questions would have needed to be tested for reliability and validity. These additions, in conjunction with cross-analyzing existing methods for relationships and including educational technology statements from the *Faculty Information Form* would have produced a much broader scope of the educational technology use for teaching and learning.

Like most assessments of practice, the feedback from student ratings of instruction evaluation may have come too late to fix any current issues. Actions can be taken for future semesters, however. Student ratings of instruction need time for collection, aggregation, and preliminary analysis. It is well known that research that includes student ratings of instruction must follow these steps before any dissemination to institutions and instructors. In-house evaluations can be returned more quickly, but not have the quantity of literature, validity, or reliability that using an established evaluation system offers. Therefore, it is difficult to undertake large-scale feedback or research that is timely enough to include effective faculty development and implementation.

Usually these cycles of assessment are also dictated by institutional policy. Although the policies have good intent, they are likely to fail to improve student learning during a current semester (Reeves, 2010) or those semesters that directly follow. This is one reason why instruction is considered a field where there is lifelong learning. At this point, student ratings of instruction are examining the return on investment. The pedagogical application of student ratings of instruction, however, should be both a formative and a summative exercise and one with a focus on the former. Instructors should receive both in a timely manner so as to make positive and relevant changes in the current term with current students but also for future offerings to future students.

Suggested Actions for Improving the Evaluation Process

Timeliness of feedback is one of the most important aspects of evaluation. This researcher strove to advance feedback practices through an analysis of, dissemination of, and a process of working with evaluation data to improve instruction. These goals can be achieved by working directly with evaluation agencies, such as the IDEA Center, to make valued improvements. This research will indeed be disseminated to the IDEA Center to generate ongoing conversations on the additional means to undertake improving teaching and learning.

Educational technology may be used for more than direct teaching and learning practices. For the purposes of faculty development, educational technology can be used to enhance feedback loops to instructors and faculty developers. With the ever increasing advancements in technology, even with paper and pencil survey techniques, evaluations should be a viable solution for suggesting faster ways to submit and analyze data with the local institution and the IDEA Center. Cloud technology allows data to be submitted as soon as it is received.

The institutional evaluation coordinator spent a multitude of hours collecting, organizing and sorting the Survey responses, mailing them to the IDEA Center for processing, receiving and re-sorting them for final distribution at the university. Educational technology can assist in removing the middle and more expensive stages of this process. If the college or university were to purchase a survey-scanning device that directly submits data to the IDEA data center for analysis, no mailing and returning of documents would be necessary. It is understood that IDEA has an online process for completing surveys for a rapid rate of return; however, they also have research in hand that says the online system, although good, still has a lower rate of completion than paper (Benton et al., 2010). Therefore, optimizing paper processing would be the most economical way to achieve better results. Any improvements on disseminating results will impact the capabilities for further positive advances at local institutions.

In particular, the small Liberal Arts University in the Midwestern United States can use the findings from this research to inform its faculty development programming decisions. Areas of such improvement include differentiating educational technology use as a part of teaching methods used for different class sizes. As a part of this larger endeavor, informing faculty of available technologies and innovative uses so as to enhance reaching learning objectives, such as teamwork, would be a paramount option. The data collected here can thus be used by a faculty development center to impact the programming for teaching and learning and administration of the larger organization. In addition, other institutional data can be used to inform on larger decisions as a viable agent of change.

Future Research

Additional research should be conducted on the items discussed previously in this chapter. For example, what are the reasons that teamwork and educational technology use had such a weak correlation? Do education majors have a different interpretation, and thus, differing responses to teaching methods and learning objectives than other students who do not have that same background?

There is also a possibility to cross analyze students' reactions with what instructors report on the IDEA Center's *Faculty Information Form*. For example, students and instructors may be interpreting educational technology use differently based on the language used in the evaluation instruments. On the student survey, the item was presented as *educational technology was used to promote learning*. On the instructor input form, instructors are asked about delivery mode, either face-to-face or online, and whether *computer applications* were used. More consistency in these terminologies will allow use of all collected data for a larger correlational study.

Correlational studies can identify where relationships exist and to what extent they exist as well the direction of those relationships. They do not offer evidence on the causation of the relationships. Additional future research to expand this study includes completing a regression analysis to find out what might have caused the correlations for each of the Survey items and expanding the current study to the larger IDEA database to inquire more on the uses of educational technology in higher education instruction. Analyses, such as these, can help identify larger trends as benchmarks for comparing individual institutional reports on teaching and learning. Also, the data could be viewed from like perspectives as other IDEA Center research for tracking departments, courses, and instructors over time to find additional patterns, correlations, and causations of educational technology use and design in instruction.

This methodology can also be repeated at other institutions that want to identify the relationships between teaching strategies and other instructional elements. These results can be used to inform timely, targeted, data-driven decisions for faculty development. To expand still further on classroom usage of educational technology, qualitative research could be conducted using focus groups and interviewing techniques. The depth of this study can provide new opportunities for strong additional educational research on student ratings of instruction and educational technology use. With the findings from this current study and future related research, faculty development could be designed much like individual classroom instruction is currently designed (Mishra, Koehler & Zhao, 2007).

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APPENDIX A: STUDENT REACTIONS TO INSTRUCTION AND COURSES – THE DIAGNOSTIC FORM

IDEA CENTER

SURVEY FORM - STUDENT REACTIONS TO INSTRUCTION AND COURSES

IMPORTANT! USE NO. 2 PENCIL ONLY

Proper Marks ●●●●●● Improper Marks

Institution:

Instructor:

Course Number:

Time and Days Class Meets:

Your thoughtful answers to these questions will provide helpful information to your instructor.

Describe the frequency of your instructor's teaching procedures, using the following code:

1=Hardly Ever 2=Occasionally 3=Sometimes 4=Frequently 5=Almost Always

The Instructor:

1. ①	②	③	④	⑤	Displayed a personal interest in students and their learning
2. ①	②	③	④	⑤	Found ways to help students answer their own questions
3. ①	②	③	④	⑤	Scheduled course work (class activities, tests, projects) in ways which encouraged students to stay up-to-date in their work
4. ①	②	③	④	⑤	Demonstrated the importance and significance of the subject matter
5. ①	②	③	④	⑤	Formed "teams" or "discussion groups" to facilitate learning
6. ①	②	③	④	⑤	Made it clear how each topic fit into the course
7. ①	②	③	④	⑤	Explained the reasons for criticisms of students' academic performance
8. ①	②	③	④	⑤	Stimulated students to intellectual effort beyond that required by most courses
9. ①	②	③	④	⑤	Encouraged students to use multiple resources (e.g. data banks, library holdings, outside experts) to improve understanding
10. ①	②	③	④	⑤	Explained course material clearly and concisely
11. ①	②	③	④	⑤	Related course material to real life situations
12. ①	②	③	④	⑤	Gave tests, projects, etc. that covered the most important points of the course
13. ①	②	③	④	⑤	Introduced stimulating ideas about the subject
14. ①	②	③	④	⑤	Involved students in "hands on" projects such as research, case studies, or "real life" activities
15. ①	②	③	④	⑤	Inspired students to set and achieve goals which really challenged them
16. ①	②	③	④	⑤	Asked students to share ideas and experiences with others whose backgrounds and viewpoints differ from their own
17. ①	②	③	④	⑤	Provided timely and frequent feedback on tests, reports, projects, etc. to help students improve
18. ①	②	③	④	⑤	Asked students to help each other understand ideas or concepts
19. ①	②	③	④	⑤	Gave projects, tests, or assignments that required original or creative thinking
20. ①	②	③	④	⑤	Encouraged student-faculty interaction outside of class (office visits, phone calls, e-mail, etc.)

Twelve possible learning objectives are listed below, not all of which will be relevant in this class. Describe the amount of progress you made on each (even those not pursued in this class) by using the following scale:

1-No apparent progress
2-Slight progress; I made small gains on this objective.
3-Moderate progress; I made some gains on this objective.
4-Substantial progress; I made large gains on this objective.
5-Exceptional progress; I made outstanding gains on this objective.

Progress on:

21. ①	②	③	④	⑤	Gaining factual knowledge (terminology, classifications, methods, trends)
22. ①	②	③	④	⑤	Learning fundamental principles, generalizations, or theories
23. ①	②	③	④	⑤	Learning to *apply* course material (to improve thinking, problem solving, and decisions)
24. ①	②	③	④	⑤	Developing specific skills, competencies, and points of view needed by professionals in the field most closely related to this course
25. ①	②	③	④	⑤	Acquiring skills in working with others as a member of a team
26. ①	②	③	④	⑤	Developing creative capacities (writing, inventing, designing, performing in art, music, drama, etc.)
27. ①	②	③	④	⑤	Gaining a broader understanding and appreciation of intellectual/cultural activity (music, science, literature, etc.)
28. ①	②	③	④	⑤	Developing skill in expressing myself orally or in writing
29. ①	②	③	④	⑤	Learning how to find and use resources for answering questions or solving problems
30. ①	②	③	④	⑤	Developing a clearer understanding of, and commitment to, personal values
31. ①	②	③	④	⑤	Learning to *analyze* and *critically evaluate* ideas, arguments, and points of view
32. ①	②	③	④	⑤	Acquiring an interest in learning more by asking my own questions and seeking answers

Continued on back page

On the next three items, compare this course with others you have taken at this institution, using the following code:

1=Much Less than Most Courses 2=Less than Most Courses 3=About Average 4=More than Most Courses 5=Much More than Most Courses

The Course:

33. ① ② ③ ④ ⑤ Amount of reading
34. ① ② ③ ④ ⑤ Amount of work in other (non-reading) assignments
35. ① ② ③ ④ ⑤ Difficulty of subject matter

Describe your attitudes and behavior in this course, using the following code:

1=Definitely False 2=More False Than True 3=In Between 4=More True Than False 5=Definitely True

36. ① ② ③ ④ ⑤ I had a strong desire to take this course.
37. ① ② ③ ④ ⑤ I worked harder on this course than on most courses I have taken.
38. ① ② ③ ④ ⑤ I really wanted to take a course from this instructor.
39. ① ② ③ ④ ⑤ I really wanted to take this course regardless of who taught it.
40. ① ② ③ ④ ⑤ As a result of taking this course, I have more positive feelings toward this field of study.
41. ① ② ③ ④ ⑤ Overall, I rate this instructor an excellent teacher.
42. ① ② ③ ④ ⑤ Overall, I rate this course as excellent.

For the following items, blacken the space which best corresponds to your judgment:

1=Definitely False 2=More False Than True 3=In Between 4=More True Than False 5=Definitely True

43. ① ② ③ ④ ⑤ As a rule, I put forth more effort than other students on academic work.
44. ① ② ③ ④ ⑤ The instructor used a variety of methods--not only tests--to evaluate student progress on course objectives.
45. ① ② ③ ④ ⑤ The instructor expected students to take their share of responsibility for learning.
46. ① ② ③ ④ ⑤ The instructor had high achievement standards in this class.
47. ① ② ③ ④ ⑤ The instructor used educational technology (e.g., internet, e-mail, computer exercises, multi-media presentations, etc.) to promote learning.

EXTRA QUESTIONS

If your instructor has extra questions, answer them in the space designated below (questions 48-67):

48. ① ② ③ ④ ⑤ 58. ① ② ③ ④ ⑤
49. ① ② ③ ④ ⑤ 59. ① ② ③ ④ ⑤
50. ① ② ③ ④ ⑤ 60. ① ② ③ ④ ⑤
51. ① ② ③ ④ ⑤ 61. ① ② ③ ④ ⑤
52. ① ② ③ ④ ⑤ 62. ① ② ③ ④ ⑤
53. ① ② ③ ④ ⑤ 63. ① ② ③ ④ ⑤
54. ① ② ③ ④ ⑤ 64. ① ② ③ ④ ⑤
55. ① ② ③ ④ ⑤ 65. ① ② ③ ④ ⑤
56. ① ② ③ ④ ⑤ 66. ① ② ③ ④ ⑤
57. ① ② ③ ④ ⑤ 67. ① ② ③ ④ ⑤

Use the space below for comments (unless otherwise directed).

Note: Your written comments may be returned to the instructor, You may want to PRINT to protect your anonymity.

Comments: ____________________

TFsaoa (oa/oa) 0 9 8 7 6 5 4 3 2 1 Printed in U.S.A.

APPENDIX B: INSTITUTIONAL REVIEW BOARD APPROVAL

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 3/30/2015

To: Karly Good
920 NE 70th Ave, Ankeny, IA 50023

CC: Dr. Ana-Paula Correia
N165B Lagomarcino Hall

From: Office for Responsible Research

Project Title: Student Perceptions of the Impacts of Educational Technology on Teaching Methods and Reaching Learning Objectives

-

The Co-Chair of the ISU Institutional Review Board (IRB) has reviewed the project noted above and determined that the project:

☐ Does not meet the definition of research according to federal regulations.

☒ Is research that does not involve human subjects according to federal regulations.

Accordingly, this project does not need IRB approval and you may proceed at any time. We do, however, urge you to protect the rights of your participants in the same ways you would if IRB approval were required. For example, best practices include informing participants that involvement in the project is voluntary and maintaining confidentiality as appropriate.

If you modify the project, we recommend communicating with the IRB staff to ensure that the modifications do not change this determination such that IRB approval is required.

APPENDIX C: TABLES 4-16 THROUGH 4-34

Educational Technology Use and Teaching Methods by Class Size

Table 4-16

Educational Technology Use (Item 47) and Teaching Method (Item 2)—By Class Size

2. [The instructor] Found ways to help students answer their own questions	
Class Size	γ
Small	**.60**
Medium	**.61**
Large	.56
All Responses	**.61**

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-17

Educational Technology Use (Item 47) and Teaching Method (Item 3)—By Class Size

3. [The instructor] Scheduled course work (class activities, tests, projects) in ways which encouraged students to stay up to date on their work	
Class Size	γ
Small	**.61**
Medium	.59
Large	**.60**
All Responses	**.60**

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-18

Educational Technology Use (Item 47) and Teaching Method (Item 4)—By Class Size

4. [The instructor] Demonstrated the importance and significance of the subject matter	
Class Size	γ
Small	**.65**
Medium	**.62**
Large	**.63**
All Responses	**.62**

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-19

Educational Technology Use (Item 47) and Teaching Method (Item 5)—By Class Size

5. [The instructor] Formed "teams" or "discussion groups" to facilitate learning	
Class Size	γ
Small	.51
Medium	**.48**
Large	**.34**
All Responses	**.49**

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-20

Educational Technology Use (Item 47) and Teaching Method (Item 6)—By Class Size

6. [The instructor] Made it clear how each topic fit into the course	
Class Size	γ
Small	**.62**
Medium	**.61**
Large	**.60**
All Responses	**.61**

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-21

Educational Technology Use (Item 47) and Teaching Method (Item 7)—By Class Size

7. [The instructor] Explained the reasons for criticisms of students' academic performance	
Class Size	γ
Small	.58
Medium	.56
Large	.56
All Responses	.57

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-22

Educational Technology Use (Item 47) and Teaching Method (Item 8)—By Class Size

8. [The instructor] Stimulated students to intellectual effort beyond that required by most courses	
Class Size	γ
Small	.58
Medium	.57
Large	.56
All Responses	.58

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-23

Educational Technology Use (Item 47) and Teaching Method (Item 9)—By Class Size

9. [The instructor] Encouraged students to use multiple resources (e.g. data banks, library holdings, outside experts) to improve understanding	
Class Size	γ
Small	**.62**
Medium	.59
Large	.54
All Responses	**.60**

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-24

Educational Technology Use (Item 47) and Teaching Method (Item 10)—By Class Size

10. [The instructor] Explained course material clearly and concisely	
Class Size	γ
Small	**.60**
Medium	.59
Large	.58
All Responses	**.60**

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-25

Educational Technology Use (Item 47) and Teaching Method (Item 11)—By Class Size

11. [The instructor] Related course material to real life situations	
Class Size	γ
Small	**.61**
Medium	**.60**
Large	**.63**
All Responses	**.60**

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-26

Educational Technology Use (Item 47) and Teaching Method (Item 12)—By Class Size

12. [The instructor] Gave tests, projects, etc. that covered the most important points of the course	
Class Size	γ
Small	**.61**
Medium	.59
Large	.58
All Responses	**.60**

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-27

Educational Technology Use (Item 47) and Teaching Method (Item 13)—By Class Size

13. [The instructor] Introduced stimulating ideas about the subject	
Class Size	γ
Small	**.64**
Medium	**.61**
Large	**.64**
All Responses	**.62**

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-28

Educational Technology Use (Item 47) and Teaching Method (Item 14)—By Class Size

14. [The instructor] Involved students in "hands on" projects such as research, case studies, or "real life" activities	
Class Size	γ
Small	**.60**
Medium	.56
Large	.50
All Responses	.57

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-29

Educational Technology Use (Item 47) and Teaching Method (Item 15)—By Class Size

15. [The instructor] Inspired students to set and achieve goals which really challenged them	
Class Size	γ
Small	**.61**
Medium	.58
Large	**.60**
All Responses	.59

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-30

Educational Technology Use (Item 47) and Teaching Method (Item 16)—By Class Size

16. [The instructor] Asked students to share ideas and experiences with others whose backgrounds and viewpoints differ from their own	
Class Size	γ
Small	.57
Medium	.54
Large	.51
All Responses	.55

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-31

Educational Technology Use (Item 47) and Teaching Method (Item 17)—By Class Size

17. [The instructor] Provided timely and frequent feedback on tests, reports, projects, etc. to help students improve	
Class Size	γ
Small	.58
Medium	.57
Large	.58
All Responses	.57

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-32

Educational Technology Use (Item 47) and Teaching Method (Item 18)—By Class Size

18. [The instructor] Asked students to help each other understand ideas or concepts	
Class Size	γ
Small	.58
Medium	.56
Large	.52
All Responses	.57

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-33

Educational Technology Use (Item 47) and Teaching Method (Item 19)—By Class Size

19. [The instructor] Gave projects, tests, or assignments that required original or creative thinking	
Class Size	γ
Small	**.62**
Medium	**.61**
Large	**.61**
All Responses	**.61**

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-34

Educational Technology Use (Item 47) and Teaching Method (Item 20)—By Class Size

20. [The instructor] Encouraged student-faculty interaction outside of class (office visits, phone calls, e-mail, etc.)	
Class Size	γ
Small	**.61**
Medium	.59
Large	**.63**
All Responses	**.60**

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

APPENDIX D: TABLES 4-39 THROUGH 4-49

Educational Technology Use and Learning Objectives by Class Size

Table 4-39

Educational Technology Use (Item 47) and Learning Objective (Item 22)—By Class Size

22. [Progress on] Learning fundamental principles, generalizations, and theories	
Class Size	γ
Small	.56
Medium	.57
Large	**.67**
All Responses	.57

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-40

Educational Technology Use (Item 47) and Learning Objective (Item 23)—By Class Size

23. [Progress on] Learning to apply course material (to improve thinking, problem solving and decisions)	
Class Size	γ
Small	**.60**
Medium	**.60**
Large	**.62**
All Responses	**.60**

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-41

Educational Technology Use (Item 47) and Learning Objective (Item 24)—By Class Size

24. [Progress on] Developing specific skills, competencies, and points of view needed by professionals in the field most closely related to this course	
Class Size	γ
Small	.59
Medium	.59
Large	**.63**
All Responses	.59

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-12

Educational Technology Use (Item 47) and Learning Objective (Item 25)—By Class Size

25. [Progress on] Acquiring skills in working with others as a member of a team	
Class Size	γ
Small	.52
Medium	.50
Large	**.43**
All Responses	.51

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-43

Educational Technology Use (Item 47) and Learning Objective (Item 26)—By Class Size

26. [Progress on] Developing creative capacities (writing, inventing, designing, performing in art, music, drama, etc.)	
Class Size	γ
Small	.54
Medium	.52
Large	.50
All Responses	.52

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-44

Educational Technology Use (Item 47) and Learning Objective (Item 27)—By Class Size

27. [Progress on] Gaining a broader understanding and appreciation of intellectual/cultural activity (music, science, literature, etc.)	
Class Size	γ
Small	.54
Medium	.51
Large	.53
All Responses	.52

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-45

Educational Technology Use (Item 47) and Learning Objective (Item 28)—By Class Size

28. [Progress on] Developing skill in expressing myself orally or in writing	
Class Size	γ
Small	.55
Medium	.52
Large	.56
All Responses	.53

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-46

Educational Technology Use (Item 47) and Learning Objective (Item 29)—By Class Size

29. [Progress on] Learning how to find and use resources for answering questions or solving problems	
Class Size	γ
Small	.58
Medium	.58
Large	.59
All Responses	.58

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-47

Educational Technology Use (Item 47) and Learning Objective (Item 30)—By Class Size

30. [Progress on] Developing a clearer understanding of, and commitment to, personal values	
Class Size	γ
Small	.55
Medium	.55
Large	.55
All Responses	.55

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-48

Educational Technology Use (Item 47) and Learning Objective (Item 31)—By Class Size

31. [Progress on] Learning to analyze and critically evaluate ideas, arguments, and points of view	
Class Size	γ
Small	.57
Medium	.57
Large	**.61**
All Responses	.57

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.

Table 4-49

Educational Technology Use (Item 47) and Learning Objective (Item 32)—By Class Size

32. [Progress on] Acquiring an interest in learning more by asking my own questions and seeking answers	
Class Size	γ
Small	.58
Medium	.58
Large	**.61**
All Responses	.58

Note. Small <15 students; Medium = 15-34 students; Large = 35-49 students.