1-1-2009

Student Perceptions of Streaming-Media Effectiveness

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Student Perceptions of Streaming-Media Effectiveness

by
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An Applied Dissertation Submitted to the
Fischler School of Education and Human Services
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Education

Nova Southeastern University
2008

Approval Page

This applied dissertation was submitted by Sara Baber under the direction of the persons listed below. It was submitted to the Fischler School of Education and Human Services and approved in partial fulfillment of the requirements for the degree of Doctor of Education at Nova Southeastern University.

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Acknowledgments

I would like to thank my dissertation committee for their insight and support throughout this process. Dr. Leite and Dr. Curless have provided wonderful guidance. In addition, I must say a huge thank you to my "support group," which includes Dr. Charles Schlosser, Dr. Russ Geanangel, special members of Nova cluster 27 (they know who they are), and the "Woodstack 11."

Most important, I would like to thank my family, who has provided continuing and unquestioning hugs and support to me throughout this adventure--Carl, Skye and Kelsey--I couldn't have done it without them.

Abstract

Student Perceptions of Streaming-Media Effectiveness. Baber, Sara, 2008: Applied Dissertation, Nova Southeastern University, Fischler School of Education and Human Services. Multimedia Instruction/Cognitive Psychology/Instructional Design/Learning Style

The purpose of this mixed-methods study was to investigate cognitive-load theory as applied to the design of streaming media. In this study, student learning preferences and cognitive style were measured on a visualizer-verbalizer scale to determine the perceived importance of visual and audio components of streaming media used to supplement classroom instruction. Additionally, this study investigated cognitive-load theory by assessing attitudes regarding the importance of learner control when accessing streaming media files.

The writer used 4 existing visualizer-verbalizer instruments in combination with 1 original survey that was designed to gather student perceptions and attitudes regarding the effectiveness of streaming media to support instruction. A group of participants was randomly selected to participate in an interview in order to probe more deeply into respondents' perceptions.

An analysis of the data revealed a weak to modest correlation among the existing instruments and the streaming-media items, which did, however, correlate strongly with one another. It is clear that visual and verbal learners perceive control over online instruction to be an important component in their understanding of content. Overall, participants responded positively in regard to the use of streaming media as an aid to understanding.

Table of Contents

Appendixes

Tables

Chapter 1: Introduction

College students may be attached to any number of wireless devices, such as iPods, MP3 players, cell phones, and PDAs, and desktop and laptop computers, that enable them to receive instructional content of their choice anywhere and at any time (Salaway & Caruso, 2007). This population comprises students who have never known life without the Internet. It has many names: Net Gens, Digital Natives, Generation X and Generation Y, Millennials, and even Neomillennials (Lorenzo & Dziuban, 2006; Roberts, 2005; Yuen, Rouse, & Rawls, 2008). Regardless of the labels or categories that are applied to these learners, they come to college with needs, preferences, attitudes, and expectations that differ from those of the traditional student body.

The students of this generation are multitaskers and proficient users of technology, and they expect technology to be used by colleges and universities in the design and delivery of educational content that is tailored to their needs. When asked, Net Gen students have identified a key component of technology as customization (Roberts, 2005). That is, they expect technology to be adaptable to their individual needs (Roberts).

The impact of the Internet on teaching and learning will be examined and researched for years to come. Through the Internet, instructional materials that include text, graphics, audio components, and video components are delivered to students in different ways, using a variety of connections.

Of the many delivery methodologies available, streaming media programs are quickly becoming means by which to provide quality instruction, both supplemental to classroom instruction and as a component of distance-learning delivery, to students (Heinich, Molenda, Russell, & Smaldino, 2002; Parfenovics & Fletcher, 2004; Simonson, Smaldino, Albright, & Zvacek, 2006).

Streaming-media instruction delivers audio content, video content, or both over the Internet (Heinich et al., 2002; Parfenovics & Fletcher, 2004; Simonson et al., 2006). It evolved from multimedia-based instruction, which is the use of computer-based hardware and software to display to the learner instructional content that may consist of any combination of text, graphics, audio content, and video content. Streaming-media instruction offers a way to deliver multimedia content one way to users over the Internet. Users do not respond to or interact with streaming media except by controlling their own viewing, listening, and pace-of-delivery options.

When accessing streaming media, a user clicks on a link that contains streaming audio or video, and the file progressively plays before it is completely downloaded to the user's computer. The user views or listens to the stream as it plays through the browser, using such software as Quick Time, Real Player, or Windows Media Player, all of which are available for users at no cost. The content flows into the active memory of the computer. It is erased when the user closes the file. In some instances, the stream may be downloaded and stored on the user's computer; however, this feature may not necessarily be activated in the event that the author of the content wishes a user to be able to view or listen to the content but not able to save it. This often applies when there may be copyright issues or when a faculty member wants to protect intellectual ownership of the content and wishes to keep users from storing or reproducing it.

Statement of the Problem

Faculty members at the university under study began the streaming-media project as a convenience tool both for their students who may be late to or absent from class and for themselves. They engaged in this project in response to the large number of repetitive questions students could raise as a result of missing class. Faculty members brought in a technical support staff to help them launch the project quickly and did not spend time researching streaming beforehand, other than to research the technical aspects. In particular, no research involving learning theory or student preferences regarding streaming-media attributes or learner control was conducted.

Background

Chemistry-faculty members at a large urban university in the southern United States have been experimenting with different ways to provide technology-based support for college students enrolled in freshman chemistry courses. Enrollment in these courses tends to be between 300 and 500 students per course section. Ninety percent of the students commute (Baez-Franceschi & Baber, 2006). To augment student learning in chemistry, the faculty has recorded, encoded, and streamed class lectures for student use. A faculty member uses software, a microphone, and a Tablet PC to record a lecture, capturing audio, video, and PowerPoint slides and including any notes, diagrams, or equations he or she creates during the lecture. The file is then saved, encoded, and made available for students to view as a media stream over a secure Web site later the same day. Students may go back and access any of the lectures that have been given during the semester and are able to start, pause, and stop the lectures at any point. They are not required to view the streams and may view them at their convenience as many times as their personal learning needs require. Baez-Franceschi, Le, and Velez (2004) reported that students across all chemistry classes access these files an average of 300 times per day during a 16-week semester.

Two important characteristics of working memory have implications for effective instructional design: its limited capacity for the number of items that may be stored at one time and the limited time during which any information is stored (Sweller, 2005a).

Therefore, effective instruction should be designed in such a way as to enhance the assimilation and processing of new information in working memory so that new information to be learned will be processed and moved to long-term memory.

Narciss, Proske, and Koerndle (2006) described the challenges of self-regulated learners in Web-based learning environments. In particular, they note that Web-based learning environments promote self-regulated learning by enabling learners to process material according to their individual preferences. In this way, students can monitor and regulate their individual cognitive load during instruction.

Author's Role

As a senior-level technical administrator within IT, the author was responsible for providing technical support to faculty members and students at this university.

Purpose of the Study

The purpose of this applied dissertation study was to investigate CLT as it applies to the design of streaming media. This study investigated CLT by assessing attitudes regarding the importance of learner control when accessing streaming media files. Through this applied dissertation study, the author sought to understand more clearly the relationship between student learner preferences and cognitive styles by using a cross-sectional survey design appropriate for describing attitudes or opinions of a population. This study was to compare these attitudes and opinions to preferences for visual and verbal elements within streaming media. This applied dissertation study was to explore these relationships in great depth through the gathering of feedback from students through interviews regarding their perceptions of the effectiveness of learner control over streaming media. Gall, Gall, and Borg (2003) reported that interviews "probe more deeply" (p. 222) into respondents' attitudes and perceptions than surveys or questionnaires, thus providing more information than a comparison of survey responses.

Rationale

That students are using streaming-media technology without being required to do so (Baez-Franceschi & Baber, 2006; Baez-Franceschi et al., 2004) supported the need to collect data and the need to develop a clearer understanding of the role streaming-media instruction plays in support of student learning. Prior to this study, it was not clear how the students chose to use the streaming media or which components worked to enhance the assimilation and processing of new information in working memory for transfer into long-term memory.

Significance of the Study

As college students continue to learn from more technology-centered media and methodologies, there is much research to be done regarding the attitudes, perceptions, and preferences of today's technology-savvy, self-directed learners. Although much has been written about CLT, media, learners, and achievement, there is a void in the literature regarding student perceptions of the effectiveness of learner control over the media and in the literature regarding learner preferences for visual and verbal components of the media. This study was expected to add to the existing body of research relating students' preferred cognitive style to streaming media.

Hypotheses

Hypothesis 1. Learners with a visual or verbal cognitive style will report a corresponding preference for visual or verbal elements in streaming media.

Hypothesis 2. Learners with a visual or verbal learning preference will report a corresponding preference for visual or verbal elements in streaming media.

Research Questions

This mixed-methods study addressed five research questions regarding cognitive load and streaming media. Two measured the relationship of the independent variables, cognitive style and learning preference, to the dependent variable, learner preferences for visual and verbal elements in streaming media. The other three investigated descriptive, qualitative aspects of student use of streaming media files: (a) student attitudes and preferences toward streaming media and (b) influence of the effects of cognitive load on learning with streaming media files. The role of learner control of streaming media must be more clearly understood as students are increasingly able to monitor and regulate the amount of instruction presented at any one time.

Two questions were addressed in this study in an attempt to investigate CLT as it applies to the design of streaming media. Three more questions addressed CLT as it applies to student preferences and attitudes regarding the importance of learner control when accessing streaming-media files. In particular, these questions attempted to clarify and narrow the impact the three effects of cognitive load.

Research Question 1. What is the relationship between student cognitive style and perceived importance of visual and verbal elements present in streaming media?

Research Question 2. What is the relationship between student learning preference and perceived importance of visual and verbal elements present in streaming media?

Research Question 3. How do the preferences of visual and verbal learners regarding the type and amount of instructional content presented at any one time through streaming media differ with respect to the three effects of cognitive load?

Research Question 4. How do the perceptions of visual and verbal learners regarding the importance of student control of streaming media as an aid to the understanding of content differ with respect to the capacity of working memory?

Research Question 5. To what extent do students perceive that the ability to control the speed, delivery pace, and repetition of steaming media improves understanding of content?

Definition of Terms

Cognitive styles are the ways that people process and represent information (thinking with words or images) along a visualizer-verbalizer dimension in a multimedia learning environment (Mayer & Massa, 2003). *Learning preferences* are the ways that people like information presented to them (preferring instruction with text or graphics) along a visualizer-verbalizer dimension within a multimedia learning environment (Mayer & Massa).

Multimedia describes sequential or simultaneous use of a variety of media formats in a given presentation or self-study program (Smaldino, Lowther, & Russell, 2008). *Hypermedia* describes nonlinear presentation of information (Dillon & Gabbard, 1998). *Streaming media* are multimedia delivered over the Internet (Heinich et al., 2002; Simonson et al., 2006). A *podcast* is an Internet-distributed multimedia file formatted for direct download to mobile devices (Smaldino et al.).

Chapter 2: Review of the Related Literature

The purpose of this applied dissertation study was to investigate CLT as it applies to the design of streaming media. This study investigated students' learning preferences and cognitive styles as measured on a visualizer-verbalizer scale and compared these preference and learning styles to students' perceptions of the importance of visual and audio components of streaming media. Additionally, this study investigated CLT by assessing attitudes regarding the importance of learner control when accessing streaming-media files.

CLT is a learning theory that has implications for the effective design of instructional materials, including online multimedia, hypermedia, and streaming media (Chandler & Sweller, 1991; Sweller, 2005a). In particular, the impact and effects of cognitive load should be considered by faculty members, instructional designers, and technology administrators to assure faculty members, instructional designers, and technology administrators that the materials and media used are effective for learning (Sweller, 2005a).

CLT

Sweller (2005a) defined *long-term memory* as "the cognitive structure that stores our knowledge base" (p. 29) and *working memory* as "the cognitive structure in which we consciously process information" (p. 29). CLT provides a framework for instructional design that reduces the load on working memory, which may be thought of as the area where learners briefly process and store new information that then may be discarded or moved into and stored in long-term memory.

Two important characteristics of working memory have implications for effective instructional design:

1. The limited capacity of working memory for the number of items that may be stored at one time.

2. The short time during which any information that is stored in working memory lasts.

Effective instruction should be designed in such a way as to enhance the assimilation and processing of new information in working memory so that new information to be learned will be processed and moved to long-term memory. According to Narciss, Proske, and Koerndle (2006), “the most important task instructional designers and teachers have to solve is to develop strategies which encourage, prime and guide learners in actively processing Web-based material” (p. 1127).

CLT has gained attention as a learning theory that provides a framework for understanding, designing, and evaluating technology-based media (Brunken, Plass, & Leutner, 2003; Moore, Burton, & Myers, 1996; Sweller, 2005a), such as multimedia programs and streaming media used in instruction. CLT examines the process of assimilating new information and identifies instructional design aspects that may support or interfere with knowledge assimilation, including visual and verbal components of media and learner control.

Thuring, Hanneman, and Haake (1995) investigated how multimedia and hypermedia programs could be designed in such a way as to optimize the coherence of instructional materials at local and global levels in order to enhance learning. They described efforts to reduce cognitive overhead, or the amount of cognitive load necessary to maintain several tasks at the same time, in working memory. Thuring et al. found two factors that are particularly crucial for increasing comprehension in these programs: coherence as a positive influence and cognitive overhead as a negative influence on learning. They concluded that designers could facilitate learning by increasing comprehension through improved document design and reduce cognitive overhead by freeing up information-processing capacities that might otherwise be engaged in navigation, orientation, or other user-controlled options.

Shapiro, Mentch, and Kubit (2007) surveyed students who used streaming media that had been launched in 2003 to support freshman students enrolled in chemistry. Among the survey questions they asked were several that pertained to students' perspectives on the effectiveness of streaming media to support their understanding of chemistry. Students reported that learning effectiveness was enhanced by their control over the pace of their learning. In addition, they reported feeling more confident about learning as a result of having access to streaming media for study and review.

CLT and Learning

CLT grew out of learning theory--in particular, processing theory (Sweller, 2005a). Cognitive load is the amount of effort a learner expends mentally when learning. CLT suggests that there are two kinds of memory: working and long term. Working memory is very limited and is able to hold only a small number of items at any one time. Theorists have proposed different limits, but most support Miller's seven items plus or minus two. In other words, a learner probably can hold between five and nine items in working memory at one time (Baddeley, 1992; Sweller, 2005a). Working memory is also limited by the length of time information can be held. Without rehearsal, information is lost within 20 seconds. According to Reiser and Dempsey (2007), "effective instructional strategies must accommodate the limited capacity of working memory" (p. 314).

Long-term memory, where information ultimately is stored, is unlimited. During instruction, learners process information in working memory. Then the information is either discarded or moved into and held in long-term memory. The process of information being held in long-term memory was described by Sweller (2005a) as schema construction. Schemas are cognitive constructs that enable learners to categorize many pieces of information to be processed and stored in memory as one element. This information may be written, spoken, visual, or textual. Understanding of the constraints upon and the relationship between working and long-term memory is critical to the effective design of instruction. Instruction that is designed in such a way as to increase cognitive load is ineffective (Chandler & Sweller, 1991).

Cognitive load was described by Sweller, van Merrienboer, and Paas (1998) as one of three types: intrinsic, extraneous, or germane. Intrinsic cognitive load is part of the information itself; it is actually generated by the content to be learned. In the performance of a learning task, a number of elements must be held in working memory; each may be held only for a short time. The greater the number of elements and the longer they must be held in working memory, the greater is the intrinsic cognitive load.

Extraneous cognitive load is the additional load imposed upon working memory by poor or inefficient design of instructional materials. When a learner holds too many elements in working memory because of poor instructional design, extraneous cognitive load is increased (Sweller, 2005a; Sweller et al., 1998). When elaborate problem-solving or searching processes are required by the design of instructional materials, working memory is overwhelmed. The primary goals of instructional design should be to reduce extraneous cognitive load and to free up working memory (Sweller, 2005a).

Germane cognitive load is the load imposed on the learner by the action of learning itself when schemata are created and stored in long-term memory (Sweller, 2005a). Germane cognitive load uses the remaining working memory space after intrinsic and extraneous cognitive loads use the available resources.

Of the three types of cognitive load, extraneous cognitive load on working memory has the greatest relevance to the effective instructional design of media. Considerable research has been conducted on CLT (Sweller, 2005a; Sweller et al., 1998), especially as it impacts instructional media. Implications for effective instructional design have been explored, and design guidelines based on CLT have been presented and supported.

Bearing of CLT on Instruction

Split-attention effect. The split-attention effect occurs when a learner must split his or her attention between multiple sources of information presented during instruction (Ayres & Sweller, 2005; Sweller, 2005a). This could occur, for example, when a student is presented with two sources of visual information, such as diagrams and associated text, or with a multimedia program that presents instruction in visual and verbal formats at the same time. The multiple sources of information must be assimilated at the same time, thus increasing extraneous cognitive load.

Using a multimedia lesson designed to teach software applications, Veronikas and Maushak (2005) conducted a study to determine student attitudes toward verbal components of instruction. The participants were divided into three groups, each of which received screen shots as the visual portion of instruction. The verbal portion of instruction was presented as text, audio, or both text and audio (dual modality). Veronikas and Maushak hypothesized that students who received the dual-modality verbal instruction would outperform the other two groups. No significant difference was reported among the three groups; however, in response to the attitude survey, participants did report a preference for dual modality during instruction.

The split-attention effect may occur during computer-based instruction that includes diagrams and text. Kalyuga, Chandler, and Sweller (1999) found that, when text was presented in auditory form rather than visual form to trade apprentices and trainees, the split-attention effect was lowered, thereby increasing effective working memory. They also found that, if the text was presented in both auditory and visual formats, effective working memory was decreased.

In Mayer and Moreno's (1998) study, learning from a multimedia program that utilized animation to depict lightning formation, college students received instruction either as on-screen text or as narration. The group that received instruction as on-screen text did not perform as well on a test of transfer and retention as did the group that received instruction as narration. Mayer and Moreno (1998) concluded that students who received the verbal portion of the instruction as narration did not have to split their attention between the visual images and verbal text, thereby lessening cognitive load.

Modality effect. Another effect that may occur during instruction is the modality effect of the presentation of information to learners using multiple modes of information, such as visual and verbal, rather than a single mode (Low & Sweller, 2005). Presenting information under certain conditions in a dual-mode context can expand working memory and reduce cognitive load. The amount of information that can be processed at any one time may be increased by using both the audio and visual channels rather than a single channel (Leahy, Chandler, & Sweller, 2003). Therefore, instructional materials that are designed to use a dual-mode presentation format may be more efficient than presentations that use a single mode.

The modality effect may also occur during instruction, when multiple pieces of essential information are presented in visual form (Tindall-Ford, Chandler, & Sweller, 1997). This occurs during instruction when a learner is expected to view graphs, diagrams, or other objects and also read associated text. The modality effect increases extraneous cognitive load, which could be decreased by presentation of the textual information in an audio or spoken format along with the necessary visual information rather than through two types of visual information. In the latter presentation, the visual channel would be overloaded, and the verbal channel would be underused (Low & Sweller, 2005).

Tindall-Ford et al. (1997) explored the relationship of visual and verbal elements in instruction. They presented two groups of students with technical engineering drawings. One group used the drawings with narration, and the second used the drawings with both text and narration. Results showed that narration with diagrams was superior to text and narration for instruction in electrical engineering containing high-level intellectual content. In a second experiment, tables were substituted for drawings, and similar results were achieved. Tindall-Ford et al. concluded that presentation of information via dual modes, rather than a single mode, increased effectiveness by reducing cognitive load.

Mousavi, Low, and Sweller (1995) also suggested utilizing multiple channels to decrease cognitive load. Using worked geometry examples with eighth-grade students, they presented information using diagrams with audio text, diagrams with visual text, and diagrams with narration. The groups that received the diagrams with either audio text or narration outperformed the groups that received the diagrams with visual text.

In a study that was conducted with 2nd-year education students, a reverse modality effect was reported (Tabbers, Martens, & van Merrienboer, 2004). The study was primarily designed to test modality and cueing in Web-based multimedia instruction.

Testing for the retention and transfer of scores in classroom settings, students were presented with instruction that was either bimodal (visual and audio information) or visual only. The group that used bimodal instruction was not found to perform better on tests of retention and transfer than the group that used visual instruction only. In Tabbers et al.'s study, the users studied the content at their own pace. Tabbers et al. concluded that, when presented with instruction that is self-paced, learners could benefit more from visually based instruction than from bimodal instruction because they can deal with the text and pictures at their own pace. Learners' ability to skim through this type of content more easily than through content that is presented in both an audio and visual form makes visually based instruction more useful in seeking a particular section or topic within the instruction.

Redundancy effect. In the redundancy effect, redundant sources of information are presented in multiple modes when a single mode would be sufficient for understanding (Chandler & Sweller, 1991; Sweller, 2005b). Whereas split-attention and modality effects reduce cognitive load by utilizing multiple modes, the redundancy effect can increase cognitive load. An example of redundancy might occur when a diagram and a statement are presented together and the statement merely describes the diagram.

Leahy et al. (2003) investigated the redundancy effect by presenting two forms of instruction to two groups of middle school students who were studying temperature graphs. They presented to one group instruction that consisted of diagrams and text. To the other group, they presented instruction that utilized nonessential explanation that was presented aurally along with written text and diagrams. The group that received instruction with only diagrams and written text outperformed the group that received instruction that used aural text, written text, and diagrams. Leahy et al. attributed this result to the redundancy effect, explaining that the narration along with the written text was redundant and so increased cognitive load.

Kalyuga et al. (1999) conducted research on both split-attention and redundancy when presenting computer-based information as diagrams and text. Participants in their study were first-year trade apprentices with little or no experience with soldering. The participants were randomly assigned to one of two groups for instruction. The performance of the group that received instruction via diagrams with text exceeded that of the group that received instruction that utilized narration, text, and diagrams. The redundancy effect was evoked when verbal information was presented both auditorily and textually along with diagrams (Kalyuga et al., 1999).

In their investigation of the effects of redundancy, Kalyuga, Chandler, and Sweller (2004) hypothesized that, if verbal information was presented in both audio and text forms serially rather than concurrently, cognitive load would be decreased. They conducted three experiments with technical apprentices learning in a training environment. Experiment 1 presented diagrams along with either concurrent (auditory and textual) verbal information or sequential (auditory followed by textual) verbal information with no time constraints. Experiment 2 was conducted with the same conditions, except that time limits were imposed. Experiment 3 differed in that presentations using audio and visual text were compared to audio-only presentations (without diagrams). The first two experiments supported the hypothesis that presenting verbal information in two forms sequentially was superior to presenting the same information concurrently. The third experiment demonstrated that it is less efficient to present dual forms of verbal information than to present auditory information alone.

Visual and Verbal Learners

Reiser and Dempsey (2007) described separate channels of the memory system for processing either visual/pictorial or auditory/verbal information. Each of these channels has its own cognitive load limit. The visual/pictorial channel is used to process graphics and images. The auditory/verbal channel is used to process spoken words. Cognitive load is increased during learning with visual and verbal information when learners are presented with written text. In this case, the words are initially processed in the visual/pictorial channel but must also be processed in the auditory/verbal channel.

Moreno and Valdez (2005) conducted a multimedia study with undergraduate students learning about lightning formation. One group in their study learned from words and pictures, one group learned from words alone, and one group learned from pictures alone. Moreno and Valdez found that students learned better from words and pictures in combination than from words or pictures alone. In tests for retention, transfer, and problem solution, the combination of words and pictures proved to be most effective. The group that learned from pictures alone demonstrated the highest cognitive load and the lowest performance of all three groups. Moreno and Valdez concluded that designers of e-learning environments should develop materials using a combination of visual and verbal elements in the presentation of topics in science in order to reduce cognitive load.

Mayer and Massa (2003) hypothesized that some learners prefer to learn visually and some prefer to learn verbally. They defined and measured learner preferences and learner cognitive styles. Learner preference is “preferring instructions with text or graphics,” and cognitive style is “thinking with words or images” (Mayer & Massa, p. 833). Some learners actually perform better when processing words, and some perform better when processing pictures. Although Mayer and Massa’s research focused on multimedia instruction, they present results that have implications for cognitive theory in general. Mayer and Massa concluded that learners making choices in the context of an "authentic learning scenario" (p. 839) are clearly able to identify preferences for verbal or visual instruction. In addition, they found that a simple learning-style self-rating tool can be an effective substitute for other, more time-consuming instruments that measure the same verbal or visual preferences.

Mayer and Moreno (2003) identified ways to reduce cognitive load in multimedia learning. In particular, they focused on verbal and visual processing during instruction, utilizing instructional design methods to foster meaningful learning. Using five different cognitive-load scenarios, Mayer and Moreno presented theory-based suggestions for decreasing cognitive load in multimedia instruction. Their suggestions were based on the dual-channel and limited-capacity assumptions of verbal and visual processing.

In a study that was designed to clarify understanding of the preferences of visual and verbal learners in a multimedia environment, English-speaking college students enrolled in a German course were presented with opportunities to choose from several presentation modes while reading a story that was presented through a computer program (Plass, Chun, Mayer, & Leutner, 1998). Learners could select a verbal translation on the screen in English (verbal annotations), a picture or video clip that represented the translation (visual annotations), or both. Students' comprehension of the material was better when they could use their preferred choice of annotation during instruction. Plass et al. concluded that learners' comprehension improves when learners actively choose the relevant information necessary for learning during instruction.

Learner Control

In a review of developments in CLT, Paas, Tuovinen, Tabbers, and Van Gerven

(2003) discussed the measurement of cognitive load and its implications for instructional design. Because CLT is based on the notion of limited working memory, instructional designers have had to take independent processing of both auditory/verbal and visual/spatial input into consideration when designing instructional media that will not overload working memory. In addition, the pacing of instruction must be considered in terms of the number of items presented and held in working memory at any given time, again with the intent of not overloading working memory.

Wheeler (1999), one of the first to report on CLT and streaming media, found that care must be taken not to cause cognitive overload when using this delivery method. He introduced both synchronous and asynchronous instruction over the Internet, including multicasting, or what is now referred to as streaming media. Technological and pedagogical factors of learning were considered by Moore (as cited in Wheeler) and Willis (as cited in Wheeler) in regard to the successful deployment of streaming media, which, in Wheeler's review, included a live streaming source, associated PowerPoint slides, and text-messaging boxes for interaction. These multiple modes appeal to different learning styles but challenge designers not to cause cognitive overload through poor design.

Mayer and Chandler (2001) examined relationships between knowledge acquisition and the learner's ability to make choices regarding navigation, speed of delivery, and turning on and off certain features of media during playback. Mayer and Chandler found that providing a modest amount of learner control could promote deeper learning in multimedia instruction. They concluded that learning improves when instruction is presented in ways that are consistent with how people learn--in this case, when instruction was presented in small chunks so as not to overwhelm cognitive capacity.

Learner control allows learners to make choices that determine the pace of delivery, the amount of information or content that is presented at any one time (Sweller, 2005a, 2005b), the repetitiveness of instructional content that is presented by means of streaming media, and the combination of visual and verbal content, thereby reducing the load on working memory.

Van Merrienboer and Kester (2005) presented an instructional-design model for multimedia learning in which they described the self-pacing principle: Giving learners control over the pace of instruction "may facilitate elaboration and deep processing of information" (p. 83). Students perform better when they control the pace of instruction (Mayer & Chandler, as cited in van Merrienboer & Kester). Mayer and Moreno's results (as cited in van Merrienboer & Kester) indicated deep processing of information and improved transfer and retention test results in cases where students were able to exercise control over the pacing or amount of instruction that was presented at any one time.

Dillon and Gabbard (1998), in a review of research on hypermedia, or nonlinear, presentation of information, examined findings on the effect of learner control on learning outcomes. They presented results from five studies, all of which tested different aspects of learner control during instruction utilizing hypermedia programs. Dillon and Gabbard concluded that, although hypermedia programs present users with options for control over access and exploration of content, the ability to control pace and delivery does not affect learning outcome except that of high-ability users.

Singhanayck and Hooper (1998) designed and conducted a study of achievement and attitudes of high- and low-achieving sixth-grade students. They reported that low-achieving students performed better in program-controlled instruction and that high-achieving students performed better in the learner-controlled environment.

Learner control and cognitive load during hypertext-based instruction was studied by Gerjets and Scheiter (2003), who set out to gain a clearer understanding of the relationship of teacher-centered or learner-centered instructional goals in hypertext-based learning to learning outcomes. They reviewed CLT and presented an augmented form of CLT that reflected a higher level of learner control. Gerjets and Scheiter found that CLT provides a solid foundation for instructional design when augmented with learner-controlled navigation in order to reduce cognitive load and enhance the formation of schema for long-term memory.

In a study with preservice teachers, Schnackenberg and Sullivan (2000) found that participants who had instructional control over the amount of practice they received during computer-based training in writing learning objectives did not perform any better than those who did not have control. Even so, participants responded more favorably to learner control when asked about their attitudes regarding learner control or program control during instruction.

Mayer and Chandler (2001) followed multimedia presentations in the form of narrated animations that explained lightning formation with retention and transfer tests. Learners who were allowed to control the pace of the presentations performed better on the transfer test than did students who received the same material at normal speeds; however, the students who received the material at normal (rather than learner-controlled) speed performed better on the retention tests than did the students who controlled the pace.

In a review of multimedia development, Cairncross and Mannion (2001) argued that a learner-centered approach must be taken in order to engage learners actively during instruction. A theoretical overview of learning provides a framework for incorporating key elements of multimedia instruction into design. Cairncross and Mannion underscored the importance of user control over delivery. The International Organization for Standardization's multimedia standards (as cited in Cairncross & Mannion) describe navigation and basic controls within audio-visual media.

Lowe (2003), whose study utilized weather-map animations that incorporated a high degree of user control, considered that animations present learners with increased information-processing demands, thereby increasing cognitive load. The learner-control element was considered because Narayanan and Hegarty (as cited in Lowe) suggested that interactive animations are not as effective as static graphics and that interactive animations may increase cognitive load if learners are not allowed to control the pace or direction of instruction as they are engaged in interactive instruction.

In Lowe's (2003) study, novice learners did not perform as well as experienced learners. This was attributed to their not recognizing the salient information that was presented, whether it was presented in static or animated form. Results of Lowe's study suggested that, in learner-controlled instruction, support and direction are necessary.

Sakar and Ercetin (2004) conducted an exploratory study with intermediate-level English learners utilizing annotations while reading hypertext. The purposes of this study were to explore learner preferences and to determine whether these annotations would facilitate reading comprehension. Sakar and Ercetin found that learners preferred visual annotations over text and audio annotations; however, they also found that a negative relationship existed between the use of annotations and reading comprehension. Nonetheless, participants responded positively to the use of annotations and hypertext.

Van Merrienboer, Schuurman, de Croock, and Pass (2002) conducted several experiments in order to test CLT in the training of complex skills. Learners were presented with three different problem formats--conventional problems, completion problems, and learner-controlled problems in which the learner chose the format--as they proceeded through training in the design and coding of computer programs. Learners were asked to report perceived mental effort during training in order to provide a subjective measure of cognitive load. Learners reported higher mental effort in the conventional group (whose assignment was design and coding of new computer programs) than in the completion group (whose assignment was completion of partial programs). Both groups demonstrated equal transfer test performance. The learner-controlled group reported a mental effort that was not significantly different from the other two groups but demonstrated superior transfer-test performance. One explanation that was offered by Van Merrienboer et al. was that, when learners were given control over their learning environment, their task involvement and their germane cognitive load investment increased.

Wallen, Plass, and Brunken (2005) studied the effects of learner-controlled annotations on cognitive load. During the study, college-level science students were provided with both picture and text annotations and were identified as low- and high-verbal learners. Wallen et al. were surprised to find that, when learners were presented with a single annotation, comprehension increased, but, when learners were presented with multiple annotations from which to choose, comprehension decreased. This effect was attributed to cognitive overload. This cognitive overload effect was stronger in low-verbal learners than in high-verbal learners.

Streaming Media in Higher Education

Yuen et al. (2008) developed and delivered streaming media as podcasts to students using portable devices, such as iPods and MP3 players. These podcasts enabled students to access lectures that had been recorded and that were made available to support classroom and distance instruction. In order to understand their students' needs and perceptions regarding the effectiveness of podcasts more clearly, Yeun et al. surveyed their students. Nine hundred sixty-five graduate and undergraduate students enrolled in both face-to-face and online courses utilizing podcasts participated in an online survey. Seventy-nine percent of the respondents were interested in accessing course materials through podcasting, and 60% of the respondents reported that podcasting materials improved learning. A majority of the students reported that the podcasting supported their learning because of learner control: They could review the material at their own pace, whenever and wherever they wanted, and they could review the materials repeatedly.

In a review of streaming-media developments in higher education, Fill and Ottewill (2006) presented an overview of various universities' projects regarding the potential effectiveness of streaming media. They found that the advantages of streaming include learner control, flexibility during playback, and cost. Fill and Ottewill also presented pitfalls: the cost of support, ineffective instructional design, and the potential for video becoming more edutaining and less educational.

At Case Western Reserve University, streaming video has supported traditional methods of instruction through captured course lectures that have been made available to students any time and anywhere (Shapiro et al., 2007). Students use these streams as review tools when they are unable to attend class and as preparation for tests. When surveyed, students reported that using the streams enabled them to control the pace of the instruction, and 75% reported that they were more confident of achieving their academic goals as a result of learning with streaming media.

Shephard (2003) reviewed case studies of the use of streaming video in postcompulsory education in the United Kingdom. The benefits of streaming video over conventional video-delivery methods included wider access over the Internet, the ability to incorporate video streams or links to streams through course-management systems or hypermedia projects, and the ability to provide small video clips rather than lengthy video programs. Consideration for continued growth and development should include increased learner engagement, appropriate levels of technical support, and integration of both online and offline learning resources (Shephard).

Summary

CLT has implications for the effective instructional design and use of annotations, hypermedia programs, multimedia programs, and streaming media in education. Split-attention, redundancy, and modality effects must be more clearly understood from a visual-verbal perspective. Additionally, the learner-control aspect must be examined in the context of these three effects, given that this control provides a means for learners to regulate and monitor the visual and verbal elements of instruction and the amount and pace of instruction at any one time. Learner control may allow the learner to reduce cognitive load and increase learning. Although CLT, instructional design of media, and achievement have been researched extensively, there is a gap between learning theory and design considerations for the effective use of streaming media.

Chapter 3: Methodology

The purpose of this study was to investigate CLT as it applies to the design of streaming media. This study investigated student learning preferences and cognitive style as measured on a visualizer-verbalizer scale. Additionally, this study investigated CLT by assessing attitudes regarding the importance of learner control when accessing streaming-media files. Demographic data that were gathered included gender and age data in order to determine whether demographics were related to significantly different opinions regarding the effectiveness of streaming media.

Data were gathered via a survey of a sample of students regarding attitudes and perceptions. The sample was representative of undergraduate students at a large urban university in the southern United States. The quantitative research design for this project was a cross-sectional-survey design. According to Creswell (2003) and Gall et al. (2003), this design is appropriate for describing attitudes or opinions of a population. Survey research is preferred for this type of data collection, allowing the researcher to design and administer the questionnaire offering a quick analysis of results.

Twenty participants were randomly selected to participate in interviews upon completion of the survey instrument. The purpose of conducting interviews as a qualitative component of this project was to gain a clearer understanding of learners' needs and perceptions regarding streaming media. Gall et al. (2003) reported that interviews probe more deeply into respondents' attitudes and perceptions than surveys or questionnaires, thus providing more information than a comparison of survey responses.

Participants

The target population for this study was made up of college students who had the opportunity to view or listen to streaming-media files that were created as a supplement to face-to-face instruction in chemistry. The streaming-media files were recordings of lectures that were given during the course. They were made available to students over the Internet. Students could access these files any time and as often as they chose. When accessing streaming media, students could choose from several combinations of visual and verbal elements: visual text, audio text (narration), instructor video, and slides or other graphics. In addition, students controlled the pace of the stream and could stop, start, pause, or rewind the stream while they viewed or listened. Students also had hypertext navigation capabilities, which allowed them to jump to a particular portion of the stream by clicking on a topic in a navigation bar.

The sample for this study was a nonprobability or convenience sample (as defined by Creswell, 2003) that consisted of students who were enrolled in a chemistry course that was taught by a senior faculty member and researcher who had taught college-level chemistry for 25 years and who served as the lead faculty design-team member for the streaming-media initiative at the university at the time of this study. The students in this class section who chose to participate made up the sample. They represented the population of freshman students who were enrolled in entry-level chemistry. Faculty members who taught this course agreed to grant permission to recruit students to participate in this study. The enrollment for this course section averages 300 students per section per semester. Students enroll in the course as a general science requirement. This course is typically taken as a general science requirement, and the results of this study were expected to be generalizable to the university population.

The target population for this study was freshman-level college students enrolled in a freshman-level basic chemistry course, Fundamentals of Chemistry. Students who were enrolled in this section were presumed to be similar to the students of the university population through a mix of age, gender, ethnicity, major area of study, class scheduling requirements, their experience with computers and the Internet, and attitudes and preferences regarding the use of streaming media. Anonymity of all participants was protected, and interactions were consistent with those specified by the University of Houston's Committee for the Protection of Human Subjects and the Nova Southeastern Institutional Review Board.

Participants were recruited during a class period and invited to participate voluntarily. One hundred forty-three students agreed to participate, but only 93 completed the entire survey. Sixty-six percent were female; 34% were male. Seventy percent were less than 20 years of age; 30% were 20 years old or older.

Hypotheses

Hypothesis 1. Learners with a visual or verbal cognitive style will report a corresponding preference for visual or verbal elements in streaming media.

Hypothesis 2. Learners with a visual or verbal learning preference will report a corresponding preference for visual or verbal elements in streaming media.

Instruments

The survey instrument for this research study was assembled from several survey components: four preexisting surveys and one component that consisted of questions that were developed primarily for this project with the intent of gathering data regarding visual and verbal students' attitudes and opinions about the streaming media that were used in this chemistry course. The preexisting instruments, designed to measure cognitive style and learning preference, included the Santa Barbara Learning Style Questionnaire (Mayer & Massa, 2003), the Verbal-Visual Learning Style Rating (Mayer & Massa), the Learning Scenario Questionnaire (Mayer & Massa), and the Multimedia Learning

Preference Questionnaire (Mayer & Massa). These four instruments were developed by Mayer and Massa, faculty members at the University of California, Santa Barbara, in Educational Psychology for the purpose of measuring cognitive style and student preferences for visual or verbal learning. These four instruments were chosen from eight that measured either cognitive style or learning preference. An exploratory factor analysis of the eight instruments was conducted by Mayer and Massa to ensure that each instrument loaded on the appropriate factor, cognitive style, or learning preference. Each of the four instruments that were selected for this study loaded most heavily, the Santa Barbara Learning Style Questionnaire and the Verbal-Visual Learning Style Rating on cognitive style and the Learning Scenario and the Multimedia Learning Preference Questionnaire on learning preference. According to Gall et al. (2003), the use of two instruments to measure each independent variable should present data that identify learner preferences and cognitive styles more clearly than a single instrument would.

To determine a level of reliability for these instruments, Mayer and Massa (2003) computed Cronbach's index of internal consistency of the Santa Barbara Learning Style Questionnaire ($\alpha = .76$), the Multimedia Learning Questionnaire ($\alpha = .80$), and the Learning Scenario Questionnaire ($\alpha = .38$). The Verbal-Visual Learning Style Rating was not tested.

An exploratory factor analysis was also performed. It validated the four instruments' correlation with the learner characteristic to be measured (either cognitive style or learning preference; Mayer & Massa, 2003). According to Gall et al. (2003), An exploratory factor analysis may be performed to determine the relationship among subtests in order to provide evidence of validity of interpretations when scores are gathered from several instruments.

The fifth survey component, the streaming-media questionnaire (see Appendix A), was an original instrument that consisted of 18 questions that were designed for this applied dissertation study. These questions pertained to the media streams that had been used by students in this course. The first 10 questions were designed to glean students' preferences for visual and verbal components contained within the streaming-media files and their perceptions of the importance of learner control over streaming-media files in relation to the limitations of working-memory capacity during instruction. The final 8 questions contained actual images that were captured from streaming-media files that were used in the course. These questions were designed to glean students' perceptions of the three effects of cognitive load during instruction. This component was written by the author and the chemistry faculty member/streaming-media advisor. It was to provide the author with students' perceptions of the effectiveness of the streaming media used in this course. In a preliminary review for validity and reliability, this instrument was pilot tested with students enrolled in the college, streaming technicians, instructional designers, and graduate teaching assistants familiar with the streaming-media project. This was done in order to determine appropriate wording and format for users of streaming media.

After completion of the survey, 20 participants were randomly selected to participate in a phone interview. As a qualitative aspect of this project, the format for the interview was not tightly structured. In the interview, respondents were asked to elaborate on their views of streaming media. Gall et al. (2003) described one of the interview formats in qualitative research as the "general interview guide approach" (p. 240), in which a set of topics with which to guide the interview is prepared.

The topics to be covered in the interview were not predetermined. The order of the questions was likewise not predetermined. The questions and the topics to be covered were pilot tested with the same team of individuals who designed and pilot tested the survey instrument. This was done in order to verify appropriate wording, validity, and reliability. The interview topics and questions were presented as guidelines to be utilized during the interview (see Appendix B).

The five survey instruments were presented and administered as one survey instrument. In order to avoid confounding of participants, the titles of the instruments were not presented during the survey, and the questions all appeared as on one instrument. The five instruments served to measure participants' specific preferences for the visual or verbal components in streaming media, their cognitive styles, their learning preferences, their preference for certain types or amounts of content presented at any one time, and their perceptions of the importance of learner control of the media in instruction.

Procedures

The combined survey instrument was administered one time during the semester using a commercially available Web-based survey client, Survey Monkey, through which one may to design and host survey instruments on a dedicated Web page. Participants were provided with the Web address for the survey and with the dates for completion.

When the students accessed the survey, the opening screen presented the informed-consent document, which included information regarding anonymity. When participants had read this information, they had the option to agree and proceed to the survey or to decline and exit the survey. In order to ensure that participants accessed and completed the survey, Survey Monkey offered password-protected access for the designer to monitor activities while the survey was open and active without interfering with participants or results. When a student completed the survey, he or she was invited to participate in a brief telephone interview. Notes that were taken during the interviews were recorded and transcribed (see Appendix C).

Bivariate analysis using the Pearson product-moment correlation was used to determine the strength and direction of the relationship between the two independent variables (cognitive style and learning preference) and the dependent variable (streaming-media preferences). Demographic frequencies and percentages were determined. Cognitive style and learning preference were correlated with streaming-media preferences for visual or verbal components of streams. SPSS 16 for Windows was used for data analysis.

The survey results and the demographic data were recorded as a mix of nominal, ordinal, interval, and ratio data by the Survey Monkey application and stored in databases on secure servers. This method provided secure and reliable means by which to record and process data, which were then downloaded through a secure connection and analyzed using SPSS 16.

Delimitations

This applied dissertation study was confined to streaming-media files that incorporated verbal information through text, audio, or both and visual information that included graphics, images, or both presented and recorded during classroom instruction. The design of the streaming-media clips that were used in this study could present different verbal and visual elements or present those elements in different ways from streaming media used in other educational settings or with content other than that of freshman-level chemistry. Findings may not be generalizable to other streaming activities in other educational settings in which different combinations of audio, text, visuals, and motion media may be utilized.

Chapter 4: Results

The purpose of this study was to investigate CLT as it applies to the design of streaming media. This study assessed attitudes regarding the importance of learner control when accessing streaming-media files. Feedback was gathered from students through interviews regarding their perceptions of the effectiveness of learner control over streaming media.

Research Question 1

Research Question 1 was "What is the relationship between student cognitive style and perceived importance of visual and verbal elements present in streaming media?" Means and standard deviations for this question were as presented in Table 1.

Table 1

Students' Cognitive-Style Statistics (N = 93)

Item	Range	*M*	*SD*
Santa Barbara Learning Style Questionnaire	-18 to 18	2.16	2.59
Verbal-visual learning-style rating	-3 to 3	0.91	1.38
Listening to the streaming files helps me understand the course content	-2 to 2	1.87	0.80
Reading the text contained in the streaming file helps me understand the course content	-2 to 2	1.96	0.72
Watching the streaming files helps me understand the course content	-2 to 2	1.74	0.71

To collect data regarding the independent variable student cognitive style and the independent variable streaming-media visual and verbal elements, two existing instruments and three streaming-media items were used. The instruments with which student cognitive style was measured were the Santa Barbara Learning Style Questionnaire (Mayer & Massa, 2003) and the Verbal-Visual Learning Style Rating

(Mayer & Massa). Three items from the streaming-media questionnaire were Likert-scale items that asked participants to rate the importance of the visual and verbal elements within media streams. For the first analysis, the Pearson product-moment correlation between the student cognitive style instruments and the streaming-media items was determined. Results were as shown in Table 2.

Table 2

Intercorrelations of Student Cognitive Style and Visual or Verbal Element Preferences in Streaming Media (N = 93)

	r				
Item	1	2	3	4	5
Santa Barbara Learning Style Questionnaire	--	.61*	.09	-.05	.07
Verbal-visual learning-style rating	--	--	.28*	.05	.29*
Listening to the streaming files helps me understand the course content	--	--	--	.48*	.77*
Reading the text contained in the streaming file helps me understand the course content	--	--	--	--	.51*
Watching the streaming files helps me understand the course content	--	--	--	--	--

**p* < .01.

A significant positive correlation between the Santa Barbara Learning Style Questionnaire (Mayer & Massa, 2003) and the Verbal-Visual Learning Style Rating (Mayer & Massa) was evident. The Santa Barbara Learning Style Questionnaire and streaming-media items showed no significant correlations. The Verbal-Visual Learning Style Rating (Mayer & Massa) correlated with two of the streaming-media-survey items (listening and watching) but did not show a correlation with reading. The three streaming-media items showed moderate to strong correlations with one another.

Research Question 2

Research Question 2 was "What is the relationship between student learning preference and perceived importance of visual and verbal elements present in streaming media?" To collect data regarding the independent variable student learning preference and the independent variable streaming-media visual and verbal elements, two existing instruments and three streaming-media items were used. The instruments by which student cognitive style was measured were the Learning Scenario Questionnaire (Mayer & Massa, 2003) and the Multimedia Learning Preference Questionnaire (Mayer & Massa). Three items from the streaming-media questionnaire were Likert-scale items that asked participants to rate the importance of the visual and verbal elements within media streams. Means and standard deviations for this question were as shown in Table 3.

Table 3

Students' Learning-Preference Statistics (N = 93)

Item	Range	*M*	*SD*
Learning Scenario Questionnaire	0 to 5	3.94	1.06
Multimedia Learning Preference Questionnaire	0 to 5	0.31	0.47
Listening to the streaming files helps me understand the course content	-2 to 2	1.87	0.80
Reading the text contained in the streaming file helps me understand the course content	-2 to 2	1.96	0.72
Watching the streaming files helps me understand the course content	-2 to 2	1.74	0.71

For this analysis, the Pearson product-moment correlation between the student learning-preference instruments and the streaming-media items was determined. Results were as shown in Table 4. The Learning Scenario Questionnaire and the Multimedia Learning Preference Questionnaire showed no correlation. The Learning Scenario

Questionnaire and streaming media items showed no correlations. The Multimedia Learning Preference Questionnaire and streaming-media items showed no correlations. The three streaming-media items showed medium to high correlations with one another.

Table 4

Intercorrelations of Student Learning Preference and Visual or Verbal Element Preferences in Streaming Media (N = 93)

	r				
Item	1	2	3	4	5
Learning Scenario Questionnaire	--	.06	.05	-.02	.05
Multimedia Learning Preference Questionnaire	--	--	-.10	.07	.05
Listening to the streaming files helps me understand the course content	--	--	--	.48*	.77*
Reading the text contained in the streaming file helps me understand the course content	--	--	--	--	.51*
Watching the streaming files helps me understand the course content	--	--	--	--	--

*$p < .01$.

Research Question 3

Research Question 3 was "How do the preferences of visual and verbal learners regarding the type and amount of instructional content presented at any one time through streaming media differ with respect to the three effects of cognitive load?" To collect data regarding the different preferences of visual and verbal learners in relation to utilizing streaming media, this research questions was broken down into two characteristics of streaming media: the type of content presented and the amount of content presented. Participants were asked to rate themselves as visual or verbal learners. Four items from the streaming-media questionnaire used frame captures from media streams and asked participants to select a visual preference (score of 1) or a verbal preference (score of 0) of presentation type for streaming content. Means and standard deviations for this question were as presented in Table 5.

Table 5

Learner Preferences for the Type of Content Presented Through Streaming Media

	Visual (n = 84)		Verbal (n = 9)	
Item	*M*	*SD*	*M*	*SD*
When accessing a streaming media file such as this one on Wavelength and Frequency, I prefer to: hear or watch or read	.57	.50	.22	.44
When accessing a streaming media file such as this one on Wavelength and Frequency, I prefer: to read or to look	.65	.48	.22	.44
When accessing a streaming media file such as this one about the Alpha Scattering Experiment, Rutherford's observations, I prefer to: hear or watch or read	.51	.50	.33	.50
When accessing a streaming media file such as this one about the Alpha Scattering Experiment, Rutherford's observations, I prefer: to read or to look	.42	.50	.44	.53

Note. Possible item scores ranged from 0 (verbal preference) to 1 (visual preference).

To further identification of any significant differences between visual and verbal learner preferences for the type of content presented at one time, a multivariate analysis was conducted. Results were as shown in Table 6. This analysis was conducted using the factor variable (learner is visual or verbal) and four dependent item variables, which were the four items from the streaming-media questionnaire that used frame captures from media streams and asked participants to choose the type of information they preferred during instruction with streaming media (visual content = score of 1, verbal content = score of 0; see Appendix A). Items 1 and 2 showed significant variance between visual and verbal groups. Items 3 and 4 showed no significant variance between visual and verbal learners.

Table 6

Multivariate Analysis of Visual and Verbal Learner Preferences for the Type of Content Presented Through Streaming Media

Type of content	*SS*	*df*	*MS*	*F*	*p*
Wavelength and frequency file, preference for hearing/ watching/reading explanation	0.991	1	0.991	4.077*	.046
Wavelength and frequency file, preference for reading definitions/looking at illustration	1.521	1	1.521	6.737*	.011
Alpha scattering experiment file, preference for hearing/watching/reading explanation	0.259	1	0.259	1.026	.314
Alpha scattering experiment file, preference for reading boxes/looking at diagram	0.006	1	0.006	0.025	.874

*Significant at $p < .05$.

Although interview responses presented preferences for both types of content, there was not a distinct preference for one over the other. Responses reflected both preferences: “I memorize and understand from verbal communication; I remember better and I understand better when I see it; once I hear something I can usually remember it; I usually remember things people say . . . not things that I read or see” (see Transcript Lines 32-58, Appendix C).

Participants were asked to rate themselves as visual or verbal learners. Four items from the streaming-media questionnaire used frame captures from media streams and asked participants to choose the amount of information (appropriate amount = score of 1, too much or not enough information = score of 0) they preferred during instruction with streaming media. Means and standard deviations for this question were as shown in Table 7.

Table 7

Learner Preferences for the Amount of Content Presented Through Streaming Media

	Visual (*n* = 84)		Verbal (*n* = 9)	
Item	*M*	*SD*	*M*	*SD*
When accessing a streaming media file such as this one on Wavelength and Frequency, I think:	.80	.40	.56	.53
When accessing a streaming media file such as this one on Wavelength and Frequency, I prefer:	.49	.50	.33	.50
When accessing a streaming media file such as this one about the Alpha Scattering Experiment, Rutherford's observations, I think:	.56	.50	.78	.44
When accessing a streaming media file such as this one about the Alpha Scattering Experiment, Rutherford's observations, I prefer:	.40	.49	.67	.50

Note. Possible item scores ranged from 0 (too much or not enough information) to 1 (appropriate amount of information).

To further identification of any significant differences between visual and verbal learner preferences for the amount of content presented at one time, a multivariate analysis was conducted. Results were as shown in Table 8. This analysis was conducted using the factor variable (learner is visual or verbal) and four dependent item variables, which were the four items from the streaming-media questionnaire that used frame captures from media streams and asked participants to choose the amount of information they preferred during instruction with streaming media (appropriate amount = score of 1, too much or not enough information = score of 0; see Appendix A). The four items showed no significant variance between visual and verbal learners.

Interview responses reflected learner preferences for the amount of content presented:

to slow down the speed of teaching; if I feel I did not understand everything fully,

Table 8

Multivariate Analysis of Visual and Verbal Learner Preferences for the Amount of Content Presented Through Streaming Media

Amount of content	*SS*	*df*	*MS*	*F*	*p*
Wavelength and frequency file, belief that there is too much/not enough/the right amount of information	0.476	1	0.476	2.747	.101
Wavelength and frequency file, preference for seeing and hearing more/less/this information	0.195	1	0.195	0.771	.382
Alpha scattering experiment file, belief that there is too much/not enough/the right amount of information	0.387	1	0.387	1.583	.212
Alpha scattering experiment file, preference for seeing and hearing more/less/this information	0.558	1	0.558	2.282	.134

> I replay a certain portion before moving on . . . understanding each item better because I can pace it as I need; I am able to understand everything fully from being able to replay and pause sections. (see Transcript Lines 172-379, Appendix C)

Research Question 4

Research Question 4 was "How do the perceptions of visual and verbal learners regarding the importance of student control of streaming media as an aid to the understanding of content differ with respect to the capacity of working memory?" To collect data regarding the different perceptions visual and verbal learners may have in regard to learner control of streaming media, this research question presented three items to participants regarding playback control, access, and the ability to replay portions of streaming media. Means and standard deviations related to this question were as shown in Table 9.

Participants were asked to rate themselves as visual or verbal learners. Then they were asked to rate on a scale from -2 (*strongly disagree*) to 2 (*strongly agree*) the importance of playback control, accessibility to streams, and the ability to replay streams.

Table 9

Learner Perceptions of Streaming-Media Control

	Visual (n = 84)		Verbal (n = 9)	
Item	*M*	*SD*	*M*	*SD*
Being able to control the playback of the stream (start/stop/pause/rewind) is important to me.	1.31	.54	1.22	.44
Having the ability to control access (anytime, anywhere) to the streams is important to me.	1.38	.54	1.00	.00
The fact that I can view a stream as often as I need is important to me.	1.38	.58	1.44	.73

Note. Possible item scores ranged from -2 (*strongly disagree*) to 2 (*strongly agree*).

To further identification of any significant differences between visual and verbal learner perceptions of streaming-media control, a multivariate analysis was conducted. Results were as shown in Table 10. This analysis was conducted using the factor variable (learner is visual or verbal) and three dependent item variables, which were the three Likert-scale questions about the importance of learner control within streaming media that were presented to participants. Items 1 and 3 (playback and ability to replay, respectively) showed no variance between visual and verbal learners. Item 2, access to streams, showed a significant difference between the two groups.

Participants' interview responses supported the perception that both visual and verbal learners perceived learner control over streaming media to be important. When asked why they would pause or stop a stream, participants responded with comments like "to make notes, to rewind the information, to rethink what was said, to review, or to write down notes" (see Transcript Lines 106-134, Appendix C). Participants responded in similar fashion regarding replaying of streams: "If I didn't understand I can replay a

Table 10

Multivariate Analysis of Visual and Verbal Learner Perceptions of Streaming-Media Control

Media control	*SS*	*df*	*MS*	*F*	*p*
Playback control	0.062	1	0.062	0.221	.639
Access control	1.180	1	1.180	4.509*	.036
Ability to replay	0.033	1	0.033	0.093	.761

*Significant at $p < .05$.

portion of the stream, to make sure I understand, being able to hear something more than once helps, if I don't understand something I can replay it" (see Transcript Lines 172-199, Appendix C). A verbal learner stated, "If I don't understand something I replay it to make sure I didn't miss something. Sometime when I listen to things over and over it helps me to understand" (see Transcript Lines 201-202, Appendix C).

Research Question 5

Research Question 5 was "To what extent do students perceive that the ability to control the speed, delivery pace, and repetition of steaming media improves understanding of content?" To collect data regarding student perceptions of streaming-media effectiveness, three Likert-scale items asked participants to rate the importance of playback, access, and repetition of streaming media, and one item asked participants to rate the importance of streaming media as an aid to understanding Fundamentals of Chemistry. Item scores ranged from -2 (*strongly disagree*) to 2 (*strongly agree*). Means and standard deviations for this question were as shown in Table 11.

For this research question, the Pearson product-moment correlation among the

Table 11

Student Beliefs Regarding Streaming-Media Effectiveness (N = 93)

Item	*M*	*SD*
Being able to control the playback of the stream (start/stop/pause/rewind) helps me understand the course content.	1.42	.70
Having the ability to control access (anytime, anywhere) to the streams helps me understand the course content.	1.41	.61
The fact that I can view a stream as often as I need helps me understand the course content.	1.42	.61
Streaming media enhanced my learning in Fundamentals of Chemistry.	1.73	.75

Note. Possible item scores ranged from -2 (*strongly disagree*) to 2 (*strongly agree*).

four streaming-media items was determined. Results were as shown in Table 12. The three items regarding learner control--playback, access, and replaying of streaming-media items--showed a moderate to high correlation with one another. The last item, regarding the overall effectiveness of streaming media as an enhancement to learning Fundamentals of Chemistry, moderately correlated with the three learner-control items.

Survey results for this question showed that, in general, learners believed streaming-media learner control to improve understanding of the content. Interview responses illustrated this belief: "I usually pause the file and look back to understand the problem clearly" (see Transcript Line 95, Appendix C) and "I am able to replay certain sections. I can pause any time I need" (see Transcript Line 220, Appendix C).

Participants' survey results also supported the concept that streaming media are effective and the concept that streaming media enhance the learning of chemistry. One respondent stated, "It helps to reinforce what I am taught so that I can fully understand the concepts" (see Transcript Line 230, Appendix C). Another participant summed this up clearly by responding as follows:

> I firmly believe the streaming media is why I am doing as well as I am in this class. If I only go to class, and then try the homework, I don't do well, but if I watch the lectures before doing to homework, the homework is usually a breeze! I wish all of my professors used the streaming media! (see Transcript Lines 304-307, Appendix C)

Table 12

Intercorrelations of Student Learning Preference and Visual or Verbal Element Preferences in Streaming Media (N = 93)

	r			
Item	1	2	3	4
Being able to control the playback of the stream (start/stop/pause/ rewind) helps me understand the course content	--	.51*	.47*	.47*
Having the ability to control access (anytime, anywhere) to the streams helps me understand the course content	--	--	.73*	.52*
The fact that I can view a stream as often as I need helps me understand the course content	--	--	--	.55*
Streaming media enhanced my learning in Fundamentals of Chemistry	--	--	--	--

*$p < .01$.

Chapter 5: Discussion

This applied dissertation study was designed to gather data regarding student attitudes and perceptions about the use of streaming media to support instruction in freshman-level chemistry. Baez-Franceschi et al. (2004) reported that students across all chemistry courses accessed these streaming-media files an average of 300 times per day during a 16-week semester. These utilization statistics established a need to determine how and why students access these streaming-media files in order to support their learning and to inform instructional designers and technology administrators about the effective design and delivery of streaming media. The purpose of this study was to investigate CLT as applied to the design of streaming media by assessing attitudes regarding the importance of learner control when accessing streaming-media files. In this applied dissertation study, 93 participants were invited to complete an online survey, and 20 of the participants were also randomly selected to participate in a brief follow-up telephone interview.

Hypothesis 1

Hypothesis 1 was "Learners with a visual or verbal cognitive style will report a corresponding preference for visual or verbal elements in streaming media." Three items from the streaming-media questionnaire asked participants to rate the importance of visual and verbal elements on a 5-point Likert scale (see Table 1). Inconsistent correlations were found to exist between the streaming-media items and the two cognitive-style instruments; no strong relationship was evident (see Table 2).

Hypothesis 2

Hypothesis 2 was "Learners with a visual or verbal learning preference will report a corresponding preference for visual or verbal elements in streaming media." Three items from the streaming-media questionnaire asked participants to rate the importance of visual and verbal elements on a 5-point Likert scale (see Table 3). Pearson product-moment correlation analysis (see Table 4) indicated a lack of correlation between the streaming-media items and the two learning-preference instruments; no relationship was evident.

Implication of Findings

It is clear that more research must be conducted to identify learners' visual and verbal cognitive styles, learning preferences, and preferences in streaming media. The items from the streaming-media questionnaire showed a moderate to strong correlation with one another but did not correlate with the instruments that were intended to measure students' cognitive styles. The two existing instruments that were intended to measure students' learning preference showed no correlation with one another or with the three streaming-media items, which also did correlate with one another.

Instruments with stronger reliability and validity must be developed in order to identify visual and verbal learners. This is consistent with other researchers' conclusions (DeLeeuw & Mayer, 2008; Kopcha & Sullivan, 2008; Mayer & Massa, 2003).

Visual and verbal learners showed no significant difference on two of the three items of streaming-media control but did present a strong difference on the question regarding access. It is clear that learners should be grouped as visual or verbal. After grouping, participants could be randomly selected for the study. This would provide more balanced results in terms of numbers of responses of members of the two groups.

Differences in the preferences of visual and verbal learners regarding the type and amount of instructional content presented at any one time through streaming media with respect to the three effects of cognitive load could be clearly delineated by students in interviews or in focus groups. Mayer and Johnson (2008) presented several multimedia learning scenarios to test the redundancy theory by incorporating different text presentations during instruction. They also presented design conditions in which redundancy could be either useful or harmful in multimedia learning. Mayer and Johnson noted that redundancy is helpful "when the on-screen text is short, highlights the key action described in the narration, and is placed next to the graphic that it describes" (p. 385).

Learner control could also influence participants' responses. Other studies (Kopcha & Sullivan, 2008; van Gog et al., 2005) have included learner control and prior knowledge, which could influence participants' responses to questions.

It would be useful to design a research project in which participants actually are being presented with live, streaming instruction. In such a study, the participants could make choices regarding their preferences for on-screen text, audio narration, and graphics.

As noted by van Gog et al. (2005) learning should be adaptable to learners' needs and capacity. Learner control was perceived by participants in this study and in other studies (Kopcha & Sullivan, 2008; van Gog et al.; van Merrienboer & Kester, 2005) to be important to their understanding. Identification and measurement of cognitive overload in learners are often subjective. Researchers (DeLeeuw & Mayer, 2008; van Gog et al.) have agreed that identification and measurement must be expanded upon but have not agreed on methodology for such expansion.

Three items on the researcher-created streaming-media survey asked participants to rate on a 5-point Likert scale (-2 to 2) the extent to which streaming-media control helped them understand chemistry. Pearson product-moment correlations of these three items were moderate to high (see Table 12). These results are consistent with those of other studies regarding learning control and media (Gerjets & Scheiter, 2003; Kopcha & Sullivan, 2008; van Gog et al., 2005).

The final item on the streaming-media survey, "Streaming media enhanced my learning in Fundamentals of Chemistry," showed strong positive results on a 5-point (-2 to 2) Likert scale (see Table 11). This result aligned with Fill and Ottewill's (2006) report of results of streaming-media projects in higher education. In those projects, major benefits of streaming media included increased learner control of access to the video and increased learner control of the starting, stopping, and searching of the video.

Limitations of the Study

The data for this study were gathered one time from participants from one section of freshman chemistry at one university. The results may not be generalizable to the overall population.

Participants may have possessed different skill levels in the operation of computers, Internet browsers, and appropriate plug-ins necessary to access the streaming-media files. Additionally, users may have had different types of computers and different connectivity speeds for accessing content delivered over the Internet. These differences could potentially bias users in their perceptions and attitudes regarding streaming-media usefulness.

The participants in this study were recruited from a freshman-level chemistry class with no prior screening other than having utilized streaming media. In terms of visual and verbal learners, the numbers of the participants were disproportionate (visual $N = 84$, verbal $N = 9$). In order to produce more revealing results among visual and verbal learners, it would be useful to screen and identify larger populations of visual and verbal learners and then to select participants to complete the survey and the interview. Two larger and more balanced groups of participants might yield a more thorough analysis of the preferences and perceptions of the two types of learners.

Recommendations for Further Research

Further research should be conducted in order to explore relationships among media design, achievement, and learner preferences (Kopcha & Sullivan, 2008; van Gog, Ericsson, Rikers, & Paas, 2005). Several intriguing directions for instructional-technology research are provided by this study.

What caused the different results from the four instruments that were used to measure cognitive load and learning preference in Mayer and Massa's (2003) study and in this applied dissertation study? Mayer and Massa's study employed those instruments along with a variety of others, whereas this study used them in conjunction with streaming-media-focused items that were designed for this project.

In a review of recent streaming-media pedagogical developments in multimedia instruction, Fill and Ottewill (2006) presented several benefits of using streaming media during instruction. Among them were increasing learner control; breaking instruction down into bite-sized, digestible sections; and streaming media to accommodate differences in learning style. Clearly, more research must be conducted to further identification of visual and verbal learners and identification of the instructional-design considerations that should be made for different learning styles in media development. A study designed to block by preference for visual or verbal instruction, with random assignment of participants to streaming treatments (visual or verbal) that match or are mismatched, may shed more light in this area, especially if achievement is clearly measured and learner feedback is gathered.

Learner control and self-management of cognitive load are other areas worthy of further investigation. Research (Gerjets & Scheiter, 2003; Kopcha & Sullivan, 2008; van Gog et al., 2005) has produced mixed results using a variety of media and various methodologies. Redundancy and split-attention effects, when produced in streaming media, can produce unexpected cognitive overload.

The ability to allow learners to measure, monitor, and control cognitive load shows great promise. More work could be done in this area, particularly with options for learner control over different media-delivery options, to test for achievement and student perceptions of effectiveness.

Streaming-media design requires more in-depth analysis. As this delivery methodology continues to evolve, as more learner-control and navigation options become available, and as more visual and verbal elements may be deployed within streams, researchers should continue to study and define effective streaming-media characteristics, especially those that align with learner preferences.

Dissemination

Results of this study will be used to guide the future development of effective streaming media and will also provide a clearer understanding of student needs in the area of media support in the sciences. Results of this study will also have implications for the field of instructional technology and distance-learning applications and programs. This information will provide data to support further development of CLT as it applies to instructional media design and to promote and support the ongoing development of effective design guidelines and applications of streaming media for instructional designers, technology administrators, and faculty members who teach in face-to-face and distance-education environments.

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Appendix A

Streaming-Media Survey

1) Listening to the streaming files helps me understand the course content

Strongly Agree Agree Neutral/No opinion Disagree Strongly Disagree

2) Reading the text contained in the streaming files helps me understand the course content

Strongly Agree Agree Neutral/No opinion Disagree Strongly Disagree

3) Watching the streaming files helps me understand the course content

Strongly Agree Agree Neutral/No opinion Disagree Strongly Disagree

4) Being able to control the playback of the stream (start/stop/pause/rewind) helps me understand the course content

Strongly Agree Agree Neutral/No opinion Disagree Strongly Disagree

5) Being able to control the playback of the stream (start/stop/pause/rewind) is important to me

Strongly Agree Agree Neutral/No opinion Disagree Strongly Disagree

6) Having the ability to control access (any time, any where) to the streams helps me understand the course content

7) Having the ability to control access (any time, any where) to the streams is important to me

Strongly Agree Agree Neutral/No opinion Disagree Strongly Disagree

8) The fact that I can view a stream as often as I need helps me understand the course content

Strongly Agree Agree Neutral/No opinion Disagree Strongly Disagree

9) The fact that I can view a stream as often as I need is important to me

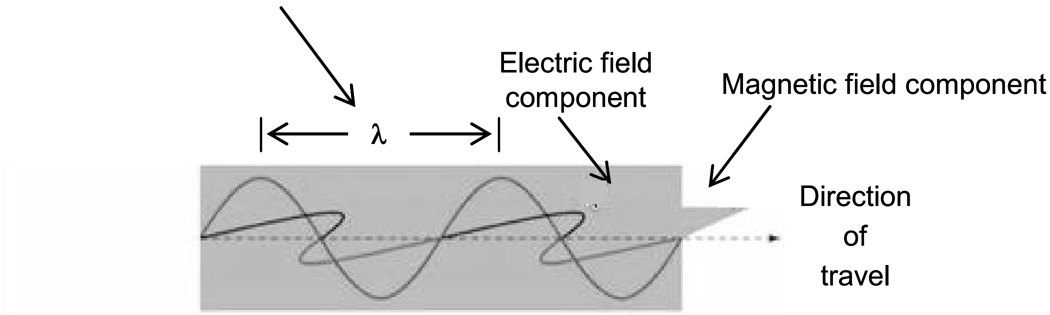
Strongly Agree Agree Neutral/No opinion Disagree Strongly Disagree

10) Streaming media enhanced my learning in Fundamentals of Chemistry

Strongly Agree Agree Neutral/No opinion Disagree Strongly Disagree

Wavelength and Frequency

Wavelength (λ) is the distance between any two identical points in consecutive cycles.



Frequency (ν) of a wave is the number of cycles of the wave that pass through a point in a unit of time. Unit=waves/s or s^{-1} (hertz).

As frequency increases, wavelength decreases.

11) When accessing a streaming media file such as this one on Wavelength and Frequency, I prefer

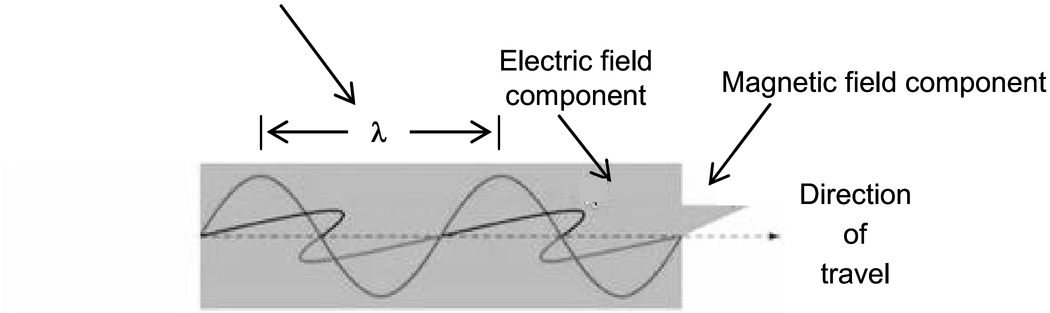
to hear the instructor's explanation

to watch the instructor's explanation

to read the instructor's explanation

Wavelength and Frequency

Wavelength (λ) is the distance between any two identical points in consecutive cycles.



Frequency (ν) of a wave is the number of cycles of the wave that pass through a point in a unit of time. Unit=waves/s or s^{-1} (hertz).

As frequency increases, wavelength decreases.

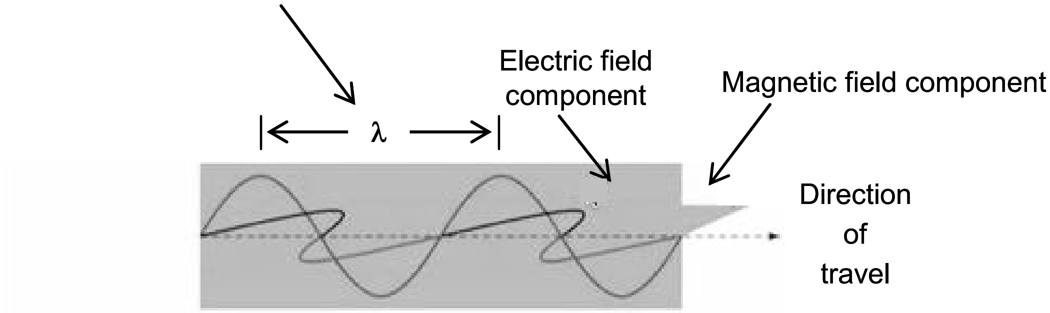
12) When accessing a streaming media file such as this one on Wavelength and Frequency, I prefer

to read the definitions

to look at the illustration

Wavelength and Frequency

Wavelength (λ) is the distance between any two identical points in consecutive cycles.



Frequency (ν) of a wave is the number of cycles of the wave that pass through a point in a unit of time. Unit=waves/s or s^{-1} (hertz).

As frequency increases, wavelength decreases.

13) When accessing a streaming media file such as this one on Wavelength and Frequency, I think

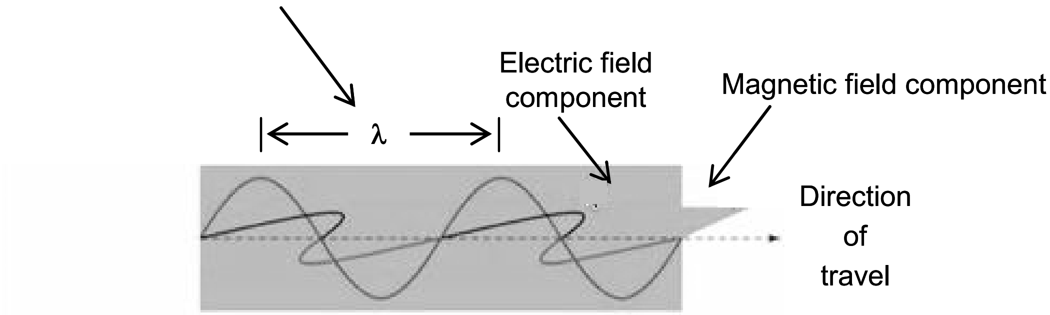
there is too much information presented

there is not enough information presented

this is the right amount of information presented

Wavelength and Frequency

Wavelength (λ) is the distance between any two identical points in consecutive cycles.



Frequency (ν) of a wave is the number of cycles of the wave that pass through a point in a unit of time. Unit=waves/s or s^{-1} (hertz).

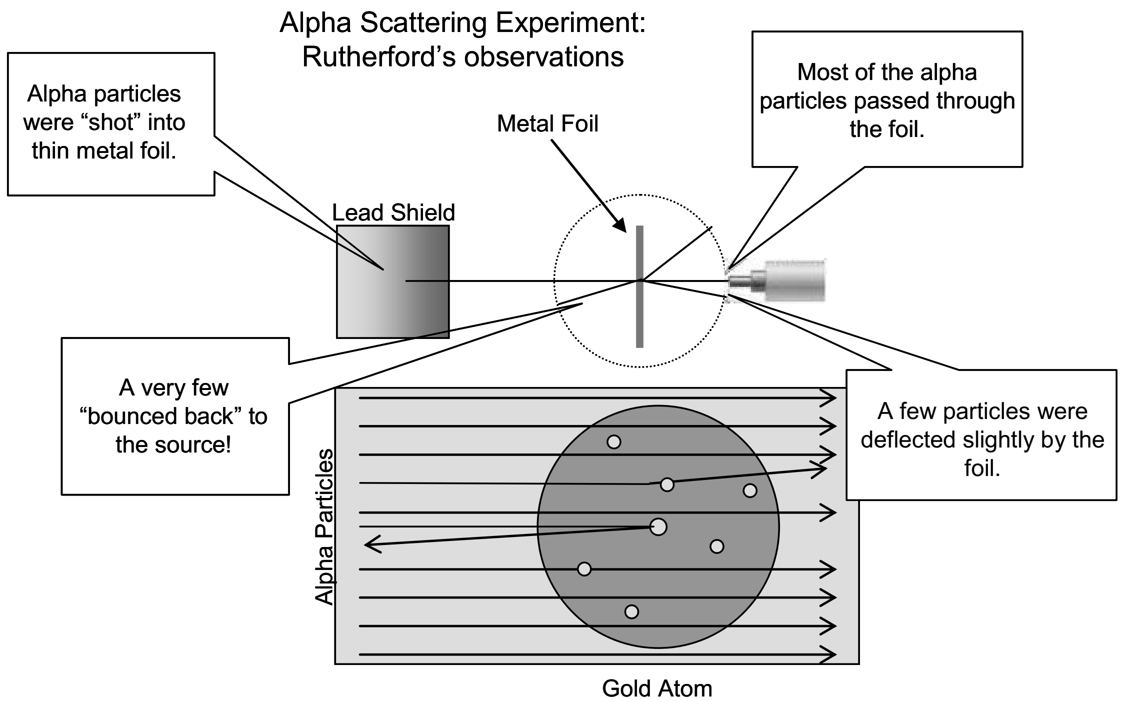
As frequency increases, wavelength decreases.

14) When accessing a streaming media file such as this one on Wavelength and Frequency, I prefer

to see and hear more information

to see and hear less information

to see and hear this information

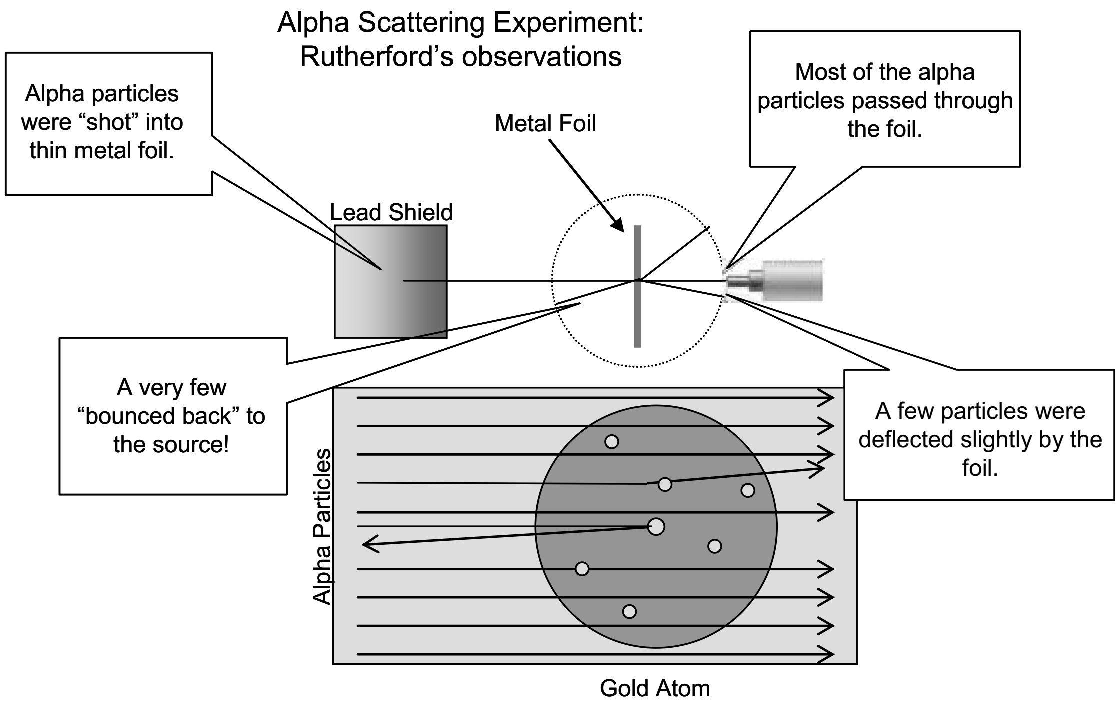


15) When accessing a streaming media file such as this one about the Alpha Scattering Experiment, Rutherford's observations, I prefer:

to hear the instructor's explanation

to watch the instructor's explanation

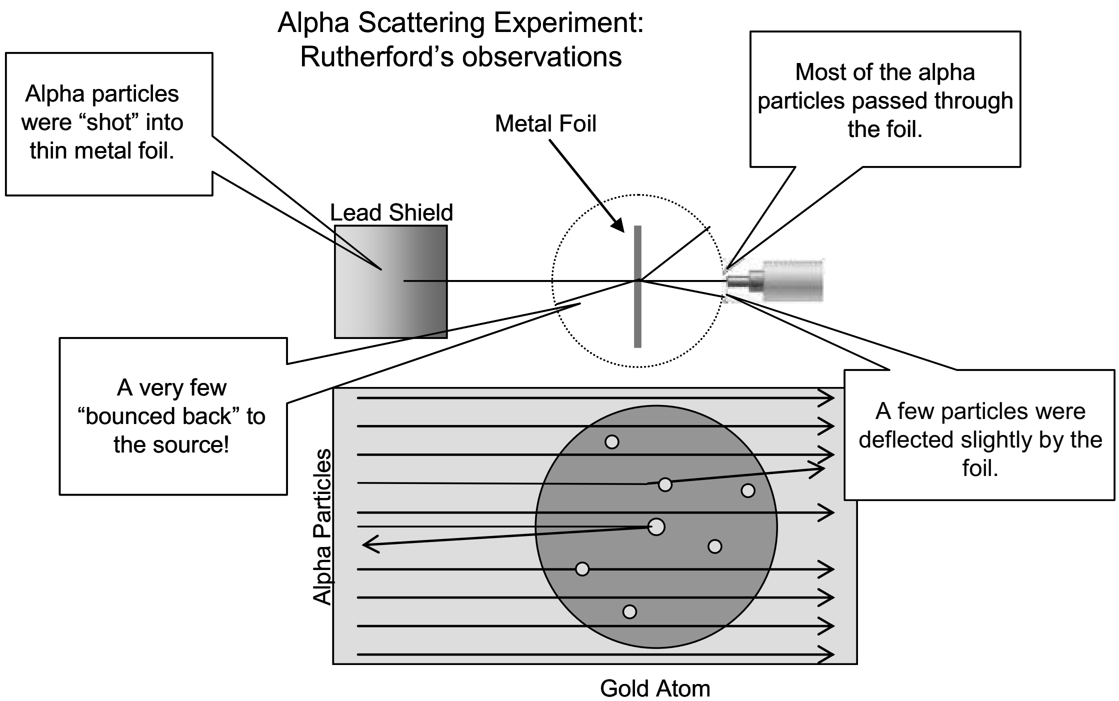
to read the instructor's explanation



16) When accessing a streaming media file such as this one about the Alpha Scattering Experiment, Rutherford's observations, I prefer:

to read the text boxes

to look at the diagram

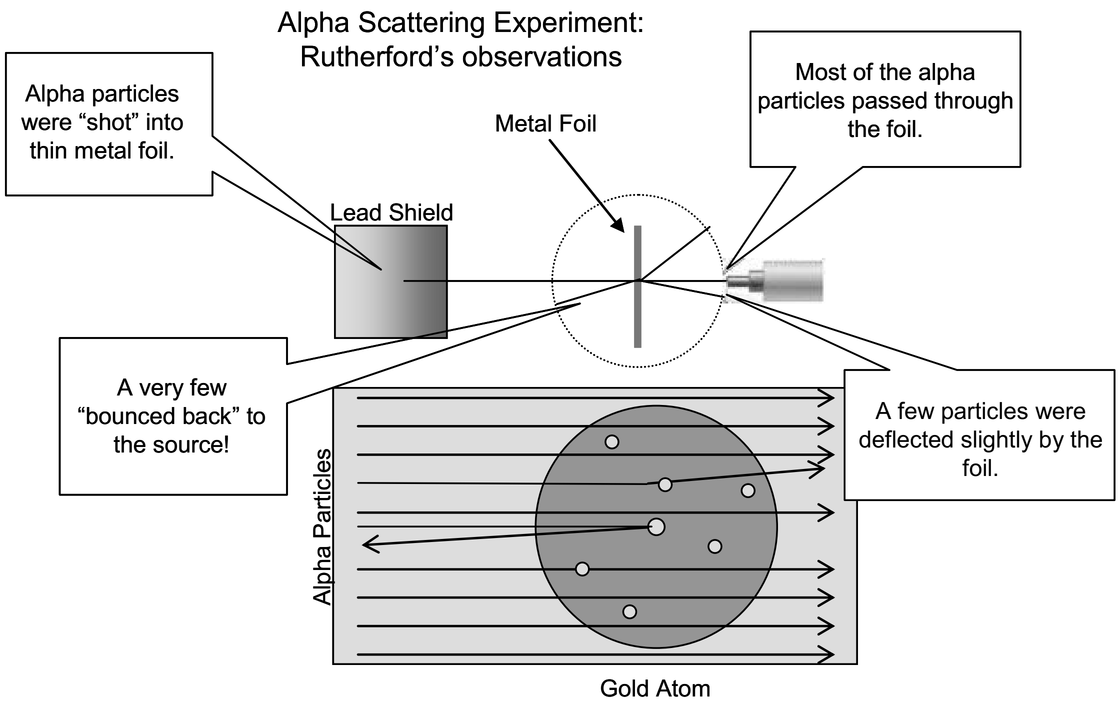


17) When accessing a streaming media file such as this one on Alpha Scattering Experiment, Rutherford's observations, I think

there is too much information presented

there is not enough information presented

this is the right amount of information presented



18) When accessing a streaming media file such as this one on Alpha Scattering Experiment, Rutherford's observations, I prefer

to see and hear more information

to see and hear less information

to see and hear this information

Appendix B

Interview Guidelines

Streaming Media Interview Guidelines

Focus Themes:

Are you a verbal or visual learner?
Why do you think so?

When accessing streaming media for class do you:
Watch or listen?

When accessing streaming media for class do you:
Stop or pause the stream? Why?
Replay any portion of the stream? Why?

Why do you choose to learn through streaming media?

How does streaming media help you in this class?

Structured questions:

Are you male or female?

What is your age?

Is this the first course you have taken that utilizes streaming media?

Should streaming media be offered with other courses?
Why or why not?

Appendix C

Interview Responses

Are you a visual or verbal learner?

Visual
Visual
Visual
Verbal
Visual
Visual
Visual
Visual
Visual
Visual
Visual
Verbal
Visual
Visual
Visual
Verbal
Visual
Visual
Visual
Visual

Why do you think so?

If I can see the work done, then I have a better understanding

Because if I seen an example I can relate it to a problem I'm doing.

I learn and understand better when I can see what's actually happening for myself.

RQ 3 I memorize and understand from verbal communication.

Visualizing helps me understand things in detail.

Because I always have to draw things out to work a problem

I have tried to learn certain things by simply listening and it has not been helpful to me. I actually think I am a combination of both, but I tend to rely more on visual learning.

If I see something I understand it better than by just being told.

I remember better and I understand better when I see it

Because I understand it more when I see my professor doing it.

I can better associate information with pictures when a lecture is more visual than I can grasp information when I just hear a lecture.

RQ 3 Once I hear something, I can usually remember it.

I think so because I understand things more when it is in front of me and written down.

I tend to grasp things better when I see examples worked and I work problems.

RQ 3 I'm more tactile, I have to see it and hear it then do it for my self to really learn.

I usually remember things that people say...not things that I read or see.

I have to look at examples to understand

I'm a visual learner because I have to see what is going on. I can't take words in and analyze it in my head.

Because I have to see what I am learning

I'm able to understand material better when I see it rather then hear it

When accessing streaming media files, do you stop or pause the stream?

Yes
Yes
Yes
Yes
Yes
Yes
Yes
Yes
Yes
Yes
Yes
Yes
Yes
Yes
Yes
Yes
Yes
Yes
Yes
Yes

Why?

RQ 5 I usually pause the file and look back to understand the problem clearly.

If I don't understand a step I try to look it over before I continue. So I can get a better understanding of it.

If I'm disturbed while studying.

RQ 5 Many times I pause it to comprehend and make sure I understood everything that was just presented before moving on to something new. I sometimes rewind to replay a section I did not fully understand. I feel that is very helpful.

So I can rewind information I don't understand and learn again.

So I can take notes

So that I can look at each detail more closely, or so that I can fully understand what is happening in each step of a worked out problem.

So that I can make notes and not lose my place

Sometimes I have to rethink what is said

That is my reason to use the media to stop or pause it whenever I don't understand it, then I will go and look for the concept that I missed from the book or from the past.

To jot down any notes

To make sure I understand what is being said, or to answer the phone.

To make sure I understand what was just said and also write notes down if I needed it.

To make sure what is written on each slide is what I have written.

To process what is being said or slow down the speed of teaching.

To review and make sure I understand correctly.

To take notes or to look over the example and make sure I understand what was just said.

To take notes.

To write down helpful information

Yes, in order to write down notes

When accessing streaming media files, do you replay any portion of the stream?

Yes
Yes
Yes
Yes
Yes
Yes
Yes
Yes
No
Yes
Yes
Yes
Yes

Yes
Yes
Yes
Yes
Yes
Yes
Yes

Why?

To get a better understanding.

RQ 4 If I come to a problem I don't understand I like to see how it's worked over and over again until I understand it

I can get down what it is that the professor said, or to better understand a certain topic.

If I feel I did not understand everything fully, I replay a certain portion before moving forward. In Chemistry everything adds on as you move forward through the chapters so you must understand fully each section and keep up with the work otherwise you will feel lost.

So I can understand information if I don't understand it the first time

So I can see what I missed

Again, so I can be sure I understand what is going on.

To make sure I understand.

I pause if I did not understand something

If there is anything that I missed and to master on the portion.

When I missed any information that I wanted to write down or when I misunderstood something

To recover subjects I am having trouble with.

To get a better understanding. Being able to hear something more than once helps.

If I get confused on an example or am trying to memorize an important concept.
I sometimes don't catch what was being shown or need to clarify something.

To review something that I did not understand.

RQ 4 If I don't understand something I replay it to make sure I didn't miss something. Sometime when I listen to things over and over it helps to understand

To get a better understanding of the topic.

If I do not understand something I will replay.

If I do not understand the material I replay until I understand it

Why do you choose to learn through streaming media?

If I might miss a class, I can always go to the streaming media and learn the material like I am in the class at the time.

When help isn't available to me I like to look at the stream so I can understand what I don't understand.

RQ 4 It's helpful and gives me the ability to learn at my own pace.

RQ 5 I am able to replay certain sections. I can pause any time I need. I am able to watch the streaming media lectures on my own time, whenever I am available.

It helps me understand what I've missed in class.

Because I want to go over things that I missed or did not completely understand

If I look at the lectures, I can catch anything that I may have missed during class, as well as understanding each item better because I can pace it as I need it.

It helps to reinforce what I am taught so that I can fully understand the topics.

If I don’t understand sometimes it helps me, but I think it is the same thing if I just read the book

Because I will be able to go back to the lecture room again, and get an answer for any question that I have.

I like to first take in the overall idea of the chapter in class and then go home and watch the streaming media to better understand the detailed information I may not have fully grasped in class.

Being comfortable while I'm learning makes all the difference in the world. I am not usually comfortable in a class setting, so after I watch a lecture, I notice that I missed quite a bit during class.

I choose it because it gives me a chance to hear and see everything again to refresh my memory. It is good to do if my notes aren't too clear.

It helps reemphasize the lecture by catching things possibly missed.

Sometimes during class the information that I don't understand right away confuses me for the rest of the time period so I must go back to really understand the material.

It helps me go back through the stuff that I did not quite understand in class.

The control I have as far as time, place and play back.

I wouldn't say I'd choose to learn through streaming media, I mean I still enjoy having lectures but if there's something that I do not understand I can simply stream it and it may or may not benefit me.

Chemistry is not my best subject and there are many things that I do not understand and with streaming media I can view it over and over until I fully understand.

I can pause or replay something I do not understand and it is also helpful in case I miss a class

How does streaming media help you in this class?

It helps me in a tremendous way to go back to the lectures and learn what I do not understand.

It helps me greatly because I used it while studying for the last test.

It helps me to catch what I would otherwise miss in class, by allowing to me view it outside of class and to be able to rewind/forward to any part that I need more time with.

I am able to understand everything fully from being able to replay and pause sections. It helps me understand the material much better. If you fall behind in Chemistry you will suffer. This helps me not to fall behind and to stay on top of the material. If in a lecture you do not fully understand something, the teacher has to keep going for the rest of the class and you will not understand anything from the rest of this lesson. Streaming media helps very much.

If I don't understand something in class I'd go back to the streaming media to understand the material again.

It helps me understand the material better by letting me learn in at my own pace

I understand the concepts that are being taught better and I can always go back if I am having trouble with a particular problem in a quiz or practice test.

RQ 3 type It has helped to reiterate the concepts in a more visual way so that I can "see" what I am learning.

I really don’t think it helps me any more than the book

I will be able to go back to the lecture room again, and get an answer for any question that I have.

RQ 4 It allows me to review notes and information at my own pace.

RQ 5 I firmly believe the streaming media is why I am doing as well as I am in this class. If I only go to class, and then try the homework, I don't do well, but if I watch the lectures before doing to homework, the homework is usually a breeze! I wish all of my professors used the streaming media!!!

It helps me because there are more examples of problems we may not have done during class. It also gives me a chance to see and hear the material again.

I can go back and rewatch examples being worked out and here what he is saying about each step instead of having to guess what was being done.

Sometimes I might not understand or remember how an answer was made so I can go back to the videos to remember how it was shown in class or if the example is from another class it might be explained more thoroughly.

It helps me go back through the stuff that I did not quite understand in class.

RQ 4 If I don't understand something in class I listen to lecture again and sometimes I find that I missed something that glues everything together and I understand the concept.

If is not feeling good that day in class or had to step out I listen to lecture again.

It's the teaching of the material that I need to learn, so it can benefit me as well as others.

It helps me in many ways because it provides examples of other works that might not be covered in class and it also helps me catch up since I have to work and have no time to actually study. And sometimes I might look at some examples from a chapter before we even get to it, just so that I can have an idea of what to look for.

Many times I am able to concentrate on the material better if I use the streaming lectures because in class there are many distractions