THE IMPACT OF MULTIMEDIA FEEDBACK ON STUDENT PERCEPTIONS: VIDEO SCREENCAST WITH AUDIO COMPARED TO TEXT BASED EMAIL

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Computer technology provides a plethora of tools to engage students and make the classroom more interesting. Much research has been conducted on the impact of educational technology regarding instruction but little has been done on students' preferences for the type of instructor feedback (Watts, 2007).

Mayer (2005) has developed an integrative, cognitive theory of multimedia learning (CTML) stipulating a principle that deeper learning occurs with words and pictures rather than words alone. This multimedia principle may be relative to not just instruction but also feedback.

Does multimedia feedback using screencast video with audio increase the motivation of the learner over text based email feedback? This study will compare the impact of text based email feedback defined as instructor comments via email with no pictures, graphics, or animation versus multimedia based feedback using video screencasts with audio. In addition, this study will look at the impact of learning preference on student perceptions for the two different feedback types.

After comparing two groups of students each receiving different feedback treatments, the results indicate support for a higher rating by students regarding the clarity of instructor's

comments, retention of information, motivation for the subject and motivation for the class with the multimedia based feedback. This result is in alignment with the cognitive theory of multimedia learning. However, there was limited evidence for the interaction between learning preference and type of feedback. Findings are discussed in regards to the study, the literature and practice.

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ACKNOWLEDEMENTS

This study is dedicated to those who teach and look for ways to improve the teaching process. It is hopeful that the results can be used to improve the teaching and feedback process.

I would like to thank my committee members who were extremely patient and who provided valuable guidance and direction during the creation of this dissertation. I found the entire process to be enlightening and humbling giving me a newly found appreciation for research and those who seek doctoral degrees.

But, most important were the faculty of the School of Information Science who were supportive and provided the time and opportunity to work on the dissertation. And, I want to give a special thank you to Dr. Ron Larsen the Dean of the School of Information Science who was not only supportive and directive but proved to be a mentor and a motivator.

1.0 INTRODUCTION

With the advent of computers, there are an increasing number of opportunities to engage students with a variety of technologies to provide interesting and captivating classroom experiences. Instructors can use an array of technologies in education ranging from learning management systems such as Blackboard to simple PowerPoint presentations. Much research has been conducted on the impact of educational technology regarding instruction but little has been done on students' preferences for the type of instructor feedback (Watts, 2007).

Research has shown that feedback has a powerful impact on learners both positive and negative (Hattie & Timperley, 2007). It is important to understand feedback mechanisms and in particular, the construction of feedback. Typically, instructors use text based systems to provide feedback to students including the tried and true red pen markings on submitted work to text based emails – no pictures or graphics. But, with today's computer technologies and software capabilities it has become more economical and increasingly feasible to create feedback that takes advantage of multimedia including pictures, narration and animation.

But, does multimedia feedback using screencast video with audio increase the motivation of the learner over text based email feedback? This is the type of question that needs to be examined. This study will compare the impact of text based email feedback such as instructor comments via email versus multimedia based feedback using multimedia video screencasts with audio.

1.1 PURPOSE OF STUDY

The key purpose of the study is to examine the impact that multimedia based feedback using screencast video with audio has on learners compared to text based email feedback in an education setting. In particular, the study will look at how the learner's perceptions are affected by the screencast video with audio feedback compared to the text-based email feedback. It's important to note the focus is not on the type of instructional method employed to convey the objectives of the lesson but rather the impact of the feedback on the learner's perceptions of the instructor, level of understanding of the material and level of involvement and motivation.

Also, the study will examine whether a learner's learning preference interacts with the type of feedback received. Are the learner's perceptions affected when the type of feedback matches their preference?

In addition, the study will examine the feasibility of instructors using computer hardware and software capable of creating and distributing multimedia feedback using screencast video with audio. Because there is a plethora of tools and techniques, careful examination will be given to the ease of use, cost and training necessary to produce quality multimedia feedback using screencast video with audio.

Feedback has been considered to be important in knowledge and skill acquisition along with motivation but, "… there are many conflicting findings and no consistent pattern of results" (Shute, 2007, p. 1). In addition, there is little research on the effects of multimedia feedback. Much of the research examines traditional feedback that uses text or email. The red pen on a written assignment would be a classic example. Watts (2007) states "there is a paucity of research on the micro-mechanisms underlying how use of new media affects the evaluative feedback process" (p. 199).

This study presents students with two treatment methods: multimedia feedback using screencast video with audio and traditional text based feedback on a homework assignment. After receiving feedback, students are surveyed in regards to their perceptions of the instructor, their knowledge acquisition, class involvement and motivation level. The study will look at whether there are significant differences of the above dependent variables in relation to the two independent variables of the different treatment methods.

1.2 PROBLEM STATEMENT

The education environment has changed with the introduction of the computer in the classroom. And, the technology continuously moves forward as new Web 2.0 tools are developed and implemented in the classroom (Keynes, Conole & Alevizou, 2010). Instructors are not only being asked to become subject matter experts and to master pedagogical constructs, but maintain currency in technology too.

In the last few years a number of software tools and technologies have become available to the casual user that supports the creation of multimedia works. Specifically, users can capture a computer screen of submitted work and use a drawing tool to highlight specific areas while conducting a narration. The receiver of this multimedia product can see their own submitted work, hear their instructor and watch animated movements.

But, the question is whether this type of multimedia feedback using screencast video with audio helps the user or simply distracts, annoys or overloads the user. Does the user even want to take the time to view this multimedia feedback? This study purports to examine this problem by presenting learners with both multimedia feedback using screencast video with audio and text

based feedback. And, the learners will complete a survey on how they perceive their instructor, knowledge acquisition, class involvement and motivation. This information will be analyzed and examined to help in understanding the impact multimedia feedback using screencast video with audio has on learners.

In addition, the time and training needed to use the necessary hardware will be examined in order to discover a base level of costs, time and skill set necessary to produce the related feedback content.

1.3 SIGNIFICANCE OF THE PROBLEM

Technology has become a bigger part of the teaching and learning process for many instructors. Often times the expectations for technology in the classroom has not been met. Historically, the expectations for the motion picture, audio tapes, instructional TV and programmed instruction have all had limitations in their impact. Therefore, it is important to study and research technological developments before promises are made and practices are altered.

As computers become more dominant and the capability of creating multimedia materials increase there are important questions that need to be answered. Is it worth taking the time and effort to create multimedia materials? Does it make an impact on a student if they receive feedback on their work via a multimedia message?

As students use their smartphones and tablets more frequently, they may become more accustomed to seeing messages of a multimedia nature. In order to determine if multimedia messaging in the feedback cycle of instruction is important, it is necessary to conduct research on how students are impacted. In this way teachers and educational administrators can make wise,

informed decisions regarding teacher training and the promotion of the usage of multimedia feedback. And, of course determining whether these types of messages have a positive impact on learning will help in developing a better understanding of adult student learners.

In conclusion the results of analyzing this problem can have an effect on teachers, administrators and adult students. It can provide some guidance on reasonable expectations, strategies and decision making within the education system.

This paper will present a theory for multimedia learning, a literature review and a proposed study design to examine the impact of multimedia feedback.

1.4 THEORETICAL FRAMEWORKS

1.4.1 Cognitive Theory of Multimedia Learning (CTML)

There are many views and paradigms associated with learning and multimedia. Some approaches are at the biological and molecular level. That level of granularity is too fine to match with the interests of this study. The focus in this study is on the impact of multimedia feedback using screencast video with audio on student perceptions. Theories that provide information and empirical evidence about the cognitive processing of multimedia are of most relevance. If multimedia is processed differently than textual information then it may have a different impact.

Mayer (2005) has developed an integrative, cognitive theory of multimedia learning (CTML) that specifies three cognitive science principles of learning: dual channels for visual/pictorial and auditory/verbal processing; limited channel capacity; and active learning. His theory has been built upon the work of other theorists including Paivio's dual coding theory,

Baddeley's model of working memory, Sweller's cognitive load theory, Wittrock's generative theory and Mayer's SOI (Select, Organize, Integrate) model of meaningful learning (Mayer & Moreno, 1998b). In essence, Mayer (2005) states his theory is "compatible" with other multimedia theories (p. 46).

Sorden (2013) notes that "ultimately, the validation of the theory lies in the fact that it has a large body of studies and literature to support it, that it has exhibited "staying power" and that it continues to demand attention and exert influence in the fields of education and training" (p.17).

Although there are many learning theories, there are few frameworks focusing on multimedia. Mayer's work provides explanation and guidance on constructing multimedia products that should be effective and useful in a learning environment. These principles will be used as a guide in the design, development and implementation of the multimedia feedback using screencast video with audio in this study.

The basic assumption of the theory is that people will learn more from a multimedia approach rather than a text only approach which is known as the multimedia principle. Mayer states that "multimedia instructional messages that are designed in light of how the human mind works are more likely to lead to meaningful learning than those that are not" (p. 32).

According to Mayer (2005) the development of the theory was guided by the principles of theoretical plausibility – consistent with cognitive science principles of learning, testability – predictions can be tested, empirical plausibility – consistent with empirical research and applicability – relevant to educational needs.

Mayer's cognitive theory of multimedia learning explicitly states that people have an auditory/verbal channel and a visual/pictorial channel. The visual/pictorial channel processes

information that is presented to the eyes and includes pictures, illustrations, video or on-screen text. Alternatively, the auditory/verbal channel processes information presented to the ears including narrations, voice, and nonverbal sounds.

Mayer notes that if adequate cognitive capacity is available some people may be able to convert information from the initial channel to the other. For example, on-screen text may be initially processed by the visual channel but converted mentally to speech by the user and then processed by the auditory channel. Conversely, spoken words may be processed by the auditory channel but the user creates a visual image from it and uses the visual channel to analyze it.

Each channel has a limited amount of processing capability. When visual information is presented with a multitude of images, animation, color and other multimedia components, the visual channel may not be able to absorb and process all of the available information thereby compromising learning. For example, when a user is presented with a narration, the user typically can only hold a limited number of words in working memory at a point in time and lacks the ability to hold the verbatim record (Mayer 2005).

Memory span tests have been given to subjects to test the limits of working capacity. Subjects are given numbers or pictures and asked how many they can recall. As subjects practice they learn how to chunk information into memory allowing them to remember more (Mayer 2005). However, there is agreement among researchers that there are limits on what working memory can handle (Shah & Miyak 1999).

Mayer proposes that humans actively process information in order to develop mental representations. Specifically, they pay attention to specific information, organize incoming information and integrate information with their current knowledge. Mayer states “this view of humans as active processors conflicts with a common view of humans as passive processors who

seek to add as much information as possible to memory that is , as tape recorders who file copies of their experiences in memory to be retrieved later" (p. 36).

The goal of the active processing is to make sense of the incoming material. The learner attempts to find connections and relations between the discrete pieces of material and in the process begins to build a mental model. The knowledge can be structured using a variety of methods including process structures which explain cause and effect; comparison structures which use matrices to examine elements along a dimension; generalization structures which use branching trees and a hierarchy of details; and enumeration structures which use a list and consists of collections of items (Mayer, 2005).

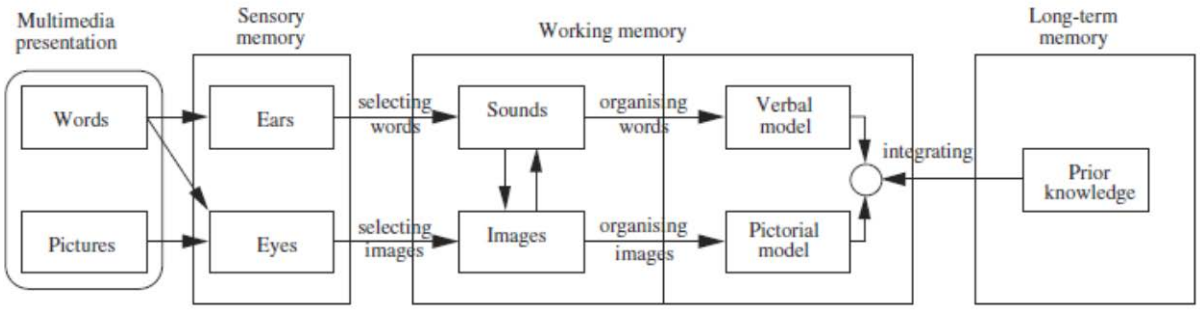

Figure 1: Cognitive Theory of Multimedia Learning (Mayer 2005)

In Figure 1 the model represents the human information processing system. The boxes are memory stores and the process starts with pictures and words representing a multimedia presentation entering the system through the eyes and ears. These pictures and sounds are exactly represented for a very short time in the sensory memory. Most of the work is done in working memory which has limited capacity and works with samplings of the original material. In other words, some words and pictures are processed but not necessarily all of them. And the arrows from sound to images and images to sound represent the work of converting from one form to

another. For example, a learner may hear the word dog but then forms a picture of a dog. And, conversely, a learner may view a picture of a house but convert the picture to the word house.

While in working memory, the learner actively selects images, selects words, organizes images, organizes words, and integrates them into a verbal or pictorial model.

1.4.1.1 Five Processes In Cognitive Theory Of Multimedia Learning

Mayer (2005) stipulates that meaningful learning occurs in a multimedia situation when the five following cognitive processes take place:

1. Selecting relevant words for processing in verbal memory,
2. Selecting relevant images for processing in visual working memory,
3. Organizing selected words into a verbal model,
4. Organizing selected images into a pictorial model,
5. Integrating the verbal and pictorial representations with each other and with prior knowledge.

These five processes and the interaction between them are key in determining what information becomes stored or is retrieved from long term memory. The long term memory process is complex, involves encoding and other neural processes which is beyond the scope of this particular study.

From these principles of types of memory, cognitive capacity and cognitive processes, Mayer and associates have conducted a variety of studies to determine a set of best practices. For example, Mayer and Moreno conducted a study with 78 college students to determine the split-attention effect in multimedia learning (1998). They divided the subjects into two groups. Group A viewed computer-generated animations of lightning formations and the illustration of a car's braking system with concurrent narration while Group B viewed the same animations but with

concurrent on-screen text. The results of the study showed Group A outperformed Group B on recall, finding named elements in an illustration and in determining the correct answers on a transfer test.

Mayer (2002) summarizes his key findings into a series of multimedia principles highlighted in the following list. These principles can be used by instructors in creating effective multimedia materials.

1. Multimedia Principle: Deeper learning with words and pictures rather than words alone.

2. Contiguity Principle: Deeper learning when pictures and words presented simultaneously.

3. Coherence Principle: Deeper learning when extraneous words, sounds or pictures are excluded rather than included.

4. Modality Principle: Deeper learning when words are presented as narration rather than on-screen text.

5. Redundancy Principle: Deeper learning when words are presented as narration rather than as both narration and on-screen text.

6. Personalization Principle: Deeper learning when words are presented in conversational style rather than formal style.

7. Interactivity Principle: Deeper learning when learners are allowed to control the presentation rate than when they are not.

8. Signaling Principle: Deeper learning when key steps in the narration are signaled rather than non-signaled.

This study on multimedia feedback is partially situated within Mayer's cognitive theory of multimedia learning as it follows the above principles in the creation of the multimedia feedback. It seems to make sense that these principles would have value in both developing instruction materials as well as developing feedback for students.

Also, Mayer's theory is integrative as it builds upon several other theories that examine memory, cognitive load and the impact of words and pictures. It is important to have guidance or principles in the construction of the multimedia in order to try to design an experiment and control the number of variables affecting the outcome. Consistency of design between each feedback unit in the study will help ensure a more consistent, definitive analysis.

Also, because Mayer's theory is grounded in empirical studies, it provides a solid foundation for this type of study with its multiple treatments and examining significant differences between subjects.

1.5 RESEARCH QUESTIONS

Overall, the guiding question is to what extent do learners react differently to multimedia feedback using screencast video with audio versus text based email feedback from an instructor in an educational setting? Following are specific research questions that will help in answering this overarching question.

1. **Instructor Focused**. To what extent does the learner's perception of the instructor differ between students who receive multimedia feedback using screencast video with audio versus text based email feedback? The perceptions of interest relate to how learners perceive the instructor's level of caring about the learner's work; the perception of the instructor's involvement in the class; the perception of how knowledgeable the instructor is; and the perception of how close the instructor is to the learner and the perception of the instructor's degree of approachability.

2. **Subject Matter Focused.** To what extent does the learner's perception of their level of understanding of the subject matter differ between learners who receive multimedia feedback using screencast video with audio or text based email feedback?
3. **Class Focused.** To what extent does the perception of the learner's level of involvement and comfort differ between learners who receive multimedia feedback using screencast video with audio or text based feedback?
4. **Motivation Focused.** To what extent does the perception of the learner's level of motivation in the class differ between learners who receive multimedia feedback using screencast video with audio or text based email feedback?
5. **Interaction Focused.** To what extent does a learner's learning preference interact with the type of instructor feedback received? In other words, will learners who receive feedback (multimedia or text based email feedback) that matches their learning preference react more positively to the above questions than those who receive feedback that does not match their learning preference?

1.6 DEFINITION OF TERMS

Web Browser – A software package that allows users to view content on the World Wide Web. Examples include Google Chrome, Apple Safari and Microsoft Internet Explorer.

Cascading Style Sheets (CSS) – The language used to style web pages with color, images and layout.

Education Setting – A university classroom where a subject is being taught by an instructor.

Educational Technology - Educational Technology is the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources.

Formative Feedback – Formative feedback represents information communicated to the learner that is intended to modify the learner's thinking for the purpose of improving learning (Shute, 2007).

HTML – Hypertext Mark-Up Language – The programming language used to design web pages on the World Wide Web.

Learner – In this study a college student who is enrolled in a classroom where a subject is being taught by an instructor.

Cognitive Theory of Multimedia Learning (CTML) – An integrative theory that builds upon several other theories that examine memory, cognitive load and the impact of words and pictures.

Multimedia Feedback –Instructor feedback that can uses video, pictures, animation or narration rather than simply words. This can include screen captures, pictures, images, illustrations, drawings or animations.

Perception – The Merriam Webster dictionary definition: the way you think about or understand someone or something.

Video Screencast with Audio – The capture of a computer screen including voice narration or drawing.

Text Based Email – Instructor feedback that uses text-based email or handwritten text comments but no pictures, sound or other graphics.

Web camera – A small camera that attaches to a computer that can capture video and audio.

Web 2.0 – A stage of Web development where web pages are not simply static but dynamic and are capable of interaction with the user. Examples of Web 2.0 sites include social media and video depositories.

World Wide Web – A term used to represent the Internet that holds documents, web pages and other resources accessible by a web address such as www.google.com.

2.0 REVIEW OF LITERATURE

This literature review will begin with the history and usage of educational technology culminating in the discussion of computer technology that enables the creation, usage and distribution of multimedia instructor feedback in the classroom. However, the history and usage of technology will not solely focus on the technology itself but rather will be limited to its connection to related concepts associated with instruction, learning and systems.

It is the intersection of technology, instruction and learning that places the technology in context of a greater system - a system whose outcome reflects the learner's characteristics, the medium's capabilities and the instructor's pedagogical expertise. From this viewpoint, the goal is to discover the interrelationships among the variables and to look at the overall view instead of a single point of reference.

Furthermore, the nature of feedback itself will be examined more closely to uncover its key role in learning along with its usage and best practices. Feedback provides information to the user and affects the user's future actions but effects vary based upon structure, timing, frequency and other characteristics and processes. There are many contradictory studies in the feedback arena and the focus will be on the areas where there is substantial evidence to support conclusions.

Examples in the literature that highlight computerized multimedia feedback in learning environments will be examined and the research gap will be further elaborated upon. There have

been few studies focusing on the mediating impact of multimedia feedback and this area appears to be an important research space due to the presently rapid development of enabling technologies. Instructors have more capability than ever to create multimedia feedback using the current family of software tools. In addition, the continued lowering of equipment costs makes this an opportunity available to a large segment of the education population.

Also, an examination of the role of learning theory and learning styles is explored. Again, there is much discussion and a variety of theories about learning and styles that focus on a plethora of approaches. After a brief introduction of learning theories and styles, the focus will emphasize learning theories/styles and technology. In particular, the focus will be on the increased use of technologies and the ensuing richness of material in instruction and feedback.

2.1 HISTORY OF EDUCATIONAL TECHNOLOGY

There have been many names associated with the educational technology field including audiovisual instruction, audiovisual communications, instructional design, instructional design and technology and instructional technology over the past one hundred plus years (Reiser & Ely, 1997; Reiser, 2001a; Reiser, 2001b; Richey, 2008; Silber, 2008). These various titles reflect a best attempt to capture the measured impact of changing forces and influences such as media, processes, psychological theory and technology over time. However, it seems that with educational technology no definition can represent all of the key theorists and influences at a point of time. In 1997, Reiser and Ely stated “throughout the history of the field, the thinking and actions of a substantial number of professionals in the field have been, and likely never will be, captured by the ‘official’ definition that is in place at that period of time” (p. 64). But, Saettler

(1990) makes a claim that at least four paradigms have impacted educational technology and "they determine to a large extent how practitioners in the field think, see, feel, and act with reference to the instructional problems they encounter" (p.7). These paradigms are: the physical science or media view; the communications and systems concept; the behavioral science-based view, comprising the behaviorist and neo-behaviorist concepts; and the cognitive science perspective.

2.1.1 Media Paradigm

As a starting point, the first paradigm illustrates the focus on the media itself and how technology was raison d'être. During the first two decades of the century the emphasis or focus was on the actual media itself. The media included everything from films, slides, pictures, slides, charts, stereographs and more (Reiser & Dempsey, 2012; Reiser 2001a). The primary actor of importance in the classroom was the teacher who used these media as "supplements to teacher-led instruction" (Reiser & Ely, 1997, p. 64). Reiser notes "instructional media will be defined as the physical means, other than the teacher, chalkboard, and textbook, via which instruction is presented to learners (p. 55). In fact, the first definitions of the field began to arise out of what is referred to as the visual instruction movement that began in the first decade of the twentieth century (Reiser & Dempsey, 2012).

During the beginning of the century as the field was in its infancy, school museums were built, educational films were created, professional associations were born, professional journals came into existence and teacher-training programs developed courses on visual instruction (Reiser & Ely, 1997). In particular, school museums made a large impact by not only

maintaining but distributing all types of visual materials to public school districts. In this way students could have a visual experience that supported their verbal, classroom instruction.

During this time period, before the introduction of sound, the field was labeled and defined as visual instruction or visual education and the focus on the media was also adopted "by the early commercial producers of slides, filmstrips and films" (Reiser, 1987, p. 8). The producers of media were happy to promote their devices as it helped them to sell products.

In particular, similar labels and definitions for the field began to appear in both professional journals and textbooks (Reiser & Ely, 1997). The rationale for visual instruction showed a bias toward the concrete which often times was represented on a continuum where abstraction was the opposite pole and of lesser value (Saettler, 2004). Saettler notes Edgar Dale's Cone of Experience as a particularly powerful continuum that affected the instructional field for decades (p. 143).

One of the early problems that needed to be addressed was distribution of the varied products and media. It would be very expensive for every school district to purchase its own films, slides and other media materials. Instead, a circuit rental system was created where schools could rent a film for example for a specified time period and return it where it again would be rented to other school districts. "This type of service was so regular that schools could depend on receiving specific films or visual materials at regular intervals throughout the school year (Saettler, 2004, p. 139).

Unfortunately, at this time the first of many lofty, unsubstantiated and even wild predictions were made about the impact of media. For example, Thomas Edison became ecstatic over the impact of using the motion picture in education environments and quipped "books will soon be obsolete in schools. Scholars will soon be instructed through the eye. It is possible to

teach every branch of human knowledge with the motion picture" (Saettler, 1990, p. 98). Even though Edison's prediction turned out to be false, educational technology will continue its pattern of hyperbole as each new technology breakthrough hails exaggerated promises that will fall short (Mishra, Koehler & Kereluk, 2009). As an explanation, Mishra et al. (2009) believe that this lackluster performance resulted because of three reasons: a lack of how to use the technology instructionally; resistance from educators; and an excessive focus on the technology itself. Interestingly, this spotted track record has not slowed down technology advancement and innovation.

The next major influence affecting the field was the introduction of sound during the 1920's and 1930's evidenced by the introduction of radio, talking films and recordings. It had an impact on the field as the center of interest now migrated from the visual to the audiovisual medium. For example, during this time period radio was adopted by higher education as they offered over the air classes, professional associations were formed and formal studies were conducted on radio related subjects (Saettler, 2004). Another example was the efforts of William Fox who through his company Fox Films Corporation wanted to "install a sound projector in every classroom and every church" (Saettler, 2004, p. 105). During this time, the Department of Visual Instruction which is the forerunner to the Association for Educational Communications and Technology was established (Reiser, 2001a cited Saettler, 1990). This professional organization exists today and provides leadership, conferences and continued support for educational technology.

During the 1940's the World War had a major impact on schools and society. Much of the progress in the audio visual field in education came to a standstill as the majority of time, effort and personnel were committed to the training efforts of the military and corporate entities

(Ely, 1963). These organizations used a variety of audiovisual methods and equipment to train both the workforce and military personnel. After the war, there was overall agreement that the audiovisual training methods worked well with the large groups of trainees (Reiser, 2001a). Obviously, this conclusion was a positive factor in the continued interest and development of the field.

The focus during the first half of the twentieth century centered on the characteristics and capabilities of the media which was ever-changing due to the creation and development of new technology. However, this made the field rather pragmatic, static and limited in its approach. This would all change as the field felt the impact from the writings of Finn (1953) who applied an analysis to the field judging its level of professionalism. Finn noted that professions have the following characteristics:

a. an intellectual technique

b. an application of that technique to the practical affairs of man

c. a period of long training necessary before entering into the profession

d. an association of the members of the profession into a closely-knit group with a high quality of communication between members

e. a series of standards and a statement of ethics which is enforced and

f. an organized body of intellectual theory constantly expanding by research (p. 7).

After applying these six principles to the field of audiovisual, Finn concluded that "audio-visual personnel meet only the first and second completely" (p16). In addition, he concluded that the fourth and fifth characteristics rated "not satisfactory" and the third and sixth were a "failure." In summary, Finn concluded that the audiovisual field "is not yet a profession."

Finn criticized the field for failing to create a cohesive, coherent set of research principles, publication and theory. Finn notes "without a theory which produces hypotheses for

research, there can be no expanding of knowledge and technique" (p. 14). Finn claimed that major theoretical influences came from the "concrete-abstract relationship in learning" and the "remainder of audio-visual theory is scattered throughout the literature" (p. 14).

2.1.2 Communications and Systems Paradigm

In addition to the writings of Finn which help shape the continued development of the professionalism of the field, there was a major shift away from simply focusing on the media to examining the entire process involved with audiovisual education. The emphasis on process would define the second major paradigm previously stated by Saettler (1990). He clearly notes "the communications approach to educational technology altered the traditional theoretical framework of the field. Instead of focusing on devices or media, the focus was shifted to the entire process of communicating information from a source (a teacher or medium) to a receiver (the learner)" (p. 9).

Saettler (1990) notes there were a variety of communication theories espoused during the 1950's, including the works authored by Harold D. Laswell and Theodore M. Newcomb. In particular, the work performed by Claude Shannon and Warren Weaver accrued much attention (Shannon & Weaver, 1949). In their theory, they portrayed communication as a linear process and highlighted the fact that this process included a sender, receiver, message, signal, noise and a channel. No longer was the emphasis simply on the medium such as film or sound recordings but rather on the system itself where each component plays a part that affects other components and funnels into an end result. Furthermore, a new journal in the audiovisual field, AV Communication Review, was founded and it incorporated the "communication" word itself in its moniker (Ely, 1963).

This new vision changed the focus from being on individual units to the entire system that included the actual unique media, communication of messages and the instructor, all united under the umbrella of a "unifying concept" noted as instructional design (Saettler, 1990). The literature shows articles and statements where the learner and his/her characteristics have become more prominent. Instructional design as a field of study continued its development to the current day.

Reiser (2001b) who earlier labeled the field as instructional technology created a definition in 2001 for instructional design and technology as follows:

> The field of instructional design and technology encompasses the analysis of learning and performance problems, and the design, development, implementation, evaluation and management of instructional and non-instructional processes and resources intended to improve learning and performance in a variety of settings, particularly educational institutions and the workplace. Professionals in the field of instructional design and technology often use systematic instructional design procedures and employ a variety of instructional media to accomplish their goals. Moreover, in recent years, they have paid increasing attention to non-instructional solutions to some performance problems. Research and theory related to each of the aforementioned areas is also an important part of the field (p. 57).

2.1.3 Behavioral Science-Based Paradigm

Whether the name is educational technology or instructional technology, behaviorism had a tremendous influence on the growing field of study. Behaviorism focuses on the observable and downplays the mental aspects. Its theories were espoused early on by John B. Watson and later

popularized by B.F. Skinner. In particular, concepts such as stimuli and reinforcements were studies to better understand how people learn and navigate problem situations.

One of the major influences in education technology came from the application of science based principles and specifically, programmed instruction which represents Saettler's third paradigm of the behavioral science-based view. With reinforcement schedules established in the background programs presented information at the pace the student could excel. This opened up tremendous opportunities for developers to use machines including early computers to create learning programs for mathematics, English and science.

One system described as the Personalized System of Instruction was developed by Fred Keller in the late 1960's. In a key paper written by Keller (1968) titled "Goodbye, Teacher…", the author summarized the key aspects of his approach as follows:

1. The go-at-your-own-pace
2. The unit-perfection requirement for advance
3. The use of lectures and demonstrations as vehicles for motivation
4. The related stress upon the written word in teacher-student communication
5. The use of proctors, which permits repeated testing, immediate scoring, almost unavoidable tutoring… (p. 83)

In this system the student works with well-defined units of material that needs to be studied and then takes a test. The test is graded and either the student is rewarded through a lecture or demonstration or the students continues preparation and takes the test again. Burton, Moore, and Magliaro (2004), examined this system and reviewed multiple studies and highlighted concerns about procrastination, completing the full number of units, the appropriate size of the units and the dependency upon written communication.

Outside of programmed instruction, Saettler notes the behaviorists imprint upon school's curriculum include "specific behavioral objectives, behavior modification, systems analysis, performance contracting, and accountability"(p. 14).

2.1.4 Cognitive Science Paradigm

However, the behaviorist's viewpoint became overshadowed by the work of cognitive scientists and their emphasis on the functioning of the mind. Saettler comments that "In a cognitive model of instructional design, the organization, processing, and storage of information by the learner constitute vital elements in instructional development. The cognitive science view of educational technology has developed the concept of learning strategies, intellectual skills that learners use to control their internal processes of attending, perceiving, encoding and retrieval" (p. 14).

It is difficult to address in-depth all of the areas of research and focus in educational technology from the cognitive perspective. An excellent summary of the ten cornerstones of the cognitive perspective on learning was developed by Schneider and Stern (2010):

1. Learning is an activity carried out by the learner.
2. Optimal learning takes prior knowledge into account.
3. Learning requires the integration of knowledge structures.
4. Optimally, learning balances the acquisition of concepts, skills and meta-cognitive competence.
5. Learning optimally builds up complex knowledge structures by organising more basic pieces of knowledge in a hierarchical way.
6. Optimally, learning can utilise structures in the external world for organising knowledge structures in the mind.
7. Learning is constrained by capacity limitations of the human information-processing architecture.

8. Learning results from a dynamic interplay of emotion, motivation and cognition.
9. Optimal learning builds up transferrable knowledge structures.
10. Learning requires time and effort.

Specifically, learning is an activity that requires the subject to do more than just memorize facts. The subject needs to structurally organize information and situate it with other knowledge structures in order to develop a more complete understanding. So even though the teacher has tools, resources and pedagogy at their reach, it is the student who actually is responsible for the actual learning (Schneider & Stern 2010).

Each paradigm offers guidance, parameters and an area of focus for understanding and applying educational technology in the study of the impact multimedia feedback has on adult students. The media paradigm places the technology itself front and center while downplaying the other elements of the learning process. And, even though the technology may not be the singular focus, it cannot be underestimated. The creation of multimedia feedback demands the use of technology. And, this involves a careful study of the software tools, skill levels of instructors, costs and motivating factors in order to capture the real effort of multimedia creation.

The systems paradigm highlights the interconnectedness of all of the components of the multimedia feedback system. Each component is important and dependent upon each other. The multimedia feedback is created by an instructor using a computer in the context of a classroom homework assignment. It is distributed to the learner who then reacts to it based upon their learner preferences and unique personality. No individual part can be isolated and studied without context.

The cognitive paradigm emphasizes the mental capacities and how the mind reacts to interacting with multimedia versus plain text. It moves away from the stimulus response mode of

behaviorism. The multimedia component of multimedia feedback is a key, critical part of this system and having it situated within the cognitive paradigm as well as in Mayer's multimedia theory allows for a richness of context and research questions. The following figure illustrates the interaction of the various paradigms within the context of this study.

As Figure 1 illustrates, the instructional/feedback process is a series of interconnected, sequential steps influenced by the systems paradigm. After, the student completes the assignment the instructor creates the multimedia feedback using elements from the media paradigm. And, the student reacts to this multimedia paradigm in reference to the cognitive and behavioral theories described earlier.

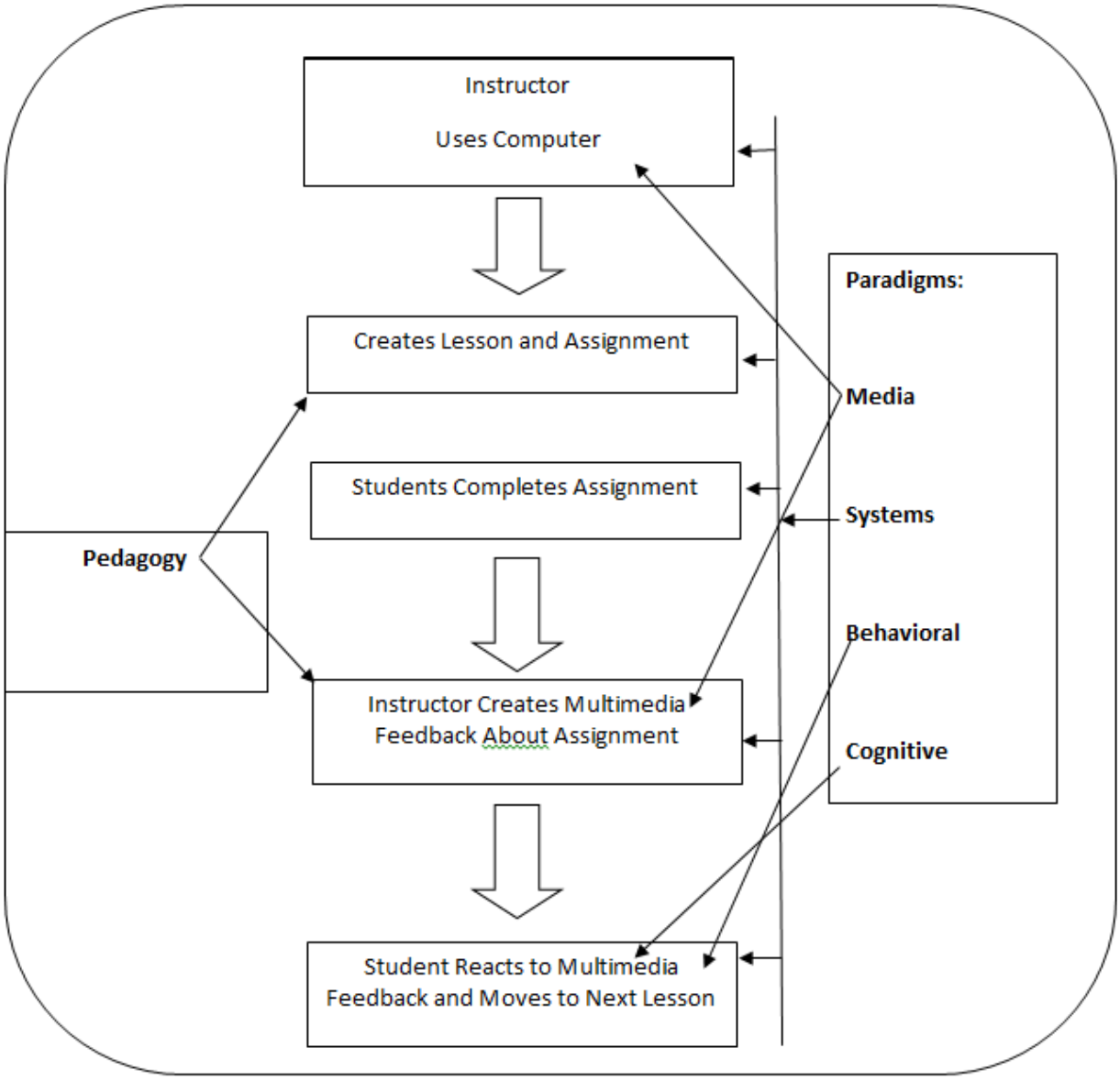

Figure 2: Paradigm interaction

2.2 THE IMPACT OF INSTRUCTOR FEEDBACK ON STUDENTS

Providing help through instructor feedback is a key component of the teaching and learning cycle. Chickering (1987) noted “in classes, students need frequent opportunities to perform and receive suggestions for improvement” (p. 4). And, Berge (2002) claims that feedback and evaluation is one of three pillars necessary for successful learning regardless of learning theory or whether the class existed as online, blended or face to face.

Recently, the National Institute for Learning Outcomes Assessment produced a report titled Assessing Learning in Online Education: The Role of Technology in Improving Student Outcomes (Prineas & Cini, 2011). In this report, the authors’ state “as students work through material delivered online, the role of the instructor will not be to teach all topics to all students but, rather, to monitor which students are having trouble mastering which concepts, so that specific help can be provided to those students at the right time” (p. 12).

It seems that feedback plays multiple roles and is more complex than simply marking an answer right or wrong. Bangert-Drowns, Kulik & Kulik (1991) solidly state that feedback is essential in any theory of learning involving an instructor and learner. They claim “any theory that depicts learning as a process of mutual influence between learners and their environments must involve feedback implicitly or explicitly because, without feedback, mutual influence by definition impossible” (p. 214).

According to Shute (2007) who conducted a major literature review of feedback studies, the feedback itself interacted with “cognitive mechanisms” and could be used by learners to “signal a gap”, could reduce the student’s level of uncertainty, could lower the level of cognitive load or can be used to change/adjust the students work to more closely align with the problem’s objectives (p. 7).

There have been researchers who have conducted a variety of meta-analyses of feedback studies and determined effect sizes along with conditions that may positively or negatively affect the role of feedback (Hattie & Timperley, 2007). In particular they reviewed 12 meta-analyses related to feedback. In their analysis they state that the average effect size was .79 which is quite high. However, they caution readers that there was a large amount of variability "indicating that some types of feedback are more powerful than others" (p. 84). The authors claimed that feedback concerning a task and instructions on how to become better at it had the highest effect sizes while the impact of praise, rewards and punishment seem to lower the effect size to the lowest tier. In addition, Kluger and Denisi (1996) also found a high amount of variability in the effects of feedback intervention in the literature and claimed that much of it was ignored by researchers. In fact, the authors stated that sometimes feedback intervention helped while in other instances it had no effect and at times it actually had a negative impact.

These insights were confirmed and expanded upon by Shute (2007) who recommends the following list of what to do to enhance learning from feedback:

1. Focus feedback on the task, not the learner.
2. Provide elaborated feedback to enhance learning.
3. Present elaborated feedback in manageable units.
4. Be specific and clear with feedback messages.
5. Keep feedback as simple as possible but no simpler.
6. Reduce uncertainty between performance and goals.
7. Give unbiased, objective feedback, written or via computer.
8. Promote a learning goal orientation via feedback.
9. Provide feedback after learners have attempted a solution (See Table 34, 35, 36, 37 in Appendix C).

There are many definitions of feedback in the literature. Hattie & Timperley (2007) state that “feedback is information provided by an agent (e.g. teacher, peer, book, parent, experience) regarding aspects of one’s performance or understanding” (p. 102). They assert that the feedback needs to address three questions: Where am I going? How am I going? and Where to next? Evans (2013) highlighted two schools of thought regarding feedback studies in her literature review. They include socio-constructivist and cognitivist views. In the socio-constructivist view, feedback is facilitative where students can use the feedback to make changes or adjustments to their actions. This differs from the cognitivist view where the feedback is perceived more as specific corrective advice that is heeded by an obedient subject.

The focus for this review lies with formative feedback. According to Shute (2007), “formative feedback represents information communicated to the learner that is intended to modify the learner’s thinking or behavior for the purpose of improving learning” (p. 1). Furthermore, Shute states, “the main goal of formative feedback—whether delivered by a teacher or computer, in the classroom or elsewhere—is to enhance learning and/or performance, engendering the formation of accurate, targeted conceptualizations and skills” (p. 2).

In a literature review of online formative assessment studies Gikandi,, Morrow & Davis (2011) concluded “formatively useful, immediate and continuous feedback is a critical component of formative assessment in online learning that helps to enhance student understanding of learning goals and content” (p. 2349). In addition, the online environment with the varied technologies allows for various electronic formats for feedback such as email or chat and for the use of multimedia such as digital video and audio (Collis, De Boer & Slotman, 2001).

As the goal of feedback is to enhance learning, it makes sense to match the delivery modality of the feedback to the perceptual learning style of the student. If the student prefers text based information it may be a deterrent to force the student to receive feedback in a rich media such as audio or video. However, there appears to be little research in this area.

Lalley (1998) examined both textual and video feedback in a computer assisted learning environment. In the study, he studied a small group of high school students who received an instructional lesson and one of the feedback modalities. The goal was to examine student retention of knowledge, level of thinking and preference. Lalley, concluded that all students learned from the instructional lesson however, the results were mixed regarding the effect of the type of feedback. In one instance, the video feedback produced higher scores on achievement while in another lesson there was no difference. Some students preferred video because it created the visual image for them and it was clear and unambiguous compared to text.

Mathieson (2012) studied the effects of text only feedback and audiovisual feedback via screencasting with students taking an on-line graduate course. She situated her research within the framework of transactional distance as developed by Moore (1993). The study consisted of fifteen students enrolled in two courses. All of the students received both types of feedback. At the end of the course an electronic questionnaire was given to the students asking them to describe their preference, what they liked and disliked about each type of feedback, which was more effective and which would they prefer. The author concluded that students were “satisfied” with the text only feedback but the majority of students liked and preferred the screencasts. In the open ended section of the questionnaire the students used words such as “personal, real and connected”. Although, this study shows support for a multimedia approach, it has limitations. The population is very small and limited to graduate students taking on-line classes. In addition,

the conclusions were discussed within the transactional distance framework. Gorsky and Caspi (2005) reviewed studies about transactional distance theory and concluded that "the basic propositions of transactional distance theory were neither supported nor validated by empirical research findings" (p. 1).

Jones, Georghiades and Gunson (2012) conducted a mixed method study of looking at the impact of text based feedback versus multimedia screencast in a higher education setting. Students who received the feedback completed a questionnaire and participated in structured interviews. The authors concluded that the video was well received and students responded positively to the tutor's voice and inflection. Also, it was easier to store the feedback electronically for future reference. The text based email feedback seemed lacking and when handwritten legibility could be a problem. It seemed that students accepted this technology as it is part of their everyday lives. Some limitations of the study include a very small sample size (only 19% answered the questionnaire), a unified body of either Information Technology or Business majors, and interviews occurred in the summer after the term ended. Also, the nature of the qualitative study seemed to produce predictive generalities rather than comparative analysis between groups.

There have not been many studies focusing on the use of multimedia and text. This is an area that would benefit from further research. Table 1 is a summary matrix of selected multimedia studies examining text vs. multimedia preference. They show mixed results in regards to the effect of each process.

Table 1: Summary Matrix of Visual vs. Text Based Feedback Studies

Study	Background	Result
Lalley (1998)	Examined textual and video feedback with high school students	Results were mixed. Some students did better with video while others did not.
Mathieson (2012)	Examined text only and audiovisual feedback with on-line graduate students	Students were satisfied with text but preferred the screencasts
Jones, Georghiades and Gunson (2012)	Examined text-based feedback versus screencast in higher education setting	It was a qualitative study and students responded well to instructor's voice and inflection. Not much comparison between groups done.

Watts (2007) claims "yet there is a paucity of research on the micro-mechanisms underlying how use of new media affects the evaluative feedback process" (p. 385). Furthermore, Biesinger & Crippen (2010) find "the application of multimedia learning has made it possible to deliver continuous, timely, individualized and pedagogically relevant feedback to learners while maintaining an efficient use of limited cognitive resources. However, the effects of feedback as well as the optimal conditions that make best use of it represent a fairly new research direction" (p. 1470).

Placing multimedia feedback within the context of limited cognitive resources and optimal learning conditions incorporates findings from cognitive science research and the role of memory. A key theory in developing an understanding of cognitive processing was proposed by Baddely (2007). He and Graham Hitch focused on describing the function of short term memory which they dubbed as working memory. Their model consists of a four multicomponent system consisting of an attentional controller: the central executive, and three temporary storage

systems. These three systems are known as the visuospatial sketchpad, the phonological loop and the episodic buffer.

The phonological loop had the ability of briefly holding acoustic information while the visuospatial sketchpad maintained a similar task for visual and spatial information. The limited processing capacity of managing these resources fell to the central executive. The role of the central executive mirrors the Norman and Shallice model where the executive engages as the cognitive task becomes more complex or is novel and it functions by organizing, coordinating and monitoring (Pezzulo n.d.). The link between these short term memory components and long term memory fell to the episodic buffer. It forms an interface between them and integrates the processing results into episodes.

The working model of memory stipulates that the storage facilities or subsystems are both temporary and limited. These constraints become important considerations regarding instruction and maybe feedback. There is a need to conduct further study regarding cognitive processing constraints to avoid the design and implementation of multimedia material simply based upon intuition or experimentation that may result in overload or learner frustration.

Sweller, Ayres, and Kalyuga (2011) declare that "the cognitive load imposed on working memory by various instructional procedures originates from either the intrinsic nature of the instructional material, resulting in an intrinsic cognitive load, or from the manner in which the material is presented and the activities required of learners, resulting in an extraneous cognitive load" (p.vii).

Mayer's (2005) cognitive theory of multimedia learning also espouses many of these same cognitive concepts. It seems that it is critical to pay attention to the construction of the multimedia message from both a cognitive perspective and from a feedback best practice

orientation. Because the area of research regarding multimedia feedback is small, there are not many solid conclusions.

Therefore, it is important to view Shute's (2007) series of recommendations regarding feedback construction and distribution along with Mayer's (2005) cognitive theory of multimedia learning.

2.3 OVERVIEW OF LEARNING THEORY AND STYLES

Learning theory can be classified in rather broad categories such as schools of behaviorism, cognitivism and constructivism. Behaviorism focuses on observed behavior rather than internal cognitive functioning. This implies that outcomes should be explicit and students can evaluate progress through testing and it's important to sequence information while giving feedback. Behaviorism received a boost with the introduction of computers and programmed instruction where drill and practice along with rewards became easier to implement (Pritchard, 2014).

Cognitivism provides a stark contrast to behaviorism. Proponents of cognitivism emphasize internal, non-observable processes. "Strategies should be used to allow learners to perceive and attend to the information so that it can be transferred to working memory. Learners use their sensory systems to register the information in the form of sensations. Strategies to facilitate maximum sensation should be used" (Ally, 2004, p. 10).

In addition, constructivism proposes individuals process information in conjunction with their own reality and create new knowledge. Ally (2004) asserts, "learners must construct a memory link between the new information and some related information already stored in long term memory" (p. 11). In addition, constructivist theory may apply to a series of good practices

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1. Encourages contacts between students and faculty.
2. Develops reciprocity and cooperation among students.
3. Uses active learning techniques.
4. Gives prompt feedback.
5. Emphasizes time on task.
6. Communicates high expectations.
7. Respects diverse talents and ways of learning.

Bangert (2005) believes, “the majority of learner-centered instructional practices which comprise the Seven Principles framework are clearly focused on constructivist-based teaching practices” (p.74). Further support comes from Partlow and Gibbs (2003) who note

"constructivists learning principles may improve the quality of Internet-based courses. However, educators must first be able to recognize them and understand how to apply such principles to their courses. In this regard, defining indicators that help educators utilize constructivist principles in Internet-based course development is important (p.74).

These three learning theories provide much information and guidelines for course authors and instructors. However, Siemens (2004) criticizes these theories because they were created when technology was in its infancy. Siemens states, "Behaviorism, cognitivism, and constructivism are the three broad learning theories most often utilized in the creation of instructional environments. These theories, however, were developed in a time when learning was not impacted through technology. Over the last twenty years, technology has reorganized how we live, how we communicate, and how we learn. Learning needs and theories that describe learning principles and processes should be reflective of underlying social environments." (p. 1).

Siemens (2004) proposes a new learning theory called connectivism that focuses on including technology and connection making which aligns more with the current digital age. He specifies the following principles about connectivism:

- Learning and knowledge rests in diversity of opinions.
- Learning is a process of connecting specialized nodes or information sources.
- Learning may reside in non-human appliances.
- Capacity to know more is more critical than what is currently known
- Nurturing and maintaining connections is needed to facilitate continual learning.
- Ability to see connections between fields, ideas, and concepts is a core skill.

Regardless of which learning theory a course constructor adopts it is important to note that technology has become a more central feature in course construction and implementation.

This can be seen in Internet courses, learning management systems and presentation software such as PowerPoint and Adobe Photoshop. And. the learner along with the instructors may need to become aware and often times use the technology to access and process information. In 2001, Bonk commented that "Higher education institutions need to demand and perhaps help develop and research different types of pedagogical tools for e-learning that foster student higher-order thinking and collaboration" (p. 11).

To better understand the student's learning process it is helpful to examine a subject area known as learning styles. There are a variety of definitions of learning styles. Pritchard (2014) has listed a number of definitions from the literature including:

- a particular way in which an individual learns.
- a mode of learning – an individual's preferred or best manner(s) in which to think, process information and demonstrate learning.
- an individual's preferred means of acquiring knowledge and skills.
- habits, strategies or regular mental behaviours concerning learning, particularly deliberate educational learning that an individual displays.

Even though there are a variety of definitions there is some support that learning styles do have some impact on learning. Cassidy (2014) stated, "There is general acceptance that the manner in which individuals choose to or are inclined to approach a learning situation has an impact on performance and achievement of learning outcomes" (p. 420).

And, more importantly, the learning theories and styles are not necessarily mutually exclusive of each other. This research assumes there is an interactive nature and overlap between them as described in Figure 1. In addition, it is important to look at implementation strategies. After describing learning theories and styles Pritchard (2014) concluded:

> We can see that, in a teacher's bank of knowledge and understanding about learning, there is a place for behaviourism, cognitive and constructivist theory, including situated learning, metacognition, and social constructivism; for an understanding of learning styles and multiple intelligence theory; and for a knowledge of what the neuropsychologists/neuroeducationalists and others are discovering about effective learning contexts. As well as knowing about these areas of theory, teachers must be able to interpret and then apply to practice what it is that they know (p. 119).

Because new technologies bring a multimedia richness to the delivery of information, it may make sense to look at a learning style approach that focuses on modalities. The VARK model is a sensory model that looks at a student's preferences for visual, auditory, reading/writing and kinesthetic modes of delivery (Hawk, 2007). Fleming (2006), the developer of the VARK model and questionnaire states the following propositions about his theory:

- preferences can be matched with strategies for learning. There are learning strategies that are better aligned to some modes than others.
- using your weakest preferences for learning is not helpful; nor is using other students' preferences.
- information that is accessed using strategies that are aligned with a student's modality preference is more likely to be understood and be motivating.
- the use of learning strategies that are aligned with a modality preferences is also likely to lead to persistence learning tasks, a deeper approach to learning, active and effective metacognition.
- knowledge of, and acting on, one's modal preferences is an important condition for improving one's learning.

The VARK questionnaire consists of thirteen questions and measures student's preferences for each one of the modalities (See Figure 9 in Appendix F). Also, students may be multi-modal, having more than one preference. VARK has been used in a variety of studies and

has both positive support and critical reviews. The VARK instrument has become more popular due to its ease of administration and self-scoring.by subjects. Sinclaire (2012) referenced eleven studies using the VARK in examining learning preferences and course delivery mode while Khanal, Shah and Koirala (2014) summarized 21 medical studies involving the VARK.

A guide was published that detailed information about the four sensory modalities and scoring (Fleming & Bonwell, 2013). The questionnaire is designed to assess a subject's preference for the way they work with information. The acronym VARK represents the four sensory modalities that subjects use to learn information. Following is a description of the four modalities from the guide:

> **Visual (V):** This preference includes the depiction of information in charts, graphs, flow charts, and all the symbolic arrows, circles, hierarchies and other devices that are used to represent what might have been presented in words. Layout, whitespace, headings, patterns, designs and color are important in establishing meaning. Learners with a strong Visual preference are more aware of their immediate environment and their place in space. It does not include pictures, movies, videos and animated websites (simulation) that belong with Kinesthetic, defined below.
>
> **Aural (A):** This perceptual mode describes a preference for information that is spoken or heard. Learners with this modality report that they learn best from discussion, oral feedback, email, cellphone chat, texting, discussion boards, oral presentations, classes, tutorials, and talking with others.
>
> **Read/**Write (R): This preference is for information displayed as words either read or written. Typically it means those who prefer books. Not surprisingly, many academics and high-achieving learners have a strong preference for this modality. These learners place importance on precision in language and are keen to use quotes, lists, texts, books and manuals. They have a strong reverence for words.
>
> **Kinesthetic (K):** By definition, this modality refers to the "perceptual preference related to the use of experience and practice (simulated or real)." Although such an experience may use other modalities, the key part of any definition is that the learner is connected to reality, "either through experience, example, practice or simulation," It is often referred to as "learning by doing" but that is an oversimplification especially for higher levels of learning which are often abstract. Such learning can still be made accessible for learners with a Kinesthetic VARK preference. This mode uses many senses (sight, touch, taste and smell) to take in their environment and to experience and learn new things. Some

theorists believe that movement is important for this mode but it is the reality of the situation that appeals most.

Leite, Svinicki and Shi (2010) found the estimated reliability coefficients to be adequate and their study indicated that there was preliminary support for the validity of the test. However, they also stated, "researchers using the VARK should proceed with caution because the use and proposed interpretations of VARK scores have not yet received a comprehensive validation" (p. 337). In addition, Fleming (2006) noted that Dr. Svinicki, who was involved in testing VARK stated that no one else has been able to design an instrument that meets all the necessary statistical properties. Hawk and Shaw (2007) reviewed five learning style type instruments including the VARK and concluded it had a moderate level of support for reliability and validity and strong support in ease of administration. However, their recommendations varied according to conditions such as cost, ease of use and the learning style dimension being studied. Furthermore, Romanelli, Bird and Ryan (2009) claim that the research in learning styles is complicated by all of the different instruments.

There has been mixed results in studies using the VARK instrument. Nasiri, Gharekhani and Ghasempour (2016) conducted a cross-sectional study with a group of 88 dental students in regards to their VARK scores and their final exam scores. They found no significant difference in final exam scores between subjects who did or did not prefer the aural, reading/writing and kinesthetic modalities. However, there was a significant difference in exam scores between students who were visual and not visual.

Ramirez (2011) administered the VARK to 312 undergraduate students and categorized scores as unimodal, multimodal and their first preferred modality. It was found that R unimodal

performed significantly better at arithmetic questions than the A and K modality students. However, with multiple choice questions, no significant differences were found.

Byrne (2002) explored whether students would prefer learning with various types of multimedia depending upon their learning modality. Different multimedia formats including images, computer mediated communication, interactivity and words were created for an online Electrical Science course and students were given a pre-test and post-test. Of the group identified as K modality 47.05% chose Interactivity as their favorite which showed to be significant. Interestingly, no student with an R modality chose Words style. This study illustrates a rather mixed result however, it had a relatively small sample size of 87 students.

Some VARK studies simply collected and analyzed descriptive statistics about participants or examined correlations between preferences. Very few studies exist where learning modalities are empirically tested in regards to the effect or preference of multimedia. In many cases, there was also difficulty in classifying students into the four modalities. Often a large number of students would choose more than one modality making it difficult to classify them. Drago and Wagner (2004) conducted a study with 326 students taking the VARK and implied that because V-visual was positively associated with A-aural and K-kinesthetic while read-write was negatively associated with K-kinesthetic it may be possible to think of these as one dimension high visual/aural/kinesthetic on one end and high read-write on the other end. This is an interesting suggestion that would need further study.

Therefore, the VARK seems to be a reasonable instrument although it has its research limitations. And, the classification modality dimensions seem well developed and examined.

In summary, there is ample evidence by both Shute (2008) and Mayer (2002) suggesting key principles exist in how to create multimedia feedback. And, educational technology has

advanced and matured making the creation of multimedia feedback feasible for an instructor. This study intends to adhere to those feedback creation principles in creating effective and useful multimedia feedback.

In addition, there is evidence that multimedia materials have a greater impact than text based materials used in instruction. Does this hold true in regards to multimedia feedback? The primary focus of this research will be to study the impact of multimedia feedback using screencast video with audio by comparing it to text based email feedback in an educational setting. The impact being examined will be learner's perceptions of their instructor, the acquisition of knowledge, class involvement and their motivation levels.

Lastly, the question of whether there is an interaction between learning modalities and treatment will be studied. Specifically, the question of whether the matching of a learning modality with the type of feedback impacts learner's perceptions of their instructor, the acquisition of subject knowledge, class involvement and their motivation levels.

3.0 OVERVIEW OF THE DESIGN

3.1 DESIGN OF STUDY

This was a quantitative, quasi experimental study that focuses on examining the relationship between two types of feedback and student's perceptions about the instructor, the subject material, class involvement and motivation level. The study attempted to control an independent variable while measuring effects on the dependent variable. The independent variable is the variable being manipulated in the experiment which is the treatment method which can be either video screencast with audio based feedback or text based email feedback. The dependent variable consists of the Likert scores from perception questions on a QUALTRICS survey.

Students were randomly assigned into two treatment groups. These groups are from a class taught at a university with two sections. Students were invited to participate in the study via a recruitment email with an option for extra credit or they can opt out (See Appendix D).

In addition, this study examined the interaction between the treatment method and subject's learning preferences.. The major independent variables in the interaction design would be type of feedback and learning preference. The factor levels for type of feedback would be video screencast with audio feedback and text based email feedback and the factor levels for learning style would be a video preference and a reading preference based on each subject's VARK score: Verbal, Auditory, Read/Write and Kinesthetic. Table 2 illustrates this:

Table 2: Interaction of Treatment and VARK Learning Preference

Preference	Text Based Email Feedback	Screencast Video with Audio
Video preference	Group Average on Question	Group Average on Question
Reading preference	Group Average on Question	Group Average on Question

The study consisted of surveying students in two sections of an introductory class INFSCI 0010. The class typically consists of 50-60 students and is offered in the Fall and Spring terms. Students in the introductory INFSCI 0010 class were randomly assigned to two groups. Group A was provided with feedback on a web design homework project using a standard email/text based process. The homework was posted by the student and within a three week time frame the student received an email of written (typed) feedback of their work based on a set of criteria.

Group B also posted a web page design homework but received multimedia based feedback of their work via a video screencast with audio using the same set of criteria as Group A. The timeframe will be the same as Group A. The multimedia feedback consisted of a screen cast and a narration by the instructor. This video screencast with audio feedback was posted on a website and all of the students in Group B were notified of its availability at the same time.

The specific feedback for both Group A and Group B was initially created without knowing whether it will become a multimedia message or text message in order to minimalize the bias that may occur due to using a microphone and screen capture technology versus keyboarding.

After Group A and Group B received their notification about their homework feedback availability, they were asked to visit a website that had a short QUALTRICS survey for them to take. Both groups had 48 hours to complete the survey. After, the first 24 hours students who have not completed the survey were sent a reminder.

In addition, students were given the VARK survey in class. The survey was collected and stored as part of the research process.

Both survey results were analyzed using the appropriate statistical techniques to discover if there were significant differences when answering the survey questions between Group A (text based email) and Group B (video screencast with audio). Also, an examination of the VARK scores using a two way ANOVA was done to see if there is any interaction between the subject's preferences of learning style and the survey questions.

3.2 DESCRIPTION OF PARTICIPANTS

The students who take this class come from a variety of backgrounds and do not necessarily attract technology based students. This is because the course meets a quantitative general education requirement and has become favored by non-technical students. However, the course is also the first course in becoming an Information Science major. Therefore, the course has a very diverse set of students coming from undeclared, technical and non-technical backgrounds.

Because human subjects are involved in this study, a proposal was submitted to the Institutional Review Board. The proposal met all the necessary criteria and was approved for an exemption.

Subjects were randomly assigned to the two treatment groups by using an online tool QuickCalcs which can be found at http://www.graphpad.com/quickcalcs/. This program facilitates the random assignment of subjects to groups.

3.3 CREATION AND DELIVERY OF FEEDBACK

As part of the class there was an assignment to create a basic web page. The instructions stated that the student should design a web page about themselves. They were asked to make it interesting by presenting an angle of interest. Suggestions are given to the student to think about using their travels, hobbies or sports. Specifically, the assignment stated that they should not use random facts about themselves; instead their website should be cohesive and interesting. The students were given a deadline and they posted their website to the university's computer system.

The students have had at least two weeks of instruction about designing web pages and also a week of interface design concepts. They should be familiar with basic HTML and some Cascading Style Sheets. During the lectures students were also taught about design concepts including use of colors, page layout, composition, white space usage and writing styles.

The researcher used a feedback guideline sheet that provides specific instruction in creating feedback. It's important to note that it takes time and practice in using the feedback guideline sheet. This feedback guideline sheet serves several purposes. Primarily, it provides guidance so that the feedback is presented with Mayer's cognitive theory of multimedia principles in mind and also adhering to recommendations from Shute's study about quality feedback (Shute, 2007). A feedback criteria sheet was completed for each student. Here is a list of the guidelines recommended by Shute that were followed:

1. Focus feedback on the task, not the learner.
2. Provide elaborated feedback to enhance learning.
    a. Tips on how to improve are provided or what would be a better way.
    b. What, how and why.
3. Present elaborated feedback in manageable units.
    a. Only five criteria are evaluated and clearly stated.
4. Be specific and clear with feedback messages.
5. Keep feedback as simple as possible but no simpler.
6. Reduce uncertainty between performance and goals.
    a. Specify goals in the design based upon rubric.
7. Give unbiased, objective feedback, written or via computer.
    a. Rubric used in evaluation, studies and professor as source.
8. Promote a learning goal orientation via feedback.
    a. Focus on continued effort.
9. Provide feedback after learners have attempted a solution.

In addition, here is a list of the guidelines recommended by Mayer:

1. **Multiple Representation Principle**: It is better to present an explanation in words and pictures than solely in words.
2. **Contiguity Principle**: When giving a multimedia explanation, present corresponding words and pictures contiguously rather than separately. Narration and animation together.
3. **Split-Attention Principle**: When giving a multimedia explanation, present words as auditory narration rather than as visual on-screen text. No onscreen words.
4. **Coherence Principle**: When giving a multimedia explanation, use few rather than many extraneous words and pictures. Simple explanations.

5. **Spatial Contiguity Principle** – People learn better when corresponding words and pictures are placed near each other rather than far from each other on the page or screen. Using graphics in real time.

6. **Temporal Contiguity Principle** – People learn better when corresponding words and pictures are presented at the same time rather than in succession.

7. **Modality Principle** – People learn better from graphics and narration than from graphics and printed text.

8. **Personalization Principle** – People learn better from a multimedia presentation when the words are in conversational style rather than in formal style.

9. **Image Principle** – People do not necessarily learn more deeply from a multimedia presentation when the speaker's image is on the screen rather than not on the screen. No image.

A webpage evaluation criteria form was completed for each student (See Figure 8 in Appendix E). This form evaluated the web page based on the following criteria: Theme, Colors, Composition, Writing and Pictures. All of these topics were covered in previous lectures.

The researcher completed each box with a feedback statement using the previous guideline sheet in mind. The researcher did not know whether the feedback will be given via text based email or through video screencasts with audio. This should reduce presentation bias.

After all of the evaluations were completed they were matched to either Group A or Group B. For students in Group A (Text based email feedback) an email was generated and their attached Web Page Evaluation Form and sent to the student along with a score. Figure 3 is a sample email message:

Hello:

I have graded all of the web pages. And one half of you will receive feedback in a text format and the other half will receive a link to a video. You have been chosen to receive text feedback in this email. After reading the following text feedback please click on this link and it will take you to the Qualtrics survey: https://pitt.co1.qualtrics.com/SE/?SID=SV_XXXXXXXXXX

Upon completing the survey which takes only a few minutes you will receive an additional five points on the Web homework.

The deadline is short and all surveys must be submitted by 6:00 PM on Monday Dec21st to receive the extra credit. ** However, you need to read this email feedback first.**

If you have any problems, please let me know.

If you prefer not to complete the survey , you can write a three page opinion paper on how to use design principles in wed design.

Figure 3: Email Message - Text

For students in Group B (Video screencast with audio feedback) an email was generated and a web link is listed for them to visit to hear/see their feedback along with a score. Figure 4 is a sample:

I have graded all of the web pages. And one half of you will receive feedback in a text format and the other half will receive a link to a video. You have been chosen to receive video feedback.

Your score on the assignment was: 18/20
Please follow this link to review your video: **http://www.XXXXXXX.com/t/xkllfsyYPgto**

After viewing the video, please click on this link and it will take you to the Qualtrics survey: **https://pitt.co1.qualtrics.com/SE/?SID=SV_bCwbNXXXXXXXXX**

Upon completing the survey which takes only a few minutes you will receive an additional five points on the Web homework.
The deadline is short and all surveys must be submitted by **6:00 PM on Tuesday, May 3rd** to receive the extra credit. ** However, you need to view the video first.**

If you have any problems, please let me know.
If you prefer not to complete the survey , you can write a three page opinion paper on how to use design principles in web design.

Figure 4: Email message - Video

In summary, a student in the text based email group received an email that would have this form (See Figure 5) attached and completed:

Theme Website has an angle or theme above a bio	The theme about horses is clear and it stands out.
Colors Colors are pleasant and work well together Colors are not too stark or weak	The background color is muted which allows for contrast with the letter and the pictures. Also, the text color is off black, sort of grayish which adds some elegance to the page
Composition Alignment – not all centered Balance – doesn't look like page will fall over Symmetry	There are some areas in the left pane that have too much white space. White space can be seen by viewers as bland or it is missing something. The alignment of your pictures is very good and allows the reader to naturally flow down the page.
Writing Well written text Right amount of text	The text is emotional, energetic and conveys a love of horsemanship.
Pictures Good size Support theme Matching colors	This is the best part of the page. Your pictures are well sized, high impact, full of energy and focuses the reader's attention
Overall	Very Good Job

Figure 5: Sample evaluation

If this student was in the video screencast with audio group he/she would be sent an email and they would go to a link where they would watch a one to two minute screencast. The screencast would show their web page and the instructor would be reading the above script while simultaneously using an electronic pen to circle the areas of interest. So, in one case a student reads about their web page evaluation while in the other case the student sees and hears about their web page evaluation.

3.4 VIDEO SCREENCASTS WITH AUDIO FEEDBACK CREATION

There are a variety of software tools that are available to capture computer screen output including Snagit and Camtasia, both by Techsmith. Both of these packages run on the Windows and Mac operating systems. In addition, drawing tool software add-ons are available for browsers. The browser used in this study was Google Chrome. In addition, a Logitech web camera was used for the purpose of recording sound, no video of the instructor from the camera was used. The drawing add-on software was PageMarker which can be obtained from the Chrome Web Store. And, the video screencasts with audio software was Camtasia.

The process included opening the Chrome browser and typing in the web address of the student's web page on the university computer system. All students have a username and a directory where students can save files including HTML files. The student's evaluation form was retrieved and reviewed. The Camtasia recording software was started and the researcher began speaking into the microphone following the comments on the evaluation sheet and keeping in mind the guidelines for providing effective feedback.

During the recording the researcher can use drawing tools to circle or highlight specific areas of the web page in order to focus attention. For example, if a page has a large, blank white space that violates a design principle it can be circled while the researcher is recommending another technique.

The Camtasia software can be paused as the researcher prepares each section of feedback. This is important as it is impossible to memorize the entire feedback page and it provides the researcher an opportunity to relax and speak at a steady pace.

When the video screen cast is finished it is saved as a file on the researcher' computer. In order for students to be able to access this video screencasts with audio, it must be posted on an

internet hosting site. There are many inexpensive hosting sites that may be used including university systems and commercial systems. This study used a service provided by Techsmith called Screencast.com. After the video screencast with audio was uploaded to Screencast.com a web link was captured and used in the email sent to the student. The student follows the web link in the email and can view the video screencast with audio within a regular browser.

Table 3 summarizes the tasks and associated times:

Table 3: Feedback Creation Tasks and Times

Task	Time	Comment
Select Student Homework	One minute	Involves using browser and web address
Review Evaluation Guidelines	Two minutes	Refresh memory
Evaluate page and complete form	Three minutes	Evaluate based upon established criteria
Review evaluation against guidelines	One Minute	Consistency
If video feedback, create video screencasts with audio and upload	Average: Three minutes	Typical video is one minute long
If text feedback create text feedback	Already created by using feedback evaluation form	
Send email	One minute	Review for accuracy

As seen from this basic chart it took approximately ten minutes to create a video screencasts with audio and approximately five-six minutes to create a text based email feedback message. And, the video screencasts with audio involved the coordination of the message delivery and screencast software packages.

3.5 DEMOGRAPHIC QUESTIONS

The following demographic data were collected via the QUALTRICS survey for each student participating in the study (See Appendix B). The main areas of focus included treatment received, gender, year, age, technology skill level, video feedback experience, expected grade, number of courses with on-line components and academic major.

3.6 SURVEY: PERCEPTION QUESTIONS

The QUALTRICS survey used a five choice Likert Scale measuring students perceptions of their instructor, knowledge acquisition, class involvement and motivation levels. The scale consisted of the following choices: Strongly Agree, Agree, Neither Agree nor Disagree, Disagree and Strongly Disagree.

Because there were very few multimedia feedback studies published there was limited resources for survey questions. Specific guidelines were followed to try to make the questions reliable and valid. Dillman, Smyth, and Christian (2014) recommend specifying clear research questions and then categorizing the concepts to measure, into domains and subdomains along with exploring other studies for questions.

In regards to other studies, Gould (2012) had created a survey and used questions to measure multimedia concepts. The questions were reviewed by peers but no specific data was available on reliability or validity. The primary domains used to build questions included:

1. Clarity of instructor's intent.
2. Student involvement.

3. Motivation.

4. How well multimedia comments were retained.

5. Whether multimedia comments were more personal.

6. Caring level of the instructor.

Ice, Curtis, Phillips, and Wells (2007) created survey questions to measure the impact of audio. They determined there were four measurable domains including ability to understand nuance, feelings of increased involvement, content retention and instructor caring.

Harrison (2009) examined the effects of various audio modes. She examined measuring students' learning, perception of attitude and motivation concepts. Harrison used a variety of formal instruments to measure these concepts but they either focused on audio only, used an eight point Likert scale or had agree/disagree choice items.

The domains from the above studies were intersected with this study's research questions concepts and domains which included the qualities of the instructor, subject material, class environment and motivation. Each of these domains was broken down into subdomains which were then used to generate questions.

The first research question focused on the instructor and had subdomains of approachability, closeness, knowledge level, involvement and caring attitude. Each of these was used as a basis to generate a question. For research question two, the focus was on the knowledge of the subject and had subdomains of understanding, clarity, knowledge level and retention. For research question three the focus was on class environment and it had subdomains of involvement and comfort level. Lastly, research question four focused on motivation and it had two subdomains of motivation for the subject topic and motivation for the class. Table 4 summarizes the process for research question development domains.

Table 4: Domains of Research Questions

Research Question	Domain	Sub domain
1.**Instructor Focused**. To what extent does the learner's perception of the instructor differ between students who receive multimedia feedback using screencast video with audio versus text based email feedback?	Instructor	Approachability Closeness Knowledge Level Involvement Caring attitude
2. Subject Matter Focused. To what extent does the learner's perception of their level of understanding of the subject matter differ between learners who receive multimedia feedback using screencast video with audio or text based email feedback?	Knowledge of Subject	Understanding Clarity Knowledge Retention
3. Class Focused. To what extent does the perception of the learner's level of involvement and comfort differ between learners who receive multimedia feedback using screencast video with audio or text-based feedback?	Classroom	Involvement Comfort
4 **Motivation Focused.** To what extent does the perception of the learner's level of motivation in the class differ between learners who receive multimedia feedback using screencast video with audio or text based email feedback?	Motivation	Motivation for subject Motivation for class

Each subdomain guided the creation of a single or multiple survey questions. Dillman et al. (2014) created a series of guidelines for wording and creating questions. The following guidelines were used:

- Make sure the question applies to the respondent.
- Ask one question at a time.
- Use simple and familiar words.
- Use specific and concrete words to specify the concepts clearly.

- Use as few words as possible to pose the question

From this the following questions were generated for each research question and its corresponding subdomains:

Research Question One: Perception of Instructor

Q17. The feedback made the instructor seem more approachable.

Q18. The feedback made me feel closer to the instructor.

Q19. The feedback made the instructor seem more knowledgeable.

Q20. The feedback made me think the instructor was more involved in the class.

Q21. The feedback made me think the instructor cares about my work.

Research Question Two: Perception of Knowledge Acquisition/Learning

Q22. The feedback increased my level of understanding of the subject.

Q23. The feedback made clearer the details that the instructor was trying to convey.

Q24. The feedback increased the clarity of the instructor's expectations.

Q25. The feedback increased my knowledge of the subject matter.

Q26. The feedback will be easy to remember.

Research Question Three: Perception of Involvement in the class

Q15. The feedback made me feel more involved in the class

Q16. The feedback made the class more comfortable.

Research Question Four: Perception of Motivation

Q27. The feedback has positively affected my motivation for the subject material.

Q28. The feedback has positively affected my motivation for class.

Because there was limited information on reliability and validity two measures were instituted in the implementation of the study. First, a measure of reliability was done by running Cronbach's analysis on each grouping of questions.

Second, each question has second part asking the subject whether they think the question is clear and easy to understand. The measurement scale for this question was a Likert scale similar to the survey question. An analysis of the means and a frequency of response for each question was conducted to determine if any questions were confusing to the subjects.

3.7 ANALYSIS OF RESULTS

The data was evaluated from the QUALTRICS perception survey and examined for any anomalies including duplication, missing values and other problems. If there were duplicate surveys then the most recent was kept and the other discarded. If there were missing values, the statistical package was set to recognize such values.

The statistical software used for analysis was SPSS Version 23. The data was downloaded from the QUALTRICS survey and the VARK survey was inputted manually. The data was analyzed for missing scores, correct datatypes and outliers.

The demographic data from the QUALTRICS perception survey was split into two groups: Group A – text based email feedback and Group B – multimedia based feedback. An analysis using SPSS –Descriptive Statistics –Frequencies was run to demonstrate the distribution of subjects based upon gender, class year, age, technical skill proficiency, previous video feedback experience, expected grade, CourseWeb experience, and major. This analysis presented

a description of the subjects and showed if there any major differences between the groups that may introduce bias.

In order to address and investigate the research questions, the following statistical techniques listed in Table 5 were applied via SPSS.

Table 5: Research Question and Technique Matrix

Question Category	Statistical Technique
1**. Instructor Focused**. To what extent does the learner's perception of the instructor differ between students who receive multimedia feedback using screencast video with audio versus text based email feedback?	The Wilcoxon Rank Sum test will be run on the two treatment groups mean scores applied to the following perception survey questions: Q17. The feedback made the instructor seem more approachable. Q18. The feedback made me feel closer to the instructor. Q19. The feedback made the instructor seem more knowledgeable. Q20. The feedback made me think the instructor was more involved in the class. Q21. The feedback made me think the instructor cares about my work.
2. Subject Matter Focused. To what extent does the learner's perception of their level of understanding of the subject matter differ between learners who receive multimedia feedback using screencast video with audio or text based email feedback?	The Wilcoxon Rank Sum test will be run on the two treatment groups mean scores applied to the following perception survey questions: Q22. The feedback increased my level of understanding of the subject. Q23. The feedback made clearer the details that the instructor was trying to convey. Q24. The feedback increased the clarity of the instructor's expectations. Q25. The feedback increased my knowledge of the subject matter. Q26. The feedback will be easy to remember.

Table 5 (continued)

<table>
<tr><th>Question Category</th><th>Statistical Technique</th></tr>
<tr><td>3. Class Focused. To what extent does the perception of the learner's level of involvement and comfort differ between learners who receive multimedia feedback using screencast video with audio or text-based feedback?</td><td>The Wilcoxon Rank Sum test will be run on the two treatment groups mean scores applied to the following perception survey questions:
Q15. The feedback made me feel more involved in the class
Q16. The feedback made the class more comfortable.</td></tr>
<tr><td>4. Motivation Focused. To what extent does the perception of the learner's level of motivation in the class differ between learners who receive multimedia feedback using screencast video with audio or text based email feedback?</td><td>The Wilcoxon Rank Sum test will be run on the two treatment groups mean scores applied to the following perception survey questions:
Q27. The feedback has positively affected my motivation for the subject material.
Q28. The feedback has positively affected my motivation for class.</td></tr>
<tr><td>5.Interaction Focused To what extent does a learner's learning style preference interact with the type of instructor feedback received? In other words, will learners who receive feedback (screencast video with audio or text based email feedback) that matches their learning style react more positively than those who receive feedback that does not match their learning style?</td><td>A two way ANOVA will be conducted on the data. The major independent variables will be Type of Feedback and Learning Style Preference. The factor levels for type of feedback would be multimedia feedback using screencast video with audio and text based email feedback and the factor levels for learning style preference would be primary preference on the VARK score.

Example:
<table>
<tr><th></th><th>Multimedia feedback using screencast video with audio</th><th>Text based email feedback</th></tr>
<tr><td>Vark preference for multimedia</td><td>Interaction score for question</td><td>Interaction score for question</td></tr>
<tr><td>VARK preference for text</td><td>Interaction score for question</td><td>Interaction score for question</td></tr>
</table>
</td></tr>
</table>

This analysis provided some insight into the effect of using a multimedia feedback using screencast video with audio system with students. The Wilcoxon test showed the mean scores of each group for each perception question. An examination of the mean scores of the groups showed whether Group A or B scored higher on the perception questions along with significance testing.

In addition, the two way ANOVA interaction analysis provided some evidence whether learning style alignment matters. This provided some insight into whether taking into account a student's learning style made a difference.

The analysis addressed each research question in conjunction with the data from the experiment. Because feedback is an important aspect of learning, increasing understanding in this area is important to instructors in the field of education.

4.0 RESULTS

The study examined the effects of two different treatment methods: text based email feedback and video screencast with audio feedback. Descriptive statistics were analyzed to see if both treatment groups had equal distributions on key factors including gender, age, major and technology expertise. And, nonparametric tests were conducted to see if the two groups responded differently to the set of survey questions. Lastly, a statistical test was conducted to discover if there was an interaction effect between the treatment groups and learning preferences.

The results section is organized into the following specific sections. First, there is the Demographic Data Analysis section followed by the Survey Questions Descriptive Statistics section and lastly the Research Question Statistical Analysis section.

4.1 DEMOGRAPHIC DATA ANALYSIS

There were two treatments groups in the study. Each treatment group was formed by randomly assigning students from the INFSCI 0010 classes. Both groups were given a web page design homework assignment. And, one treatment group received text based feedback on the homework assignment while the other group received video screencast feedback on the homework assignment.

After the two treatment groups were formed a demographic data analysis was performed to look for any major differences between the groups that may lead to bias in the survey results. Following is a summary of the information details.

Type of Feedback: There were a total of 74 valid participants in the study. They were randomly divided into two groups. As Table 6 indicates, the two group sizes were relatively similar. The text based email feedback group had 38 subjects while the screencast video with audio group had 36 subjects.

Table 6: Subjects by Type of Treatment

Treatment	Frequency	Percent	Cumulative Percent
Text based email	38	51.4	51.4
Screencast video with audio	36	48.6	100.0
Total	74	100.0	

Gender: As Table 7 indicates, the subjects were relatively evenly divided between male and female subjects for both treatment groups. There were 20 males and 18 females in the text based email feedback group along with an equal 18 males and females in the screencast video with audio group.

Table 7: Subjects by Gender

Treatment	Gender	Frequency	Percent	Cumulative Percent
Text based email	Male	20	52.6	52.6
	Female	18	47.4	100.0
	Total	38	100.0	
Screencast video with audio	Male	18	50.0	50.0
	Female	18	50.0	100.0
	Total	36	100.0	

Year: The subjects were selected from a university class that satisfied a quantitative requirement and attracted students from all years. Also, it was the first course in the Information Science major. As Table 8 shows, the majority of students were freshman, sophomores and juniors. There are two responses where subjects indicated the other category and this may represent students who transferred from another institution or students who were "between" years. In any case, the number was very small. As can be seen from table 8 students were similarly distributed between the two treatment groups.

Table 8: Subjects by Student Year

Treatment	Year	Frequency	Percent	Cumulative Percent
Text based email	Freshman	8	21.1	21.1
	Sophomore	15	39.5	60.5
	Junior	10	26.3	86.8
	Senior	4	10.5	97.4
	Other	1	2.6	100.0
	Total	38	100.0	
Screencast video with audio	Freshman	8	22.2	22.2
	Sophomore	11	30.6	52.8
	Junior	12	33.3	86.1
	Senior	4	11.1	97.2
	Other	1	2.8	100.0
	Total	36	100.0	

Age: Table 9 shows that the majority of students for both treatment groups were between the ages of 18 to 25. The text based email feedback group had 36 subjects and the screencast video with audio had 30 subjects. The video screencast with audio group had 6 students over 25 while the text based email feedback group had a lesser number at two subjects.

Table 9: Subjects by Age

Treatment	Age	Frequency	Percent	Cumulative Percent
Text based email	18-21	29	76.3	76.3
	21-25	7	18.4	94.7
	31-35	1	2.6	97.4
	40-45	1	2.6	100.0
	Total	38	100.0	
Screencast video with audio	18-21	24	66.7	66.7
	21-25	6	16.7	83.3
	26-30	5	13.9	97.2
	36-40	1	2.8	100.0
	Total	36	100.0	

Technology Skills: There was a difference between the groups regarding their perception of technology skills. The text based email feedback group had a larger number of people (53%) who indicated they were of minimal or average proficiency while fewer subjects in the video screencast with audio group chose those same ratings (31%). Both groups were similar in the number of subjects choosing above average and excellent as displayed in Table 10.

Table 10: Subjects by Technology Skill Level

Treatment	Level	Frequency	Percent	Cumulative Percent
Text based email	Minimal	5	13.2	13.2
	Average	15	39.5	52.6
	Above average	14	36.8	89.5
	Excellent	4	10.5	100.0
	Total	38	100.0	

Table 10 (continued)

Treatment	Level	Frequency	Percent	Cumulative Percent
Screencast video with audio	Minimal	2	5.6	5.6
	Average	9	25.0	30.6
	Above average	20	55.6	86.1
	Excellent	5	13.9	100.0
	Total	36	100.0	

Previous Video Feedback: The vast majority of students indicated that they had not received video feedback before in a class along with a similar distribution of scores. So, it seems that this was a new experience for them as shown in Table 11.

Table 11: Subjects by Previous Video Classes

Treatment	Response	Video Feedback	Frequency	Percent	Cumulative Percent
Text based email	Valid	Yes	1	2.6	2.6
		No	37	97.4	100.0
		Total	38	100.0	
Screencast video with audio	Valid	Yes	2	5.6	5.7
		No	33	91.7	100.0
		Total	35	97.2	
	Missing	99	1	2.8	
	Total	36	100.0		

Note: The number 99 was used to represent missing values in SPSS

Expected grade: Table 12 shows almost no one believed from both groups that they were going to get a D grade or fail the class. The distributions between the two groups were similar for letter grades A and B while nine students in the text based email feedback group chose C versus only two in the screencast video with audio group.

Table 12: Subjects by Expected Grade

Treatment	Grade	Frequency	Percent	Cumulative Percent
Text based email	A	18	47.4	47.4
	B	11	28.9	76.3
	C	9	23.7	100.0
	Total	38	100.0	
Screencast video with audio	A	22	61.1	61.1
	B	11	30.6	91.7
	C	2	5.6	97.2
	D	1	2.8	100.0
	Total	36	100.0	

Courses With an On-Line Component: Table 13 shows the vast majority (96%) of students from both groups had multiple courses previously that had an on-line component such as the Blackboard system. There were only three students that had no courses with an on-line component. The distribution between the groups were similar except for the category 3-5 where the text based email feedback group had 11 subjects while the screencast video with audio only had 4 subjects.

Table 13: Number of Courses with an On-line Component

Treatment	Number	Frequency	Percent	Cumulative Percent
Text based email	0	1	2.6	2.6
	1-3	2	5.3	7.9
	3-5	11	28.9	36.8
	Over 5	24	63.2	100.0
	Total	38	100.0	
Screencast video with audio	0	2	5.6	5.6
	1-3	5	13.9	19.4
	3-5	4	11.1	30.6
	Over 5	25	69.4	100.0
	Total	36	100.0	

Major: Table 14 represents all of the students in the study. Students who indicated that they were Undeclared, Unknown, Information Science hopefuls were classified as Undeclared/Unknown. Dual majors were treated as a primary major. Table 14 shows the majors with the largest numbers were Information Science (31%), Unknown/Undeclared (18%) and Computer Science (7%) respectively. Information Science and Computer Science students made up slightly more than one third (38%) of the subjects in the study.

There were 22 additional majors represented however, most of these consisted of one or two students. An analysis showed that the Information Science and the Computer Science students distributed fairly evenly between the two treatment groups with 11 students in the text based email feedback group and 15 in the screencast video with audio group. Also, there were 7 undeclared in the text based email feedback group and 3 in the screencast video with audio group.

Table 14: Subjects by Majors

Major	Frequency
Information Science	23
Unknown/Undeclared	13
Computer Science	5
Communication	4
Finance	3
Health Information Management	3
Administration of Justice	2
Architectural studies	2
English	2
Health services	2
Anthropology	1
Business Information Systems	1
Communication Science and Disorders	1
Communications	1

Table 14 (continued)

Major	Frequency
Computer Science/Music	1
English Literature	1
History	1
Media and Professional Communications	1
Neuroscience	1
Nonfiction	1
Political science	1
Psychology	1
Public Service	1
Urban Studies	1
User-centered design	1
Total	74

4.2 SURVEY QUESTION DESCRIPTIVE STATISTICS

The Shapiro-Wilk test was used to test for normality in the survey question distributions. Table 33 shows all the questions had a $p < .05$ indicating they were not normally distributed (See Appendix A). This confirmed the need for a nonparametric test like the Wilcoxon Rank-Sum test.

Table 15 is a summary of the means for each survey question grouped by treatment. In addition, it shows the standard deviation for both treatments. The table shows that most of the means were over 4.0 . However, there were a few that fell below the 4.0 mark which needs to be examined more closely.

Table 15: Survey Questions Means and Standard Deviation

Question	Text Based		Video Screencast	
	Mean	SD	Mean	SD
Q15. The feedback made me feel more involved in the class	3.66	.781	3.64	.961
Q16. The feedback made the class more comfortable.	3.39	.855	3.60	.695
Q 17. The feedback made the instructor seem more approachable.	3.81	.908	4.11	.667
Q18. The feedback made me feel closer to the instructor.	3.16	1.068	3.64	1.073
Q19. The feedback made the instructor seem more knowledgeable.	3.51	.804	3.89	.887
Q20. The feedback made me think the instructor was more involved in the class.	4.11	.737	4.39	.645
Q21. The feedback made me think the instructor cares about my work.	4.19	.701	4.14	.798
Q22. The feedback increased my level of understanding of the subject.	3.43	.987	3.61	1.128
Q23. The feedback made clearer the details that the instructor was trying to convey.	3.97	.799	4.28	.849
Q24. The feedback increased the clarity of the instructor's expectations.	4.16	.823	4.09	.853
Q25. The feedback increased my knowledge of the subject matter.	3.39	1.054	3.39	1.022
Q26. The feedback will be easy to remember.	3.82	.955	4.31	.710
Q27. The feedback has positively affected my motivation for the subject material.	3.45	.828	3.92	.874
Q28. The feedback has positively affected my motivation for class.	3.29	1.011	3.81	.889

A follow-up question was asked of the subjects for each survey question (dependent variable) from question 15 to question 28. The follow-up question (Part 2) asked whether the current question was clear and easy to understand. A summary of the answers is displayed in Table 16. In this way a basic view of whether the subject understands each question was obtained.

Table 16: Question Validity Frequency and Mean Tally

Question	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree	Mean	S.D
Q15 Part 2	1	6	7	39	21	3.99	.914
Q16 Part 2	3	4	4	41	21	4.00	.972
Q17 Part 2	0	1	2	40	31	4.36	.610
Q18 Part 2	1	1	4	43	25	4.22	.727
Q19 Part 2	0	0	7	38	29	4.30	.635
Q20 Part 2	0	1	3	39	31	4.35	.629
Q21 Part 2	0	0	2	41	31	4.39	.544
Q22 Part 2	0	0	9	38	26	4.23	.657
Q23 Part 2	0	3	8	39	24	4.14	.764
Q24 Part 2	0	1	6	37	29	4.29	.677
Q25 Part 2	0	1	4	43	26	4.27	.626
Q26 Part 2	0	0	3	41	30	4.36	.563
Q27 Part 2	1	0	4	39	30	4.31	.701
Q28 Part 2	1	0	3	44	26	4.27	.668

A quick overview shows that there were relatively few responses in the Strongly Disagree and Disagree categories demonstrating that the majority of subjects had a good understanding of the questions. The question with the lowest mean (M = 3.99) was question 15: The feedback made me feel more involved in class. However, the majority (81%) still indicated they Agreed or Strongly Agreed that the question was clear and easy to understand. All of the other means for the other questions were above 4.0.

In addition, a Cronbach analysis was conducted on the questions categorized on each domain as previously outlined in Table 4. The results are summarized in Table 17. Cronbach's alpha is a test designed to measure reliability with a range of .7 to .8 considered good (Field, 2015).

Table 17: Cronbach results

Question Group	Cronbach's Alpha	Num of Items
Instructor Focused Q17-21	.803	5
Subject Focused Q 22-26	.705	5
Class Focused Q15-16	.584	2
Motivation Focused Q27-28	.841	2

Note. Cronbach's Alpha is a measure of reliability.

4.3 RESEARCH QUESTION STATISTICAL ANALYSIS

4.3.1 Research Question One: Instructor Focused

The Wilcoxon Rank Sum test was performed on the two treatment groups mean scores applied to questions 17, 18, 19, 20, 21. Mean ranks are displayed in Table 18. And significance results are shown in Table 19. None of the questions showed a significant difference between the two treatment groups. However, the mean ranks scores were higher for all of the questions with the exception of question 21. This may indicate that there was an impact from the video screencast with audio group but the effect was not strong enough to be significant. This will be explored further in the discussion section.

Table 18: Wilcoxon Test Mean Ranks: Questions 17, 18, 19, 20, 21

Question	Treatment	N	Mean Rank	Sum of Ranks
Q 17. The feedback made the instructor seem more approachable.	email	37	33.84	1252.00
	video	36	40.25	1449.00
	Total	73		
Q18. The feedback made me feel closer to the instructor.	email	37	32.76	1212.00
	video	36	41.36	1489.00
	Total	73		
Q19. The feedback made the instructor seem more knowledgeable.	email	37	32.81	1214.00
	video	36	41.31	1487.00
	Total	73		
Q20. The feedback made me think the instructor was more involved in the class.	email	37	33.12	1225.50
	video	36	40.99	1475.50
	Total	73		
Q21. The feedback made me think the instructor cares about my work.	email	37	37.27	1379.00
	video	36	36.72	1322.00
	Total	73		

Table 19: Wilcoxon Test for Significance: Questions 17, 18, 19, 20, 21

Question	Z Score	Exact Sig. (2-tailed)	Exact Sig. (1-tailed)
Q 17. The feedback made the instructor seem more approachable.	-1.391	.168	.084
Q18. The feedback made me feel closer to the instructor.	-1.796	**.**073	.037
Q19. The feedback made the instructor seem more knowledgeable.	-1.817	.070	.035
Q20. The feedback made me think the instructor was more involved in the class.	-1.746	.082	-.123
Q21. The feedback made me think the instructor cares about my work.	-.123	**.**926	.469

4.3.2 Research Question Two: Subject Focused:

The Wilcoxon Rank Sum test was performed on the two treatment groups mean scores applied to questions 22, 23, 24, 25 and 26. . Mean ranks are displayed in Table 20 and significance testing in Table 21.

This research question focused on students' perception of the subject matter and question 23 and question 26 showed significant differences between the two groups. First, the Wilcoxon Rank-Sum test indicated that the video screencast with audio group rated question 23 higher (mean ranks = 41.47) than the text based audio group (mean ranks = 32.65), z = -1.940, p = .049. The effect size calculated using -1.940 ÷ √(73) equals -0.23 which would be small with .3 being the minimum for medium (Field, 2013).

Second, the Wilcoxon Rank-Sum test indicated that the video screencast with audio group rated question 26 higher (mean ranks = 43.13) than the text based audio group (mean ranks = 32.17), z = -2.399, p = .016. The effect size calculated using -2.399 ÷ √(74) equals -0.28 which would be small and slightly below the .3 being the minimum for medium (Field, 2013).

Table 20: Wilcoxon Test Mean Ranks: Questions 22, 23, 24, 25, 26

Question	Treatment	N	Mean Rank	Sum of Ranks
Q22. The feedback increased my level of understanding of the subject.	email	37	34.80	1287.50
	video	36	39.26	1413.50
	Total	73		
Q23. The feedback made clearer the details that the instructor was trying to convey.	email	37	32.65	1208.00
	video	36	41.47	1493.00
	Total	73		
Q24. The feedback increased the clarity of the instructor's expectations.	email	38	37.88	1439.50
	video with	35	36.04	1261.50
	Total	73		

Table 20 (continued)

Question	Treatment	N	Mean Rank	Sum of Ranks
Q25. The feedback increased my knowledge of the subject matter.	Text based email	38	37.74	1434.00
	video	36	37.25	1341.00
	Total	74		
Q26. The feedback will be easy to remember.	email	38	32.17	1222.50
	video	36	43.13	1552.50
	Total	74		

Table 21: Wilcoxon Test for Significance: Questions 22, 23, 24, 25, 26

Question	Z Score	Exact Sig. (2-tailed)	Exact Sig. (1-tailed)
Q22. The feedback increased my level of understanding of the subject.	-.958	.341	.171
Q23. The feedback made clearer the details that the instructor was trying to convey.	-1.940	**.049**	.025
Q24. The feedback increased the clarity of the instructor's expectations.	-4.11	.693	.342
Question	Z Score	Exact Sig. (2-tailed)	Exact Sig. (1-tailed)
Q25. The feedback increased my knowledge of the subject matter.	-.103	.920	.460
Q26. The feedback will be easy to remember.	-2.399	**.016**	.009

Note: Bold indicates significance $p < .05$

4.3.3 Research Question Three: Class Focused

The Wilcoxon Rank Sum test was performed on the two treatment groups mean scores applied to question 15 and 16. . Mean ranks are displayed in Table 22 and significance testing in Table 23.

None of the questions showed a significant difference between the two treatment groups although the mean ranks were higher for both of the questions for the screencast video with audio group over the text based email feedback group.

Table 22: Wilcoxon Test Mean Ranks: Questions 15, 16

	Treatment	N	Mean Rank	Sum of Ranks
Q15. The feedback made me feel more involved in the class	email	38	37.26	1416.00
	video	36	37.75	1359.00
	Total	74		
Q16. The feedback made the class more comfortable.	email	38	34.57	1313.50
	video with	35	39.64	1387.50
	Total	73		

Table 23: Wilcoxon Test for Significance: Questions 15, 16

Question	Z Score	Exact Sig. (2-tailed)	Exact Sig. (1-tailed)
Q15. The feedback made me feel more involved in the class	-.108	.922	.464
Q16. The feedback made the class more comfortable.	-1.106	.275	.141

4.3.4 Research Question Four: Motivation Focused

The Wilcoxon Rank Sum test was performed on the two treatment groups mean scores applied to question 27 and 28. Mean ranks are displayed in Table 24 and significance testing in Table 25

This research question focused on students' perception of their motivation for the subject material and their motivation for the class. Both questions demonstrated significant differences

between the two groups. First, the Wilcoxon Rank Sum test indicated that the video screencast with audio group rated question 27 higher (mean ranks = 42.81) than the text based audio group (mean ranks = 32.47), z = -2.226, p = .025. The effect size calculated using -2.226 ÷ √(74) equals -0.26 which would be small with .3 being the minimum for medium (Field, 2013).

Second, The Wilcoxon Signed-Ranks test indicated that the video screencast with audio group rated question 28 higher (mean ranks = 42.29) than the text based audio group (mean ranks = 32.96), z = -1.971, p = .049. The effect size calculated using -1.971 ÷ √(74) equals -0.23 which would be small with .3 being the minimum for medium (Field, 2013).

Table 24: Wilcoxon Test Mean Ranks: Questions 27, 28

Question	Treatment	N	Mean Rank	Sum of Ranks
Q27. The feedback has positively affected my motivation for the subject material.	email	38	32.47	1234.00
	video	36	42.81	1541.00
	Total	74		
Q28. The feedback has positively affected my motivation for class.	email	38	32.96	1252.50
	video	36	42.29	1522.50
	Total	74		

Table 25: Wilcoxon Test for Significance: Questions 27, 28

Question	Z Score	Exact Sig. (2-tailed)	Exact Sig. (1-tailed)
Q27. The feedback has positively affected my motivation for the subject material.	-2.226	**.025**	.013
Q28. The feedback has positively affected my motivation for class.	-1.971	**.049**	.025

Note: Bold indicates significance p < .05

4.3.5 Research Question Five: Interaction Focused

A summary table showing the frequency of each VARK score of all of the subjects is presented in Table 26. There were 33 subjects who indicated they had a single primary preference. Five subjects indicated their primary preference was Visual (V), three subjects indicated Aural (A), thirteen subjects indicated Read/Write (R) and twelve subjects indicated Kinesthetic (K). In addition, 36 other subjects indicated they were multimodal: using multiple preferences. And there were five missing scores.

Table 26: VARK Distribution of Scores of Subjects

Response Type	VARK Score	Frequency	Valid Percent	Cumulative Percent
Valid	Aural	3	4.3	4.3
	AK	5	7.2	11.6
	AR	2	2.9	14.5
	ARK	1	1.4	15.9
	Kinesthetic	12	17.4	33.3
	Read/Write	13	18.8	52.2
	RK	3	4.3	56.5
	Visual	5	7.2	63.8
	VA	1	1.4	65.2
	VAK	4	5.8	71.0
	VAR	1	1.4	72.5
	VARK	14	20.3	92.8
	VK	1	1.4	94.2
	VRK	4	5.8	100.0
	Total	69	100.0	
Missing	99	5		
Total		74		

Note: V is Visual, A is Aural, R is Read/Write and K is Kinesthetic. The number 99 was used to represent missing values in SPSS

Also, a two way ANOVA was conducted on the data. The major independent variables were type of feedback and learning style preference. The factor levels for type of feedback were screencast video with audio and text based email and the factor levels for learning style preference were the primary preference of R on the VARK score which represents a preference for reading/writing and K which represents a preference for video. Table 27 shows the number of subjects in each group.

Table 27: Subjects in Two Way ANOVA: Compare Treatment and VARK Groups K and R

	Description	N
Treatment	Text based email	13
	Screencast video with audio	12
VARK Score	Kinesthetic	12
	Read/Write	13

Table 33 is a summary table of the Main Effect and the Interaction statistic between the two treatment types and the two VARK groups of R and K for each survey question (See Appendix A). There were only two situations that resulted in a significant reading.

As shown in Table 28 there was a significant interaction between treatment groups and learning preference for question 24: The feedback increased the clarity of the instructor's expectations, $F(1, 21) = 14.485$, $p = .001$. The partial Eta Squared value = .408 indicating 41% of the variance due to the effect and associated error and the observed power value = .952. This would indicate a large effect (Brown, 2008; Draper, 2002). The Levene's test of Equality of Error Variances value = .473 indicating that the error variance was equal across groups.

Table 28: Two Way ANOVA Results for Interaction Effect for Question 24

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Treatment	.008	1	.008	.022	.884
VARK_Score	.151	1	.151	.413	.527
Treatment * VARK_Score	5.294	1	5.294	14.485	**.001**
Error	7.675	21	.365		
Total	471.000	25			
Corrected Total	13.040	24			

a. R Squared = .411 (Adjusted R Squared = .327)

Note: Dependent Variable: Question 24: The feedback increased the clarity of the instructor's expectations. Bold indicates significance p <. 05.

As shown in Table 29, there was also a significant finding with the main effect between treatment groups in regards to question 26: The feedback will be easy to remember F(1, 21) = 8.746, p = .008. The partial Eta Squared value = .294 indicating 29% of the variance due to the effect and associated error and the observed power value = .805. This partial eta indicates a large effect (Brown, 2008; Draper, 2002). The Levene's test of Equality of Error Variances value = .246 indicating that the error variance was equal across groups.

Table 29: Two Way ANOVA Results for Main Effect for Question 26

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Treatment	4.758	1	4.758	8.746	**.008**	.294
VARK_Score	.008	1	.008	.015	.904	.001
Treatment * VARK_Score	.258	1	.258	.474	.499	.022
Error	11.425	21	.544			
Total	441.000	25				
Corrected Total	16.640	24				

Note: Dependent Variable: Q28: The feedback will be easy to remember. Bold indicates significance p <. 05

In summary, the results of this study show that the two treatment groups basically had similar distributions across factors and the questions were mostly reliable and valid. And, most importantly, there were significant differences between the two treatment groups on four survey questions while learning preferences seem to have some impact on at least two survey questions. These findings around subject matter, motivation and learning style interaction will be examined in detail.

5.0 DISCUSSION AND INTERPRETATION

This section examines the overall results of the study and explores each research question. In regards to each research question, the findings are interpreted and related to the literature, theory and to practice.

As mentioned earlier in the paper, the key purpose of the study is to examine the impact that video screencast with audio feedback has on learners compared to text based email feedback in an education setting. In particular, the study examines how the learner's perceptions are affected by the multimedia feedback using screencast video with audio compared to the text-based email feedback.

5.1 DEMOGRAPHIC ANALYSIS

It appears that gender and sample size of the two groups were not a source of bias because each group had similar numbers. This is an important point because unbalanced sample sizes can create problems with the robustness of statistical testing. And, if males and females were unbalanced then some of the findings may have occurred due to gender rather than the treatment.

The subjects were relatively evenly distributed over class rank. The majority of subjects (87%) from the screencast with video feedback group were drawn from Freshman, Sophomores and Juniors while a similar number (86%) represented the text based email feedback group. In

both groups, only four seniors participated. Even though this number is low it was equal in both groups which probably eliminated any class rank bias. So, the results can be generalized more to underclass students rather than to seniors or graduate students.

There was a slight difference in the representation of age brackets in the two groups. Both groups had most of their participants from the ages of 18-25. The smaller percentage (83%) was from the screencast video with audio group compared to the larger percentage (95%). However, there were six subjects over the age of 26 in the screencast video with audio group and only two subjects from the text based email group. The screencast video group had a few people in higher age category.. This is still a relatively small number and probably contributed little to the study outcome. However, students in a higher age category typically are more practical and focused on getting an education. And, they might have appreciated the screencast video with audio more because it gave them more insight to their performance of the assignment.

The text based email feedback group had a larger number of people (53%) who indicated they were of minimal or average proficiency while fewer subjects in the video screencast with audio group chose those same ratings (31%). This may indicate that these students perceive a higher comfort and experience level with technology which would likely make them more receptive to using computer video and multimedia. However, both groups indicated that video feedback was relatively a new experience for them. So, this may balance the effect of technology expertise. The vast majority of students indicated that they had not received video feedback before in a class along with a similar distribution of scores with two subjects saying yes from the video screencast with audio group and only one from the other.

It's interesting to note that the subjects from both groups had fairly high expectations for their expected grade. All of the screencast video with audio group expected an A, B or C grade while almost all (97%) of the screencast video with audio group did also. Only one student expected a D grade. So, the distribution seemed to be fairly equal also. This shows a class of highly motivated students who would take the homework assignment seriously and follow through with the survey. It's important to have willing and motivated participants in the study in order to give the study results more credibility.

Most of the students in both groups had experience with an on-line component like CourseWeb. In the video screencast with audio group the majority (70%) had over five courses with an on-line component while there was a majority (64%) in the other group. This indicates that the students had become familiar with the use of technology course delivery and would not likely be surprised by having homework and lectures assigned via CourseWeb.

Lastly, there was a fairly equal distribution of majors between the two groups. In both cases there were many majors represented only once. Technology majors including Information Science and Computer Science made up the largest groups. An analysis showed that the Information Science and the Computer Science students distributed fairly evenly between the two treatment groups with 15 in the screencast video with audio group and 11 students in the text based email feedback group. If one group had a predominant number of technical majors then they may have been more influenced by the technology than the treatment.

In summary, it appears that the randomization process along with the number of subjects allowed for the creation of two groups with fairly equal distributions. Keep in mind that there were a few students in higher age category and student who rated their technology skills higher in the video screencast with audio group. However, the numbers are low and probably have little

impact on the study results. Nonetheless, it is important to note the slight differences in the groups because participants who are more comfortable with technology may be more likely to mark higher scores on the survey questions if they received the video screencast with audio feedback.

5.2 SURVEY QUESTION DISCUSSION

Each subject was asked to rate their understanding of each survey question by responding to a follow-up question: The follow-up question was: This question is clear and easy to understand. The subject responded by choosing one option from a five point Likert based scale ranging from Strongly Disagree to Strongly Agree. In the majority of cases the subjects chose the options Agreed or Strongly Agreed. Table 30 summarizes the results.

Nine questions (17, 18, 19, 20, 21, 25, 26, 27, and 28) received over 90 per cent of responses from the Agree and Strongly Agree options. This is a strong indicator that the subjects understood these questions. Also, three questions (22, 23, and 24) received over 85 per cent of responses from the Agree and Strongly Agree options. Although not as strong as the first set of questions, this still represents a vast majority of subjects who comprehended the question. In regards to Question 22, no subject choose the Strongly Disagree or Disagree options and in regards to Question 23 there were three Disagree and lastly for Question 24 there was only one subject choosing the Disagree option. Again, this seems to show that these questions too were well understood by the vast majority of the subjects.

The two questions with the lowest percentage of choices from the Agree and Strongly Agree options were Questions 15 and 16. With both Question 15 and Question 16 there were

seven students who indicated that they strongly disagreed or disagreed that the question was clear and easy to understand. Question 15 had only one subject choosing Strongly Disagree and Question 16 had three. Even though there were more students who chose the options of Strongly Disagreed and Disagreed, there numbers seem to be relatively small. However, it is important to keep in mind when interpreting Questions 15 and 16 that there may have been a few students who did not understand the question well.

By examining the last column of Table 30 it shows a very small percentage of students opting for the Strongly Disagree or Disagree options for nearly all the questions with the exception of Questions 15 and 16.

In summary, as the results of the survey questions are interpreted some variability of responses for Questions 15 and 16 may have occurred due to a lack of understanding of the question while all of the other survey questions seemed to have a high level of understanding by the vast majority of the subjects.

Table 30: Frequency of Agree or Disagree of the Clear and Understanding Questions

Question	Frequency of Agree and Strongly Agree	Percentage	Frequency of Strongly Disagree and Disagree	Percentage
Q15	60	81	7	9
Q16	62	84	7	9
Q17	71	96	1	1
Q18	68	92	2	3
Q19	67	91	0	0
Q20	70	95	1	1
Q21	72	97	0	0
Q22	64	86	0	0
Q23	63	85	3	4
Q24	66	89	1	1
Q25	69	93	1	1

Table 30 (continued)

Question	Frequency of Agree and Strongly Agree	Percentage	Frequency of Strongly Disagree and Disagree	Percentage
Q26	71	96	0	0
Q27	69	93	1	1
Q28	70	95	1	1

5.3 RESEARCH QUESTION ONE

5.3.1 Instructor Focused

To what extent does the learner's perception of the instructor differ between students who receive multimedia feedback using screencast video with audio versus text based email feedback? The above research question was examined by asking the subjects of the study the following survey questions:

Q17. The feedback made the instructor seem more approachable.

Q18. The feedback made me feel closer to the instructor.

Q19. The feedback made the instructor seem more knowledgeable.

Q20. The feedback made me think the instructor was more involved in the class.

Q21. The feedback made me think the instructor cares about my work.

This research question focused on student's perception of the instructor and none of the questions showed a significant difference between the two treatment groups although the mean ranks were higher for all of the questions for the screencast video with audio group with the exception of question 21.

At first it may seem surprising that the students' perception did not change about the instructor but the study was implemented at the end weeks of the semester. So, students in the class all had a chance to experience the instructor first-hand. And as Garrison (2008) indicates the face to face medium is rich. So, one possibility is that students developed an impression about the instructor's knowledge, approachability, involvement, caring level and personal distance through watching the instructor lecture, ask students questions, respond to questions, grade tests, interpret difficult concepts for approximately thirteen weeks. So, when asked about whether their perceptions changed based upon one homework assignment and the feedback treatment, it may be reasonable to assume that their viewpoints about the instructor had already solidified. Gould (2012) had a similar concern with his study and concluded "As a result, student activities that occurred over the first three weeks, such as interacting with me (the instructor) and their classmates and engaging with the course environment and learning resources, online and in the classroom, may have influenced the attitudes and perceptions of participants" (p. 109).

Mathieson (2012) had conducted a crossover design with two treatments: text only and text plus audiovisual feedback. The sample was small with 15 students but Mathieson indicated that the students stated they felt that the audio visual feedback helped them feel more "connected" to the instructor and was more "personal and real " (p. 149). However, it is interesting to note that this study was done with two online post professional courses. An online course would probably not provide as many cues and information about the instructor and it may be such that multimedia feedback may have more of an impact with online courses than face to face courses. Another example to support this thought was the work of Ice et. al (2007) who conducted a study of seven asynchronous online courses where students received text based and

audio feedback. The study indicated that students felt that the instructor cared more about the students and there was a greater sense of community with the audio based feedback.

Pearcy (2009) conducted a study examining student satisfaction with online, face to face and blended instruction. While the perceived success rate for the blended and the online classes were 70%, the perceived success rate for face to face classes was near 90%. Pearcy indicated that the students had specifically mentioned the teacher's style, enthusiasm, knowledge and presentation style. This appears to further emphasis the import and influence that the face to face classroom has on student's perception of instructors.

5.4 RESEARCH QUESTION TWO

5.4.1 Subject Matter Focused

To what extent does the learner's perception of their level of understanding of the subject matter differ between learners who receive multimedia feedback using screencast video with audio or text based email feedback?

The above research question was examined by asking the subjects of the study the following survey questions:

Q22. The feedback increased my level of understanding of the subject.

Q23. The feedback made clearer the details that the instructor was trying to convey.

Q24. The feedback increased the clarity of the instructor's expectations.

Q25. The feedback increased my knowledge of the subject matter.

Q26. The feedback will be easy to remember.

This research question focused on students' perception of the subject matter and question 23 and question 26 showed significant differences between the two groups with the video screencast with audio group scoring higher than the text based feedback group on both questions.

The fact that the video screencast group rated a higher level of understanding then the text based feedback group fits well with Mayer's multimedia research and previous studies regarding the multimedia principle. Mayer stated, "According to the cognitive theory of multimedia learning, deeper understanding occurs when students mentally connect pictorial and verbal representations of the explanation" (p. 63).

One of the assumptions underlying this effect is explained in part by the cognitive theory of multimedia learning (Mayer, 2005). As indicated earlier, the theory posits that the humans have a cognitive structure comprised of two channels. One of these can process visual information while the other processes verbal information. Second, there is limited capacity for processing information. And, lastly meaningful learning occurs when a learner actively processes information by selecting, organizing and integrating information with other prior knowledge in order to move it to long term memory.

For deep learning to occur Mayer suggests following a number of principles. For this study, Table 31 shows specific principles that were followed in the design of the video screen cast with audio:

Table 31: Principles of CTML

Multimedia Principle	Deeper learning with words and pictures rather than words alone.
Contiguity Principle	Deeper learning when pictures and words presented simultaneously
Coherence Principle	Deeper learning when extraneous words, sounds or pictures are excluded rather than included.

Table 31 (continued)

Modality Principle	Deeper learning when words are presented as narration rather than on-screen text
Redundancy Principle	Deeper learning when words are presented as narration rather than as both narration and on-screen text
Personalization Principle	Deeper learning when words are presented in conversational style rather than formal style.

The video screencast followed Mayer's modality principle and did not show on-screen text during the narration. Instead, the video included using a digital pen to specify and highlight areas that were good or needed improvement while the narration provided more detail. And, the feedback followed the personalization principle as the scripts for the feedback were created by following Shute's (2007) recommendations of focusing feedback on the task and not the learner.

These principles may also have contributed to the video screencast with audio group rating higher the question about whether the feedback made clearer the details the instructor was trying to convey. In particular, the presentation of both words and pictures allowed the subject to have the narration pinpointed on the exact area of the web page that was being discussed. This focus may have helped the student concentrate the narration on a particular area. For example, if a student read text that stated there appeared to be too much white space on the web page, the student may not know specifically what area is a problem. But, with the video screencast with audio, the exact area can be circled and the narration suggests specific improvement.

Gould (2012) also had a similar finding when he found that there was a significant difference between pre and post course survey results with the question : The instructor's intent was/will be clearer when using multimedia (audio & visual) than text alone. Gould stated, "Participants in this study indicated that inflections in the instructor's voice made the intent of

his message clearer" (p. 97). In addition, Gould found a significant difference when asking the question: The instructor's intent was / will be clearer when using multimedia (audio & visual) than text alone. Other studies have showed an increase with retention when using video multimedia, audio or both. (Lalley, 1997; Mathieson, 2012; Ice et al. (2007).

As a consequence of following these principles it may be assumed that the subjects perceived they had the cognitive processing available to them to select, organize and interact with the incoming information and to move it to long term memory.

In summary, the results related to question 23 and question 26 seem to provide support to the cognitive theory of multimedia learning.

5.5 RESEARCH QUESTION THREE

5.5.1 Class Focused

To what extent does the perception of the learner's level of involvement and comfort differ between learners who receive multimedia feedback using screencast video with audio or text based feedback?

Q15. The feedback made me feel more involved in the class

Q16. The feedback made the class more comfortable.

This research question focused on student's perception of the class and neither of the questions showed a significant difference between the two treatment groups.

It is important to note that both of these questions had the highest percentage of subjects (9% each) who indicated that they disagreed or strongly disagreed that the question was clear

and easy to understand. This may have contributed to some misunderstanding or a lack of an agreed upon definition of what comfort level and involvement meant.

Again this may be indicative of the fact that the experiment was carried out at the end of the term and the students had a solid perception of the classroom environment and their level of involvement. In addition, the impact of a face to face class may take priority over an online course. Borup (2012) discovered through interviews of students taking on-line courses that asynchronous video made their instructors seem more real, present and familiar. In addition, Borup stated, "Overall, the majority of students indicated that video communication helped improve the social presence exhibited by instructors and peers and that social presence in the course would have been weaker if text communication had been used exclusively" (p. 201). This was further supported by a study that used audio feedback to enhance the experience of online courses (Ice, Curtis, Phillips, & Wells). In this study, the authors concluded that students felt the audio increased the feelings of involvement.

Another consideration is that some studies that use multimedia are using it for instruction and not for feedback. In online courses an instructional video or auditory segment can be up to an hour in length. In this study the feedback videos with audio are typically only about a minute long. So, there may be more impact based upon the length of the multimedia experience.

These two questions are of interest because they relate to the personalization effect as described previously but also to area of study known as social agency theory (Atkinson , Mayer, & Merrill, 2005) Mayer (2003), indicates, "social cues in multimedia messages can encourage learners to interpret human–computer interactions as more similar to human-to-human conversation" (p.1). The video with screencasts with audio have various inflections, focus on the task rather than the learner and were created in a rather conversational style. Therefore, it seems

reasonable to assume that the subject may have interpreted the multimedia interactions more like a social interaction and perceived a higher level of comfort and involvement. But, this was not supported by the data and the analysis.

5.6 RESEARCH QUESTION FOUR

5.6.1 Motivation Focused

To what extent does the perception of the learner's level of motivation in the class differ between learners who receive multimedia feedback using screencast video with audio or text based email feedback?

Q27. The feedback has positively affected my motivation for the subject material.

Q28. The feedback has positively affected my motivation for class.

This research question focused on students' perception of their motivation for the subject material and their motivation for the class. Both questions demonstrated significant differences between the two groups with the video screencast with audio group scoring higher than the text based audio feedback group on both questions.

This was the strongest finding of the study in regards to the survey questions and the two treatment groups. A contributing factor to this result may have come from the construction of the feedback following good practice in conjunction with the multimedia feedback. The feedback scripts were written before the author knew it was going to be used for subjects in the video screencast with audio group or the text based email group. And, all of the feedback scripts followed Shute's (2007) feedback principles. Accordingly, Nicole and Macfarlane-Dick (2007)

claim after synthesizing the research literature on feedback that good feedback practice encourages positive motivational beliefs and self-esteem. So, the feedback could initially have impacted both groups in a similar, positive fashion.

However, that supports the idea that the differentiating factor may have been the multimedia that was in the feedback. Obviously, the question is what might have caused the multimedia to have this positive motivational effect. Unfortunately, there is little research on multimedia and motivation while some studies seem simply to assume that multimedia material is more interesting than traditional methods (Low, 2009).

Mayer's work may provide insight on why multimedia may increase motivation (Mayer, 2009). In this instance, subjects may have been affected by the personalization effect and social agency. The audio of the video screencast were created in an informal manner without direct criticism of the person. This was due to following effective feedback guidelines (Shute, 2007). In essence, this also satisfies the personalization effect where deeper learning occurs when words are presented in conversational style rather than a formal style (Mayer, 2005). Mayer (2003) states, "Our working hypothesis is that using words like "you" and "I" prime a conversational schema in learners, causing them to work harder to understand what the narrator is saying. Thus, we can predict that conversational style motivates the learner to engage in the five cognitive processes (p. 307). Furthermore, students indicated in one study that they felt the video feedback enhanced the personalization (Jones, Georghiades & Gunson, 2012).

Also, the video screencasts adhered to the coherence principle: Deeper learning occurs when extraneous words, sounds or pictures are excluded rather than included. There were no extraneous sounds, decorations, or mark-up on the screen other than a digital pen that would highlight and pinpoint areas of interest and the narrator's voice. Mayer (2003) states, "A

common-sense theory of motivation would predict that making a presentation more interesting—such as by adding some eye-grapping video or background music—would cause the learner to work harder and thus result in deeper learning" (p. 307). But research shows that this is typically not the case. Instead, by limiting the amount of multimedia more cognitive processing can applied to more meaningful learning.

Even though social agency theory seemed to not to impact subjects' perceptions in regards to the class focused research questions about involvement and comfort, it may have played a more important role in motivation. "The main thesis in social agency theory is that social cues in a multimedia message can prime the social conversation schema in learners. Once the social conversation schema is activated, learners are more likely to act as if they are in a conversation with another person. Thus, at least to some extent, the social rules of human-to-human communication come into play" (Mayer, Sobko, & Mautone, 2003, p. 419).

It may be reasonable to assume as the subject began to perceive more of a human-to-human communication with the video screencast with audio, that the subject became more engaged and motivated about the subject and the class. Chen & Weng (2011) noted that in their study that video-based multimedia material elicited the most positive emotions among multimedia types. So, as the subject engaged with the material it may have created more emotion and may have primed them to think of the engagement as more of a human to human interaction thereby increasing motivation levels.

5.7 RESEARCH QUESTION FIVE

5.7.1 Interaction Focused

To what extent does a learner's learning preference interact with the type of instructor feedback received? In other words, will learners who receive feedback (screencast video with audio or text based email feedback) that matches their learning preference react differently than those who receive feedback that does not match their learning preference?

In order to assess this question the subjects were given the VARK questionnaire. For this study, it is critical to note under the Visual modality that this does not include video or animation. The guide specifically states that pictures, movies, videos and animated websites belong to the Kinesthetic modality therefore, those subjects were compared with those who indicated they were of the R modality which represented read/write against the two treatment methods.

In addition, it is very important to note that some subjects were multimodal. This would include subjects that are bi-modal, tri-modal and quad-modal. However, multimodal subjects would be using two or more modalities and would not be beneficial in this analysis as it would be difficult to determine which mode was contributing to their scores on the survey questions.. This limited the number of subjects to 12 using the K modality and 13 using the R modality. Out of the 25 subjects being compared 12 subjects had the screencast with video treatment and 13 subjects had the text based email treatment. Although the sample sizes were roughly equivalent, the sample sizes were reduced and probably affected the power of the test and the ability to discover effects.

Also, there were only three subjects who rated A as a unimodal choice. This small number would have been of limited value in the statistical test so it was not used. The primary interest in this study was looking at learning preferences that may match the two treatment methods. And it seemed that the K and R modality fit best. And, as mentioned previously the multimodal group had the problem of which modality was affecting the subjects' scores. Lastly, the Visual group did not have a strong correlation with the K group and was not combined as in other studies. This design grouping may be less than ideal but it aligned with the study's objectives.

There were only two instances where there were any significant results. In the first instance of significance, there was a significant interaction between treatment groups and learning preference for question 24: The feedback increased the clarity of the instructor's expectations. By examining the estimated marginal means it appears that for subjects rating themselves as K modality, they rated Q 24 higher when they experienced the video screencast with audio treatment and rated question 24 lower when they received the text based audio treatment. And, for subjects rating themselves as R modality, they rated Q 24 higher when they experienced the text based audio treatment and rated question 24 lower when they received the text based audio treatment. Figure 3 illustrates this.

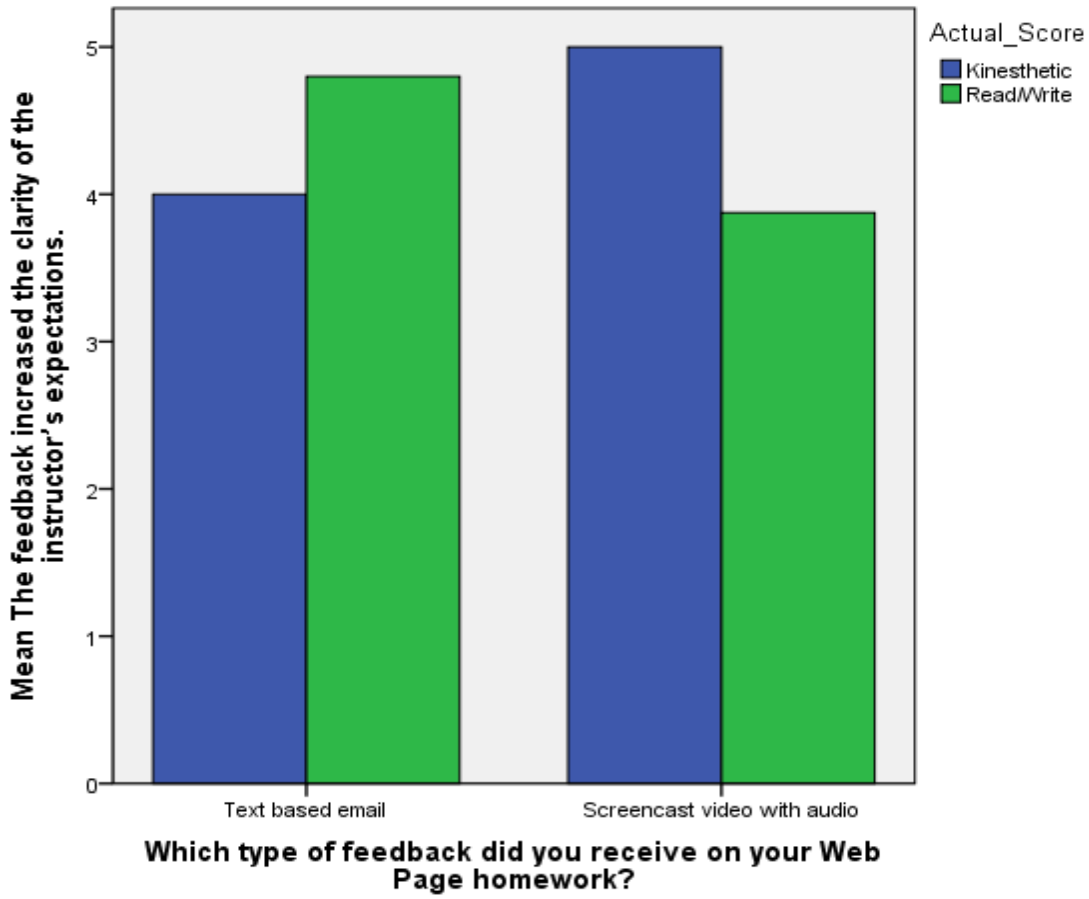

Figure 6: Marginal means of interaction effect for question 24

This finding seems to also support Mayer's theory that multimedia can create deeper learning than just text plus it provide some support that when a learning preference is matched with a treatment method the result is positive. In this example the subjects who had learning preference of K scored higher on this question when they received the video screencast with audio treatment. And, the subjects with learning preference R scored higher when they received their complimentary text based email treatment then the video screencast with audio treatment.

The second instance was the main effect between treatment groups in regards to question 26: The feedback will be easy to remember. Subjects in the video screencast group scored higher regardless of their learning preference. Figure 2 illustrates this point.

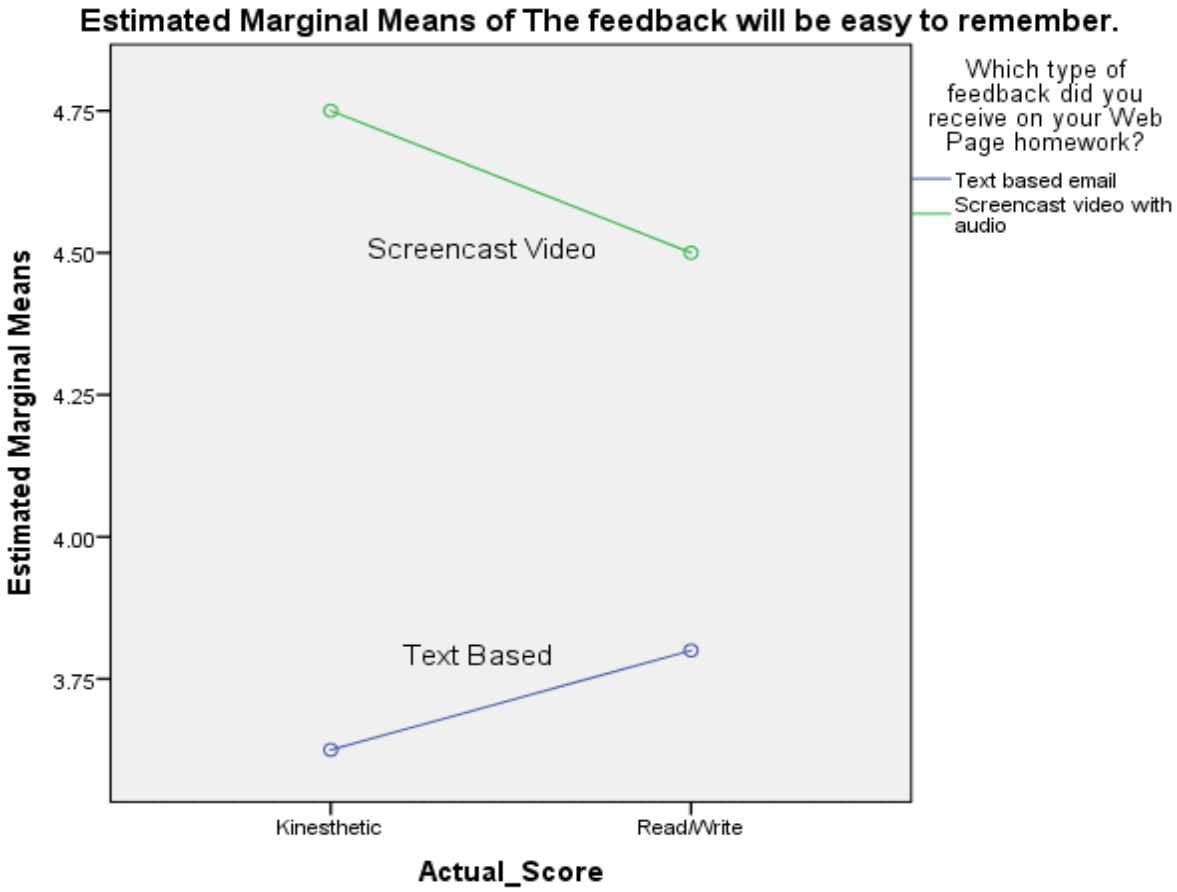

Figure 7: Marginal means of treatment main effect for question 26

This result is similar to the Wilcoxon test results which also showed a significant difference between treatment groups regarding remembering the feedback. However, there was no significance for the interaction between independent variables on the dependent variable.

In summary, there seems to be some support for considering learning preferences in regards to providing feedback to students. It may be beneficial for teachers to include multimedia feedback in those situations where the material is complex and difficult to remember. And, it may be the case that the instructor's comments are more easily understood by students who have a K learning modality if multimedia is used and students who have an R learning modality may benefit from the written email.

5.8 LIMITATIONS

In summary, the two way ANOVA only showed two instances of significant differences in regards to main effects and interaction. There are many possible reasons to account for the results. But, primarily, the sample size was reduced as a result of the distribution of VARK scores. There were few cases where subjects chose a single modality. So, even though there was a finding of significance the results need to be reviewed with caution.

The study's participants are mostly traditional aged college students enrolled in an entry level Information Science class. Generalizations are somewhat limited based on the pool of subjects coming from college students at a single university. In addition, the number of subjects is relatively small and because this is one study there is caution on the applicability of findings to other populations.

The data comes from a self-report survey and with all self-report data there may be some bias. This bias may come from the student's perception of the instructor's teaching methods, the level of difficulty of the class, the student's performance in the class, the student's interpretation of the questions and the student's interpretation of the Likert scale. Even though the survey instrument was created by the researcher and the questions were informed by various studies (Gould, 2012; Ice et al., 2007; Harrison, 2009), there was limited reliability and validity data.

Lastly, there were both supportive and critical reviews regarding the VARK instrument. It would seem that a much larger sample size would be necessary in order to try to compare single primary modalities. Other instruments may be considered in further study.

5.9 FUTURE RESEARCH

The study of the impact of multimedia feedback is both interesting and valuable. Continued research in this area would benefit from developing a multimedia feedback questionnaire with improved reliability and validity. Specifically, the analysis of domains can be expanded to investigate aspects of nuance, emotion and social agency.

It would be interesting to compare and contrast the impact of multimedia across face to face classes and on-line classes. There is some initial evidence that there may be more impact if the instructor is not physically present. In addition, the experiment can be conducted for a full term rather than just one homework assignment. In this way students would experience the multimedia feedback multiple times.

It would be valuable to use the VARK survey with a larger audience in order to increase sample sizes. And, the design grouping can be expanded to look at differences between all of the single preference modalities along with combining all of the multimodalities. Of course, a different approach would be necessary to analyze the aggregated multimodal group to decipher which combinations were causing an effect.

And, further analysis of learning preferences or styles using a different instrument to investigate the interaction between learning styles and type of feedback might be of value. Although, the results of learning style studies is mixed it would helpful if instructors had guidance in this area. In particular, working with larger sample sizes may also be more informative.

And, more research around multimedia and social agency theory would be very valuable to discover the emotional and personal aspects of multimedia, computers and people.

5.10 SUMMARY AND CONCLUSION

The study attempted to determine the effects of video screencast with audio compared to text based email on students' perceptions of the instructor, subject matter, class environment and motivation. In order to isolate the effect of the multimedia treatment a number of steps were taken. The study used a randomization procedure to place the students in either group. In addition demographic factors were analyzed to determine if there were major differences between the two treatment groups. For the most part they were very similar. The minor exceptions included a few more people in higher age category in the video screencast with audio group, a larger percentage of students in the text based email group ranked their technology skills lower, and the text based email group had slightly lower grade expectancy. However, these were mostly small differences but some caution should be heeded.

In addition, all of the survey questions were tested by asking each student if the question was clear and easy to understand. Question 15 and question 16 both were rated higher by the students in not being clear and easy to understand. In addition, Cronbach's Alpha showed a lower rating for both question 15 and 16. This may indicate that students were unsure of how to interpret the questions. But, all of the other questions either met the minimum requirement or were above.

The assumptions for the Wilcoxon Rank-Sum test were performed and confirmed that the distributions were not normal. The Wilcoxon test is very robust and well suited for this situation.

Also, specific principles were used to create both the video screencast with audio and text based email. In this way if the receiving of feedback itself made a difference then both groups should be affected equally.

As a result, there is a high level of confidence that the differences that were found were due to the multimedia principle and not do to some other uncontrolled factor.

However, when the Two Way ANOVA was used to investigate an interaction effect between treatment and learner preferences there were a few concerns. There were fewer people than expected that chose single modalities and the cell sizes became fairly small and uneven in the analysis. This can create some doubt on the results due to concerns over both power and robustness. A quick calculation using G*Power with inputs of effect size = .25, alpha = .05, power = .80, degrees of freedom = 1, number of groups =2 and no covariates, its estimate of needed sample size is over 100. So, there is caution on interpreting the two way ANOVA results.

Lastly, the time to create feedback and to follow the guidelines by Shute (2007) and Mayer (2005) accounted for at least two to four hours of work. And, it is necessary to practice in order to sound natural. The writing of the feedback took longer than normal because of trying to follow the guidelines. Teachers who are familiar with technology software such as screencasting may actually enjoy creating the multimedia feedback. But, keep in mind that the extra time to do so can be burdensome especially with today's demands on teachers. It was interesting to note that a few students sent emails to the instructor or mentioned in class how impressed they were with the video screencast with audio feedback. They indicated that they had never experienced anything like that before. No student said anything negative about the experience. Also, no students said anything about the text based email feedback.

Students had no problem clicking on a web link and watching the screencast video or opening an attachment via email. However, it took approximately five minutes to create a one minute video screencast. It takes some practice to create and distribute this type of feedback.

However, technologies around screen casting are getting less expensive and some major learning platforms now allow instructors to draw on student submitted work. It would seem that a onetime investment into learning good principles of feedback creation along with the ease of use by integrating multimedia into learning platforms would justify the extra effort. Especially, if the instructor is interested in increasing student retention of material, motivation for the subject and class and increasing the clarity of the instructor's comments. It would be worth the time investment.

In fact, the utilization of multimedia in feedback may become an important tool for teachers who are conveying complex subject material by benefitting from providing specific multimedia feedback. The students can better understand the instructor's details and therefore understand the subject matter better. The results of this study show that students can become more motivated about the subject matter and the class. This can be a major factor in the online learning movement. Using multimedia feedback in online learning can help personalize the experience and increase students' motivation. Developing increased motivation for both the subject material and a class are two key components all teachers try to increase.

And, it is exciting to note that even though it does take some time to learn the techniques for developing effective multimedia tools for feedback it is certainly within the grasp of most teachers. And, as a result of a relatively short learning curve, the incorporation of multimedia into electronic learning platforms and the increasing appetite students have for technology multimedia feedback may become more standard in the future world of pedagogy.

APPENDIX A

STATISTICAL ANALYSIS RESULTS

Table 32: Summary Table of Two Way ANOVA for Main and Interaction Effects

Factor	Type III Sum of Squares	df	Mean Square	F	Sig	Survey Question
Treatment	.022	1	.022	.031	.862	15
VARK Score	.021	1	.201	.279	.603	15
Treatment * VARK_Score	.022	1	.022	.031	.862	15
Treatment	.860	1	.860	1.824	.192	16
VARK Score	2.054	1	2.054	4.357	.050	16
Treatment * VARK_Score	.064	1	.064	.136	.716	16
Treatment	.057	1	.057	.080	.780	17
VARK Score	.700	1	.700	.977	.334	17
Treatment * VARK_Score	.129	1	.129	.179	.676	17
Treatment	.014	1	.014	.013	.911	18
VARK Score	2.80	1	2.80	2.481	.130	18
Treatment * VARK_Score	1.032	1	1.032	.915	.350	18
Treatment	.258	1	.258	.369	.550	19
VARK Score	.972	1	.972	1.391	.251	19

Table 32 (continued)

Treatment * VARK_Score	1.972	1	1.972	2.822	.108	19
Treatment	.108	1	.108	.231	.636	20
VARK Score	1.358	1	1.358	2.903	.103	20
Treatment * VARK_Score	.072	1	.072	.155	.698	20
Treatment	.201	1	.201	.304	.587	21
VARK score	.558	1	.558	.845	.369	21
Treatment * VARK_Score	.558	1	.558	.845	.369	21
Treatment	1.222	1	1.222	1.539	.228	22
VARK Score	.651	1	.651	.820	.376	22
Treatment * VARK_Score	.008	1	.008	.010	.921	22
Treatment	1.094	1	1.094	2.065	.165	23
VARK Score	.558	1	.558	1.053	.316	23
Treatment * VARK_Score	1.808	1	1.808	3.413	.079	23
Treatment	.008	1	.008	.022	.884	24
VARK Score	.151	1	.151	.413	**.**527	24
Treatment * VARK_Score	5.294	1	5.294	14.485	**.001**	24
Treatment	.032	1	.032	.026	.873	25
VARK Score	.032		.032	.026	.873	25
Treatment * VARK_Score	.014	1	.014	.012	.915	25
Treatment	4.758	1	4.758	8.746	**.008**	26
VARK Score	.008	1	.008	.015	.904	26
Treatment * VARK_Score	.258	1	.258	.474	.499	26

Table 32 (continued).

Treatment	.751	1	.751	1.527	.230	27
VARK Score	1.501	1	1.501	3.053	.095	27
Treatment * VARK_Score	.751	1	.751	1.527	.230	27
Treatment	1.222	1	1.222	1.587	.222	28
VARK Score	.151	1	.151	.196	.663	28
Treatment * VARK_Score	.258	1	.258	.335	.569	28

Bold indicates significance p <. 05.

Table 33: Tests for Normality

Question	Type of feedback	Shapiro-Wilk		
		Statistic	df	Sig.
The feedback made me feel more involved in the class	Text based email	.783	37	.000
	Screencast video with audio	.830	34	.000
The feedback made the class more comfortable.	Text based email	.871	37	.001
	Screencast video with audio	.823	34	.000
The feedback made the instructor seem more approachable.	Text based email	.871	37	.001
	Screencast video with audio	.796	34	.000
The feedback made me feel closer to the instructor.	Text based email	.906	37	.004
	Screencast video with audio	.868	34	.001
The feedback made the instructor seem more knowledgeable.	Text based email	.859	37	.000
	Screencast video with audio	.867	34	.001
The feedback made me think the instructor was more involved in the class.	Text based email	.807	37	.000
	Screencast video with audio	.685	34	.000
The feedback made me think the instructor cares about my work.	Text based email	.779	37	.000
	Screencast video with audio	.795	34	.000

Table 33 (continued).

The feedback increased my level of understanding of the subject.	Text based email	.857	37	.000
	Screencast video with audio	.850	34	.000
The feedback made clearer the details that the instructor was trying to convey.	Text based email	.772	37	.000
	Screencast video with audio	.754	34	.000
The feedback increased the clarity of the instructor's expectations.	Text based email	.654	37	.000
	Screencast video with audio	.828	34	.000
The feedback increased my knowledge of the subject matter.	Text based email	.859	37	.000
	Screencast video with audio	.882	34	.002
The feedback will be easy to remember.	Text based email	.841	37	.000
	Screencast video with audio	.765	34	.000
The feedback has positively affected my motivation for the subject material.	Text based email	.761	37	.000
	Screencast video with audio	.866	34	.001
The feedback has positively affected my motivation for class.	Text based email	.843	37	.000
	Screencast video with audio	.870	34	.001

APPENDIX B

QUALTRICS SURVEY

Note: When downloaded into SPSS questions 3, 4, 5 and 6 numbers were skipped. And the last question was labelled 23.This is a record keeping issue because question numbers were not displayed when students took the survey and it had no effect on the student's responses.

Feedback

Important Instructions: Welcome to the feedback survey in INFSCI 0010. You must be 18 or older to participate in this survey. Please answer the following questions. Thank You for your time.

Q1 What is your user-name?

Q2 Which type of feedback did you receive on your Web Page homework?
Text based email (1)
Screencast video with audio (2)

Q7 What is your gender
Male (1)
Female (2)

Q8 What year student are you?
Freshman (1)
Sophomore (2)
Junior (3)
Senior (4)
Other (5)

Q9 What is your age?
18-21 (1)

21-25 (2)
26-30 (3)
31-35 (4)
36-40 (5)
40-45 (6)
46-50 (7)
over 50 (8)

Q10 How would you rate your technology skills?
Minimal (1)
Average (2)
Above average (3)
Excellent (4)

Q11 Have you ever received video feedback before in a class?
Yes (1)
No (2)

Q12 What grade do you expect in the class?
A (1)
B (2)
C (3)
D (4)
F (5)

Q13 How many courses have you had that have an on-line component like CourseWeb?
0 (1)
1-3 (2)
3-5 (3)
Over 5 (4)

Q14 What is your major? If none write undeclared.
Q15 Please respond to each of the following statements based on your homework feedback.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The feedback made me feel more involved in the class	O	O	O	O	O
This question is clear and easy to understand	O	O	O	O	O

Q16 Please respond to each of the following statements based on your homework feedback.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The feedback made the class more comfortable.	O	O	O	O	O
This question is clear and easy to understand	O	O	O	O	O

Q17 Please respond to each of the following statements based on your homework feedback.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The feedback made the instructor seem more approachable.	O	O	O	O	O
This question is clear and easy to understand	O	O	O	O	O

Q18 Please respond to each of the following statements based on your homework feedback.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The feedback made me feel closer to the instructor.	O	O	O	O	O

This question is clear and easy to understand	O	O	O	O	O

Q19 Please respond to each of the following statements based on your homework feedback.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The feedback made the instructor seem more knowledgeable.	O	O	O	O	O
This question is clear and easy to understand	O	O	O	O	O

Q20 Please respond to each of the following statements based on your homework feedback.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The feedback made me think the instructor was more involved in the class.	O	O	O	O	O
This question is clear and easy to understand	O	O	O	O	O

Q21 Please respond to each of the following statements based on your homework feedback.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The feedback	O	O	O	O	O

made me think the instructor cares about my work.					
This question is clear and easy to understand	O	O	O	O	O

Q22 Please respond to each of the following statements based on your homework feedback.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The feedback increased my level of understanding of the subject.	O	O	O	O	O
This question is clear and easy to understand	O	O	O	O	O

Q23 Please respond to each of the following statements based on your homework feedback.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The feedback made clearer the details that the instructor was trying to convey.	O	O	O	O	O
This question is clear and easy to understand	O	O	O	O	O

Q24 Please respond to each of the following statements based on your homework feedback.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The feedback increased the clarity of the instructor's expectations.	O	O	O	O	O
This question is clear and easy to understand	O	O	O	O	O

Q25 Please respond to each of the following statements based on your homework feedback.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The feedback increased my knowledge of the subject matter.	O	O	O	O	O
This question is clear and easy to understand	O	O	O	O	O

Q26 Please respond to each of the following statements based on your homework feedback.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The feedback will be easy to remember.	O	O	O	O	O
This question is clear and easy to understand	O	O	O	O	O

Q27 Please respond to each of the following statements based on your homework feedback.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The feedback has positively affected my motivation for the subject material.	O	O	O	O	O
This question is clear and easy to understand	O	O	O	O	O

Q23 Please respond to each of the following statements based on your homework feedback.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The feedback has positively affected my motivation for class.	O	O	O	O	O
This question is clear and easy to understand	O	O	O	O	O

APPENDIX C

C.1 FORMATIVE FEEDBACK GUIDELINES TO ENHANCE LEARNING

Table 34: Feedback - Things to Do

Prescription	Description and references
Focus feedback on the task, not the learner.	Feedback to the learner should address specific features of his or her work in relation to the task, with suggestions on how to improve (e.g., Butler, 1987; Corbett & Anderson, 2001; Kluger & DeNisi, 1996; Narciss & Huth, 2004).
Provide elaborated feedback to enhance learning.	Feedback should describe the what, how, and why of a given problem. This type of cognitive feedback is typically more effective than verification of results (e.g., Bangert-Drowns et al., 1991; Gilman, 1969; Mason & Bruning, 2001; Narciss & Huth, 2004).
Present elaborated feedback in manageable units.	Provide elaborated feedback in small enough pieces so that it is not overwhelming and discarded (Bransford et al., 2000; Sweller et al., 1998). Presenting too much information may not only result in superficial learning but may also invoke cognitive overload (e.g., Mayer & Moreno, 2002; Phye & Bender, 1989). A stepwise presentation of feedback offers the possibility to control for mistakes and gives learners sufficient information to correct errors on their own.
Be specific and clear with feedback message.	If feedback is not specific or clear, it can impede learning and can frustrate learners (e.g., Moreno, 2004; Williams, 1997). If possible, try to link feedback clearly and specifically to goals and performance (Hoska, 1993; Song & Keller, 2001).
Keep feedback as simple as possible but no simpler (based on learner needs and instructional constraints).	Simple feedback is generally based on one cue (e.g., verification or hint) and complex feedback on multiple cues (e.g., verification, correct response, error analysis). Keep feedback as simple and focused as possible. Generate only enough information to help students and not more. Kulhavy et al. (1985) found that feedback that was too complex did not promote learning compared to simpler feedback.

Table 34 (continued)

Prescription	Description and references
Reduce uncertainty between performance and goals.	Formative feedback should clarify goals and seek to reduce or remove uncertainty in relation to how well learners are performing on a task, and what needs to be accomplished to attain the goal(s) (e.g., Ashford et al., 2003; Bangert-Drowns et al., 1991).
Give unbiased, objective feedback, written or via computer.	Feedback from a trustworthy source will be considered more seriously than other feedback, which may be disregarded. This may explain why computer-based feedback is often better than human-delivered in some experiments in that perceived biases are eliminated (see Kluger & DeNisi, 1996).
Promote a "learning" goal orientation via feedback.	Formative feedback can be used to alter goal orientation—from a focus on performance to a focus on learning (Hoska, 1993). This can be facilitated by crafting feedback emphasizing that effort yields increased learning and performance, and mistakes are an important part of the learning process (Dweck, 1986).
Provide feedback after learners have attempted a solution.	Do not let learners see answers before trying to solve a problem on their own (i.e., presearch availability). Several studies that have controlled presearch availability show a benefit of feedback, whereas studies without such control show inconsistent results (Bangert-Drowns et al., 1991).

C.2 FORMATIVE FEEDBACK GUIDELINES TO ENHANCE LEARNING

Table 35: Feedback - Things to Avoid

Prescription	Description and references
Do not give normative comparisons.	Feedback should avoid comparisons with other students—directly or indirectly (e.g., "grading on the curve"). In general, do not draw attention to "self" during learning (Kluger & DeNisi, 1996; Wiliam, 2007).

Table 35 (continued)

Be cautious about providing overall grades.	Feedback should note areas of strength and provide information on how to improve, as warranted and without overall grading. Wiliam (2007) summarized the following findings: (a) students receiving just grades showed no learning gains, (b) those getting just comments showed large gains, and (c) those with grades and comments showed no gains (likely due to focusing on the grade and ignoring comments). Effective feedback relates to the content of the comments (Butler, 1987; McColskey & Leary, 1985).
Do not present feedback that discourages the learner or threatens the learner's self-esteem.	This prescription is based not only on common sense but also on research reported in Kluger and DeNisi (1996) citing a list of feedback interventions that undermine learning as it draws focus to the "self" and away from the task at hand. In addition, do not provide feedback that is either too controlling or critical of the learner (Baron, 1993; Fedor et al., 2001).
Use "praise" sparingly, if at all.	Kluger & DeNisi (1996), Butler (1987), and others have noted that use of praise as feedback directs the learner's attention to "self," which distracts from the task and consequently from learning.
Try to avoid delivering feedback orally.	This also was addressed in Kluger & DeNisi (1991). When feedback is delivered in a more neutral manner (e.g., written or computer delivered), it is construed as less biased.
Do not interrupt learner with feedback if the learner is actively engaged.	Interrupting a student who is immersed in a task—trying to solve a problem or task on his or her own—can be disruptive to the student and impede learning (Corno & Snow, 1986).
Avoid using progressive hints that always terminate with the correct answer.	Although hints can be facilitative, they can also be abused, so if they are employed to scaffold learners, provisions to prevent their abuse should be made (e.g., Aleven & Koedinger, 2000; Shute, Woltz, & Regian, 1989). Consider using prompts and cues (i.e., more specific kinds of hints).
Do not limit the mode of feedback presentation to text.	Exploit the potential of multimedia to avoid cognitive overload due to modality effects (e.g., Mayer & Moreno, 2002) and do not default to presenting feedback messages as text. Instead, consider alternative modes of presentation (e.g., acoustic, visual).
Minimize use of extensive error analyses and diagnosis.	In line with findings by Sleeman et al. (1989) and VanLehn et al. (2005), the cost of conducting extensive error analyses and cognitive diagnosis may not provide sufficient benefit to learning. Furthermore, error analyses are rarely complete and not always accurate, thus only helpful in a subset of circumstances.

C.3 FORMATIVE FEEDBACK GUIDELINES IN RELATION TO TIMING ISSUES

Table 36: Feedback - Timing Issues

Prescription	Description and references
Design timing of feedback to align with desired outcome.	Feedback can be delivered (or obtained) either immediately or delayed. Immediate feedback can help fix errors in real time, producing greater immediate gains and more efficient learning (Corbett & Anderson, 2001; Mason & Bruning, 2001), but delayed feedback has been associated with better transfer of learning (e.g., Schroth, 1992).
For difficult tasks, use immediate feedback.	When a student is learning a difficult new task (where "difficult" is relative to the learner's capabilities), it is better to use immediate feedback, at least initially (Clariana, 1990). This provides a helpful safety net for the learner so she does not get bogged down and frustrated (Knoblauch & Brannon, 1981).
For relatively simple tasks, use delayed feedback.	When a student is learning a relatively simple task (again, relative to capabilities), it is better to delay feedback to prevent feelings of feedback intrusion and possibly annoyance (Clariana, 1990; Corno, & Snow, 1986).
For retention of procedural or conceptual knowledge, use immediate feedback.	In general, there is wide support for use of immediate feedback to promote learning and performance on verbal, procedural, and even tasks requiring motor skills (Anderson et al., 2001; Azevedo & Bernard, 1995; Corbett & Anderson, 1989, 2001; Dihoff et al., 2003; Phye & Andre, 1989).
To promote transfer of learning, consider using delayed feedback.	According to some researchers (e.g., Kulhavy et al., 1985; Schroth, 1992), delayed may be better than immediate feedback for transfer task performance, although initial learning time may be depressed. This needs more research.

C.4 FORMATIVE FEEDBACK GUIDELINES IN RELATION TO LEARNER CHARACTERISTICS

Table 37: Feedback - Relation to Learner

Prescription	Description and references
For high-achieving learners, consider using delayed feedback.	Similar to the Clariana (1990) findings cited in Table 4, high-achieving students may construe a moderate or difficult task as relatively easy and hence benefit by delayed feedback (see also Gaynor, 1981; Roper, 1977).
For low-achieving learners, use immediate feedback.	The argument for low-achieving students is similar to the one above; however, these students need the support of immediate feedback in learning new tasks they may find difficult (see Gaynor, 1981; Mason & Bruning, 2001; Roper, 1977).
For low-achieving learners, use directive (or corrective) feedback.	Novices or struggling students need support and explicit guidance during the learning process (Knoblauch & Brannon, 1981; Moreno, 2004); thus, hints may not be as helpful as more explicit, directive feedback.
For high-achieving learners, use facilitative feedback.	Similar to the above, high-achieving or more motivated students benefit from feedback that challenges them, such as hints, cues, and prompts (Vygotsky, 1987).
For low-achieving learners, use scaffolding.	Provide early support and structure for low-achieving students (or those with low self-efficacy) to improve learning and performance (e.g., Collins et al., 1989; Graesser et al., 2005).
For high-achieving learners, verification feedback may be sufficient.	Hanna (1976) presented findings that suggest that high-achieving students learn more efficiently if permitted to proceed at their own pace. Verification feedback provides the level of information most helpful in this endeavor.
For low-achieving learners, use correct response and some kind of elaboration feedback.	Using the same rationale as with supplying scaffolding to low-achieving students, the prescription here is to ensure low-achieving students receive a concrete, directive form of feedback support (e.g., Clariana, 1990; Hanna, 1976).
For learners with low learning orientation (or high performance orientation), give specific feedback.	As described in the study by Davis et al. (2005), if students are oriented more toward performance (trying to please others) and less toward learning (trying to achieve an academic goal), provide feedback that is specific and goal directed. Also, keep the learner's eye on the learning goal (Hoska, 1993).

APPENDIX D

RECRUITMENT SCRIPT FOR IRB

The recruitment of students will consist of the instructor of the INFSCI 0010 class making an announcement on Courseweb following this script:

I will be conducting a research study in this class.

The purpose of this research study is to determine whether two different delivery methods for feedback on homework have unique impacts. The first method is feedback delivered through a traditional text-based method such as email. The second method is feedback delivered through the use of a screencast video with audio.

As part of the class, all students will receive feedback on their last submitted Web Page design homework. Approximately half of the students (random assignment) will receive text-based feedback (email) while the other half will receive a screencast with audio (video).

To help determine if students are affected differently by these two methods, I will distribute the VARK survey in class and you will self-score it. The VARK survey will help in determining whether you have a preference for visual, auditory, written or kinesthetic processing of information. In addition, you will complete the Qualtrics Feedback Survey via the Internet that will take 10-15 minutes to complete. To participate in the research study you will need to

complete both surveys. The second Internet survey which will ask about your background (age, gender, major, Fr-Sr) as well as your perceptions of the feedback in regards to feeling involved/connected to the class, perception of the instructor, knowledge acquisition and motivation. Your actual choice of answers has no bearing on your grade in the class. By completing the VARK and Qualtrics Feedback survey you will qualify for the extra credit. Each survey will ask for your username. After you complete the Feedback survey all username information will be deleted. Whether you participate in the research study has no impact on your grade in class.

If you choose not to participate in the research study (do not complete the surveys) there will be a link in the email to a short homework assignment that when completed will allow you to receive the extra credit points. Complete the homework assignment and email it back to the instructor at perks@pitt.edu to qualify for the extra credit.

There are no foreseeable risks associated with this project, nor are there any direct benefits to you. Each participant who completes the Internet surveys or chooses to complete the homework assignment will receive an extra credit point boost (5pts) added to the Web Page homework assignment for the class. Completing both the Internet surveys and homework assignment will not result in additional extra credit points.

Initially, your usernames will be collected but only for the purpose of identifying who should receive extra credit. After, the survey deadline has passed and the extra credit recorded, this username information will be deleted.

Your participation is voluntary and you may withdraw from this project at any time. This study is being conducted by Robert R. Perkoski, who can be reached at 412-624-9425, if you have any questions.

APPENDIX E

WEB PAGE EVALUATION CRITERIA

Web Page Evaluation Criteria

Name:

Theme Website has an angle or theme above a bio	
Colors Colors are pleasant and work well together Colors are not too stark or weak	
Composition Alignment – not all centered Balance – doesn't look like	

page will fall over Symmetry	
Writing Well written text Right amount of text	
Pictures Good size Support theme Matching colors	
Overall	

Figure 8: Web page evaluation sheet

APPENDIX F

VARK SURVEY

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The VARK Questionnaire (Version 7.8)

How Do I Learn Best?

Choose the answer which best explains your preference and circle the letter(s) next to it. **Please circle more than one** if a single answer does not match your perception.
Leave blank any question that does not apply.

1. You are helping someone who wants to go to your airport, the center of town or railway station. You would:
    a. go with her.
    b. tell her the directions.
    c. write down the directions.
    d. draw, or show her a map, or give her a map.

2. A website has a video showing how to make a special graph. There is a person speaking, some lists and words describing what to do and some diagrams. You would learn most from:
    a. seeing the diagrams.
    b. listening.
    c. reading the words.
    d. watching the actions.

3. You are planning a vacation for a group. You want some feedback from them about the plan. You would:
    a. describe some of the highlights they will experience.

b. use a map to show them the places.

c. give them a copy of the printed itinerary.

d. phone, text or email them.

4. You are going to cook something as a special treat. You would:

a. cook something you know without the need for instructions.

b. ask friends for suggestions.

c. look on the Internet or in some cookbooks for ideas from the pictures.

d. use a good recipe.

5. A group of tourists want to learn about the parks or wildlife reserves in your area. You would:

a. talk about, or arrange a talk for them about parks or wildlife reserves.

b. show them maps and internet pictures.

c. take them to a park or wildlife reserve and walk with them.

d. give them a book or pamphlets about the parks or wildlife reserves.

6. You are about to purchase a digital camera or mobile phone. Other than price, what would most influence your decision?

a. Trying or testing it.

b. Reading the details or checking its features online.

c. It is a modern design and looks good.

d. The salesperson telling me about its features.

7. Remember a time when you learned how to do something new. Avoid choosing a physical skill, eg. riding a bike. You learned best by:

a. watching a demonstration.

b. listening to somebody explaining it and asking questions.

c. diagrams, maps, and charts - visual clues.

d. written instructions – e.g. a manual or book.

8. You have a problem with your heart. You would prefer that the doctor:

a. gave you a something to read to explain what was wrong.

b. used a plastic model to show what was wrong.

c. described what was wrong.

d. showed you a diagram of what was wrong.

9. You want to learn a new program, skill or game on a computer. You would:

a. read the written instructions that came with the program.

b. talk with people who know about the program.

c. use the controls or keyboard.

d. follow the diagrams in the book that came with it.

10. I like websites that have:

a. things I can click on, shift or try.

b. interesting design and visual features.

c. interesting written descriptions, lists and explanations.

d. audio channels where I can hear music, radio programs or interviews.

11. Other than price, what would most influence your decision to buy a new non-fiction book?

a. The way it looks is appealing.

b. Quickly reading parts of it.

c. A friend talks about it and recommends it.

d. It has real-life stories, experiences and examples.

12. You are using a book, CD or website to learn how to take photos with your new digital camera. You would like to have:

a. a chance to ask questions and talk about the camera and its features.

b. clear written instructions with lists and bullet points about what to do.

c. diagrams showing the camera and what each part does.

d. many examples of good and poor photos and how to improve them.

13. Do you prefer a teacher or a presenter who uses:

a. demonstrations, models or practical sessions.

b. question and answer, talk, group discussion, or guest speakers.

c. handouts, books, or readings.

d. diagrams, charts or graphs.

14. You have finished a competition or test and would like some feedback. You would like to have feedback:

a. using examples from what you have done.

b. using a written description of your results.

c. from somebody who talks it through with you.

d. using graphs showing what you had achieved.

15. You are going to choose food at a restaurant or cafe. You would:

a. choose something that you have had there before.

b. listen to the waiter or ask friends to recommend choices.

c. choose from the descriptions in the menu.

d. look at what others are eating or look at pictures of each dish.

16. You have to make an important speech at a conference or special occasion. You would:

a. make diagrams or get graphs to help explain things.

b. write a few key words and practice saying your speech over and over.

c. write out your speech and learn from reading it over several times.

d. gather many examples and stories to make the talk real and practical.

The VARK Questionnaire Scoring Chart

The VARK Questionnaire Scoring Chart Use the following scoring chart to find the VARK category that each of your answers corresponds to. Circle the letters that correspond to your answers
e.g. If you answered b and c for question 3, circle V and R in the question 3 row.

Question	a category	b category	c category	d category
3	K	V	R	A

Scoring Chart

Question	A category	B category	C category	D category
1	K	A	R	V
2	V	A	R	K
3	K	V	R	A
4	K	A	V	R
5	A	V	K	R
6	K	R	V	A
7	K	A	V	R
8	R	K	A	V
9	R	A	K	V
10	K	V	R	A
11	V	R	A	K
12	A	R	V	K
13	K	A	R	V
14	K	R	A	V
15	K	A	R	V
16	V	A	R	K

Calculating your scores

Count the number of each of the VARK letters you have circled to get your score for each VARK category.

Total number of **Vs** circled =

Total number of **As** circled =

Total number of **Rs** circled =

Total number of **Ks** circled =

Figure 9: Vark survey

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