Design and Development of a Metadata-Driven Search Tool for use with Digital Recordings

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Dissertation submitted to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of
Doctor of Philosophy
in
Curriculum and Instruction

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April 26, 2019
Blacksburg, Virginia

Keywords: Digital Recordings, Keyword Search, Interviews,
Speech Recognition Technology, Transcription

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DEVELOPMENT OF A SEARCH TOOL FOR DIGITAL VIDEOS

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ABSTRACT

It is becoming more common for researchers to use existing recordings as a source for data rather than to generate new media for research. Prior to the examination of recordings, data must be extracted from the recordings and the recordings must be described with metadata to allow users to search for the recordings and to search information within the recordings. The purpose of this small-scale study was to develop a web based search tool that will permit a comprehensive search of spoken information within a collection of existing digital recordings archived in an open-access digital repository. The study is significant to the field of instructional design and technology (IDT) as the digital recordings used in this study are interviews, which contain personal histories and insight from leaders and scholars who have influenced and advanced the field of IDT. This study explored and used design and development research methods for the development of a search tool for use with digital video interviews. The study applied speech recognition technology, tool prototypes, usability testing, expert review, and the skills of a program developer. Results from the study determined that the produced tool provided a more comprehensive and flexible search for users to locate content from within AECT Legends and Legacies Project video interviews.
GENERAL AUDIENCE ABSTRACT

It is becoming more common for researchers to use existing recordings in studies. Prior to examination, the information about the recordings and within the recordings must be determined to allow users the ability to search information. The purpose of this small-scale study was to develop an online search tool that allows users to locate spoken words within a video interview. The study is important to the field of instructional design and technology (IDT) as the video interviews used in this study contain experience and insight from people who have advanced the field of IDT. Using current and free technology, this study developed a practical search tool to search information from AECT Legends and Legacies Project video interviews.
Dedication

To my children, Lilamae, Adaline, and James.

Your patience has been my inspiration.

Farewell, “In a minute.”
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Acknowledgements

I would like to express my deepest appreciation to my advisor at Virginia Tech, Dr. Ken Potter. My success in the completion of this study was possible due to his guidance and support. I am grateful that Dr. Potter opened a door for me to complete a doctoral program and contribute to a project that has historical significance to the field of instructional design and technology.

I would like to extend my gratitude to my committee member, Dr. Barbara Lockee. Dr. Lockee granted me the opportunity to contribute to the future direction of the AECT Legends and Legacies Project. I look forward to following this collaborative project over the years.

I was very fortunate to work with Dr. Kibong Song, an expert developer whose knowledge, skills, and insight were fundamental throughout my study. Because of Dr. Song’s work, I was able to utilize prototypes and demonstrate practical application of my research tool.

I am also grateful to my committee members, Dr. Mark Aaron Bond and Dr. Alicia Johnson. The valuable advice and suggestions from Dr. Bond during my examinations contributed to new directions taken within my research process. Dr. Johnson’s encouragement, support, and willingness to share personal progress experience reminded me during my studies that despite life’s obstacles, my research work was doable with planning, navigation, and persistence.

I am fortunate that the foundation of my support has been family. I am thankful for my mother who provided Art-time-with-Grandma J., transportation, the quiet place to work, and many other forms of support when asked. I am also thankful for my father who shared long-distance encouragement and his sense of pride for my accomplishments. The frequent words of optimism and confidence from other family members and friends fueled my momentum.

The cornerstone throughout this journey to degree has been the combined support from Brian, Lilamae, Adaline, and James. I am indebted to their patience and cheer during my work.
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Chapter 1: Introduction

In recent years, new forms of data collection have emerged in the literature to include interviews and observations through the examination of videos (Creswell & Poth, 2018). With this trend, it is becoming more common for researchers to use existing video recordings as a source for data rather than to generate new media for research (Jewitt, 2012). The research value of both interviewing and recording video recording for the data collection has contributed to publically accessible video collections in place to improve the intellectual environment (Columbia Center for Oral History Research, 2017b; Interdisciplinary Center for Innovative Theory and Empirics, 2019). The current availability of the large amount of online multimedia has brought about a growing need for improvements to content analysis and summarization to support the primary interests of users to be entertained or informed (Forlines, Peker, & Divakaran, 2006). To support convenient information gathering, data within multimedia must first be extracted and then described with metadata to allow search of content information.

Significant to the field of instructional design and technology, members of the Association for Educational Communications and Technology (AECT) have collaboratively developed a collection of digital video interviews with people influential to the field of instructional design and technology. The AECT Legends and Legacies Project is an ongoing initiative to capture the personal histories of pioneers, leaders, and scholars who have helped advance the field of instructional design and technology. (Lockee & Song, 2016; Leary & Lockee, 2018). The AECT Legends and Legacies Project video interviews are archived in an open-access digital repository on an online website (http://aectlegends.org/) hosted by Virginia Polytechnic Institute and State University (AECT Legends and Legacies, 2018b, Leary & Lockee, 2018). Though existing means were in place to explore AECT Legends and Legacies
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Project video interviews, there was a need for a more comprehensive and flexible search tool, as defined by the Society of American Archivists (2018c), to enable users to search and locate material relevant to their interest.

Statement of the Problem

A large scale problem exists in that recorded interviews frequently contain spoken words that are not in a form to allow efficient search. Spanning from analog to digital, this significant problem affects both audio and audio visual recordings across multiple disciplines. To allow the problem to be addressed within this dissertation, a small-scale study was created with design and development methods devised to transcribe spoken words from interview data into text form to allow efficient search. The small-scale study used an existing collection of 50 digital video interviews.

When determining a research problem, it is advised to consider the significance of the problem and the interest to the profession (Richey & Klein, 2007, p. 16). Significant to the field of instructional design and technology, and at the time of this study, there were 50 digital video interviews belonging to the AECT Legends and Legacies Project archived on a website (AECT Legends and Legacies, 2018b). The AECT Legends and Legacies Project is an ongoing initiative to capture personal histories of leaders and scholars who have advanced the field of instructional design and technology (Leary & Lockee, 2018). Existing features on the AECT Legends and Legacies Project online interface have allowed users to navigate to video interviews and to locate playback position of interview questions (Lockee & Song, 2016; Leary & Lockee, 2018). However, a significant problem existed in that the interview data within the video interviews had not been extracted to allow users the ability to efficiently search spoken information.

Need for the Study
Across academic disciplines, professional specializations, and other roles of contribution, video interviews often contain conversations of people—conversations that are a central tool to obtaining knowledge (Brinkmann, 2012, p. 1). A limited capability to search spoken information from within video interviews hinders data collection, data use, and the provision of knowledge to practitioners. The requisite to determine information within video interviews for content analysis has caused a need for tools to allow users to search spoken information within video interviews. In this small-scale study, there was a need for a comprehensive and flexible tool to improve search capabilities for data within AECT Legends and Legacies Project video interviews.

**Purpose Statement of the Study**

Though a wide-range empirical investigation is often beyond the scope of a dissertation study, a small-scale study that seeks to undertake a study in a single institution within limitations of time may be able to make a contribution to the understanding of a phenomenon if the problem can be linked to a wider context with indication of significance for study (Stanford University, n.d). The purpose this small-scale study was to incorporate a design and development approach to create a working prototype of a tool to provide a more comprehensive and flexible search for AECT Legends and Legacies Project video interviews. The study sought to demonstrate a proof of concept applicable to a multidisciplinary context for use of recorded material to generate metadata.

**Benefits of the Study**

An important goal of design and development research is to provide practical solutions to problems confronted (Richey & Klein, 2007, p. 154). This small-scale study built upon foundational work implemented in the ground up development of the AECT Legends and Legacies Project (Lockee & Song, 2016) to extend the applicability of existing agile methods.
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(Abrahamsson, Conboy, & Wang, 2009) while responding to a need for project change (Boehm & Turner, 2003).

Theoretically, this study determined a way to design and develop a more comprehensive and flexible search tool for existing AECT Legends and Legacies Project video interviews. Practically, the design and development of the search tool could be used across contexts for organizational improvement for searching content in digital recordings, which could be used by researchers, practitioners, and general users to contribute to the interdisciplinary knowledge base. Use of the search tool with AECT Legends and Legacies Project video interviews may increase user exploration and discovery of information significant to the field of instructional design and technology which may facilitate learning and understanding of theoretical boundaries of the field to help clarify, as stated by Rita Richey: our practice base, our theory base, who we are, and who we are not (Larson, 2012, 29:58-30:16).

Organization of the Study

To strengthen the significance of this small-scale study and to provide a high-quality written account, the following components were incorporated into the study: a critical review of the literature with aim to make clear connections between the existing knowledge and the study; a design and development approach with methods aligned to the purpose of the study; a described process of data preparation, summary, and analysis; a discussion of the findings relating to the research problem; and a summary of what the study achieved (Stanford University, n.d.).

Chapter One introduces background information for the small-scale study, defines the research problem, describes the need for the study, states the research purpose, suggests benefits of the study, and describes the organization of the study. Chapter Two reviews the literature and
as recommended by Richey and Klein (2007, p. 25), explores the research problem to identify if
the problem had been previously addressed and what had been learned, as well as explores how
the small-scale study could contribute to what was already known. Relevant to the study, the
review focused on two areas: (1) the research problem and how to solve the problem, and (2)
designing and developing a tool to solve the research problem. As the AECT Legends and
Legacies Project video interviews are in digital format, the first part of the chapter explores and
research use of video interviews and describes digital objects. The remainder of the chapter
discusses metadata, data extraction, and explores and describes current technologies in place to
support permit search for digital recordings. Chapter Three presents the research methods and
procedures employed for the small-scale study to determine a solution to the research problem,
and includes Design and Development Research background information; the appropriateness of
the research strategy for the study; the significance of application to the field of instructional
design and technology; the project profile; and processes of tool design, tool development, data
analysis, tool usability, and final tool evaluation. Chapter Three also describes ethical standards
implemented, the study setting, and the validity and reliability of the study. Chapter Four reports
the results from the analysis of interview content, intended use, and search tool features. The
chapter additionally reports findings from design concern, study setting, and final tool
evaluation. Chapter Five discusses the results of interview content, usability testing, and the
functions of search tool features. The chapter provides discussion for the expansion of the
knowledge base, the generalization of the findings, lessons learned, and limitations to the study.
Chapter 2: Literature Review

Introduction

Review of the literature gave focus to two areas: (1) the research problem and how to solve the problem, and (2) the development of a tool to solve the problem. Exploration of the literature sought to determine a way to improve search capabilities to allow users to search, retrieve, and view in textual form spoken information within digital video interviews. Guided by a review of the literature, this small-scale study determined a systematic way to design and develop a tool to provide users a more comprehensive and flexible search of data within existing AECT Legends and Legacies Project video interviews.

Video Interviews in Research

Interviews play an important role in collecting data and beyond report, may contribute in studies with aim to discover or generate a theory (Creswell & Poth, 2018). In recent years, new forms of data collection have emerged in the literature to include interviews and observations through the examination of videos (Creswell & Poth, 2018). Using video to collect data allows experiences to be revealed, provides new insight on a topic or problem, and increases review and analysis opportunities (Bowman, 1994; Flewitt, 2006). Often, conversations found within video interviews are a central tool to obtaining knowledge (Brinkmann, 2012, p. 2).

The research value of both video recording and interviewing for collecting data has contributed to publically accessible video interview collections and resources to generate knowledge and improve the intellectual environment (Interdisciplinary Center for Innovative Theory and Empirics, 2019). Over the years, it has become more common for researchers to use existing videos for research data rather than to generate new videos (Jewitt, 2012) – many of which are found in the public domain. For example, with over 10,000 interviews, the Oral
History Archives at Columbia University Libraries is one of the largest oral history collections in the United States with collections open to the public (Columbia University Libraries, 2019). Other examples include the Civil Rights History Project collection and the Carnegie Hall Collection of Conversations with Composers collection (Library of Congress, 2018a). The increase in use of existing digital recordings for data collection in research has contributed to the need to facilitate the search of content within digital video interviews. As with other digital objects, prior to searching data within a digital recording, searchable descriptions and associated information, termed metadata, need to be in place to allow users to identify and access information associated with and within the digital recording (Smiraglia, 2005, p. 3; Society of American Archivists, 2018a).

Digital Objects

A digital object is a data structure with digital material, or data, in addition to a naming convention that allows the digital object to be searched and accessed (Paskin, 2006). A digital object is also defined as a unit of information that includes properties of the object and often includes metadata to describes the resource and contents in a manner that supports administration, access, and preservation (Society of American Archivists, 2018a). In addition to promoting consistency in the long-term storage and value of digital objects, such as digital videos, metadata standards facilitate the ability for information to be searched for and shared (Sotirova, Peneva, Ivanov, Doneva, & Dobreva, 2012; UNC University Libraries, 2017a).

Properties of digital objects. Digital objects can be distinguished from analog objects based on properties such as the ability to be readily copied and shared, the ability for the same content to be formatted differently to enable use across different systems and software, and the ability to edit and transform the object for reuse for multiple purposes (Higgins, 2016, p. 30).
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The properties of digital objects are beneficial in research and application because in addition to the ability of content to be copied and altered, the content can be aggregated (Foster & Rafferty, 2016). Though properties of digital objects allow for flexibility of use and multiple purposes, the properties also cause digital objects to be vulnerable to technological failure and data loss (Higgins, 2016, p 30).

**Formation of digital objects.** Digital objects can be digitized or created digitally. A digitized object is an object that existed initially in analogue form but was digitized to allow the object to be shared, transformed, and reused, with the original analogue object remaining (Higgins, 2016 p. 31). In comparison, a digitally created object is an object created in digital format rather than by originating from an analogue equivalent (Higgins, 2016 p. 31). For many digital objects created today, it is more common for the objects to be created digitally rather than digitized (Sotirova et al., 2012). This small-scale study worked with data that had been created digitally.

**Management of digital objects.** There are different types of digital objects (e.g., digital recordings), and distinctions of the types should be considered when managing and developing a search method for digital objects as the differences in digital object types can affect search interfaces and behaviors delivered to a user (Higgins, 2016. p 30). Institutions such as libraries, museums, and universities, manage digital objects for various purposes, such as for historical or scientific significance, through phases of digitization, access, and preservation (Sotirova et al., 2012). As discussed previously, digitization is the process of converting an analogue object into a digital form (Sotirova et al., 2012). Digitization techniques are selected dependent upon the type of object (e.g., photograph, audio file, and video file), with technology for digitization often
including specialized hardware, software, and networks, along with standards to address management such as security, maintenance, and upgrades (Sotirova et al., 2012).

When determining methods for disseminating digital objects, consideration should be given to who the user will be and how the user will use the information belonging to the digital object (Foster & Rafferty, 2016). Consideration to the user and use should drive both the organization of the digital objects as well as the services and tools to provide search and access for the digital objects (Foster & Rafferty, 2016). As defined by The Library of Congress, the active management of digital content over time to ensure ongoing access is called digital preservation (Library of Congress, 2018b). The purpose of digital preservation is to keep the digital object physically intact and allow the digital object to be accessed and used in the future (Sotirova et al., 2012).

**Storage of digital objects.** A collection of digital objects is commonly called a digital repository, and digital repositories often serve as both a software platform as well as a location to collect (deposit), organize, preserve, and disseminate digital objects (Walsh, 2011, p. 33). Digital repositories are commonly organized in collection sets and stored in computer networks (Sotirova et al., 2012). For example, the AECT Legends and Legacies Project collection of digital recordings, worked with in this study, are archived and disseminated to the public on the AECT project website (Association for Educational Communication and Technology, 2018b). Digital repositories can include a wide range and variety of content for different purposes and for different users (Sotirova et al., 2012). Prior to storing digital objects in a digital repository, searchable description, termed metadata, is needed for users to identify and access digital objects (Smiraglia, 2005, p. 3). To support searchable description for digital objects, standards such as the Dublin Core Metadata Initiative (DCMI), have been developed as a framework to use when
describing digital objects (Dublin Core, 2017a). The DCMI Metadata Element Set consists of the following 15 core data elements: creator, contributor, coverage, date, description, format, identifier, language, publisher, relation, rights, source, subject, title, and type; with no requirement to include all of the standards when describing digital objects (Dublin Core, 2017b).

**Searching digital objects.** Tools such as catalogs and indexes, used to find information objects such as digital objects, are often assessed on the efficiency to allow a user to search the information object (Smiraglia, 2005, p. 3). As with determining methods for disseminating digital objects, when determining tools to provide search for the digital objects, consideration should be given to who the user will be and how the user will use the information belonging to the digital object (Foster & Rafferty, 2016). To support tools to search information about digital objects and within digital objects such as digital recordings, digital objects are associated with metadata (Society of American Archivists, 2018a).

**Metadata**

Metadata is defined as information that has meaning in relation to another piece of information (UNC University Libraries, 2017b). Commonly referred to as “data about data”, metadata can describe anything, and be created, managed, stored, and shared (Riley, 2017, p. 1, UNC University Libraries, 2017b). As with the term data, metadata is often used as a mass noun to take the singular verb “is”, though both the plural and single form of the term are standard in use (Merriam-Webster, 2018a). Though sometimes used interchangeably, the terms metadata and data do not have the same meaning. Data refers to an information object whereas metadata refers to information about the information object (Wootton, 2007). For example, in reference to a digital recording, data could refer to the digital recording file (i.e., the information object) while metadata could refer to information from within the digital recording file such as spoken words.
or time codes of the spoken words. Metadata allows users to interact with information described by metadata to obtain knowledge (Riley, 2017, p. 1).

**Use of metadata.** Libraries and museums have a long history of determining and using metadata to create finding aids to help users locate groups of related items such as papers and records from individuals and organizations (Riley, 2017, p. 5). From early handwritten books and catalogs to computerized database management systems, libraries use metadata to describe inventoried items to allow users to search for and discover the items, while museums use metadata to interpret and convey the historical significance to visitors and track information about acquisitions, exhibits, and loans (Riley, 2017, p. 5). Though metadata has been present within collections for thousands of years, the term has not been formalized until recently (Wootton, 2007).

Daily activities are often driven by and permitted through the application and use of metadata such as searching for a physical book, browsing a web page, or viewing an online digital recording with retrieved information often including additional information to describe the name, creation, topic, or other descriptive information about the information object (Riley, 2017, p. 2). In 2012, Google released the Knowledge Graph, which describes real-world entities and enables users to search for people, places, and things (Google, 2019a). Focused on comprehensive depth and breath, the Knowledge Graph contains more than 500 million objects and more than 3.5 billion facts (i.e., metadata) about the objects and about relationships between the objects (Singhal, 2012).

**Types of metadata.** The different types of metadata are classified based upon the type of function the metadata supports (Higgins, 2016, p. 39). To assist with an understanding of metadata types, an abbreviated description of the function of common metadata types, as
identified by Higgins (2016), follows: *administrative metadata* document the changes and custody of a digital object; *descriptive metadata* describe the content and retrieval of a digital object; *rights metadata* manage intellectual property rights of a digital object; *structural metadata* describe the internal structure and parts of a digital object; *preservation metadata* describe processes taken to facilitate long-term access to a digital object; *technical metadata* describe the technical environment in which a digital object was developed; and *use metadata* manage user access and user tracking of a digital object (Higgins, 2016, p. 39). There is no requirement for a set number of metadata types to be integrated with a digital object as the choice of metadata depends upon the nature of the information (Australian National University, 2018). With digital object collections, information can be organized and searched when metadata is consistent in content and structure (Higgins, 2016, p. 39).

**Metadata standards.** Metadata standards provide rules for structuring information, promote consistency in recording information, and are considered fundamental in facilitating information exchange and protecting the long-term value of the information (Sotirova et al., 2012). The process of the standardization of metadata often includes an agreed upon language, spelling, and format to facilitate comparison of data (UNC Libraries, 2017c). Metadata standards can be classified by the application served in different contexts such as libraries, museums, and universities, with each context managing metadata by need such as bibliographic descriptions, artifact records, and discovery of learning objects (Sotirova et al., 2012). Though there are many metadata standards that have been designed by different communities and organizations, it is suggested to select a type of metadata standard that is applicable for the users of the resource (Higgins, 2016, p. 42). For example, some people work with metadata standards applicable to descriptions of non-textural artifacts (Ervine, 2016), while other may work with metadata
standards applicable to descriptions of digital geospatial data (Federal Geographic Data
Committee, 2018); each metadata standard serving a different community with a unique
community language.

Some metadata designers choose to standardize metadata through a consistent way to
describe data by using a controlled vocabulary (UNC University Libraries, 2017a). A controlled
vocabulary may be a list of terms on a topic that identify one word or phrase for a concept
(Riley, 2017, p. 17), or may be subject headings (UNC University Libraries, 2017a). Using a
controlled vocabulary will facilitate the search of information and additionally increase the
ability of the information to be shared with those in the same discipline (UNC University
Libraries, 2017a). For example, the Getty Vocabularies provide a structured vocabulary for
catalogers, data providers, and researchers for use in multiple areas such as archival materials,
bibliographic materials, and digital history (Getty Research Institute, 2018).

**Database Management**

Historically, data in records has been documented throughout civilizations often
dependent upon tracking needs such as for trade and taxation; though challenges were presented
in both retrieving the data and in producing reports (Lake & Crowther, p. 2013, p. 21). A
database is a logical way to group data (IBM Corporation, 2010), and can be defined as a
structured collection of information organized with a purpose of easy access, which can be used
to track a variety of data ranging in complexity from small lists to detailed statistics (Princeton
University Office of Information Technology, 2001, p. 4). A database must be organized to allow
the retrieval of data (Lund University Libraries, 2019). Similar to a catalog card file, a database
separates information into sections with each section containing similar data (Princeton
University Office of Information Technology, 2001, p. 4). Today, metadata is found in a variety
of forms and settings, and in traditional information systems design, can be found stored as fields in relational database tables known as a record (Riley, 2017, p. 8). Database management systems allow users to perform operations such as data entry, data manipulation, and management of database structures (IBM Corporation, 2010), and can be used to record, store, and retrieve metadata (Princeton University Office of Information Technology, 2001, p. 4).

**Data Integration and Performance**

Over time, the primary purpose of metadata has broadened from defining data to being a requirement for databases and data warehouses in data integration and tool management (Sen, 2004). For example, algorithms developed to retrieve can be combined with conventional metadata retrieval approaches to provide cross-collection searching and navigation in use with gallery and museum digital image collections (Lewis, et al., 2004). An advantage of metadata-oriented systems in comparison to a traditional programming method is that held in a database format, metadata can be formatted once and accessed through tools which allow the data to be used multiple times in a reliable and easily accessible manner throughout the life cycle of a project (Dilorio, 2007, p. 11). When put into use, metadata often exists as a configurable set of data that can determine a feature of performance in an application (Kendall, 2015). Interface development for metadata entry requires a skill set unique to program developers (Dilorio, 2007, p. 11.)

**Data Extraction**

The increasing availability of online academic content, such as lecture videos, has created a need for content based retrieval systems, to include metadata extraction and support for search within videos (Balasubramanian, Doraisamy, & Kanakarajan, 2016, p. 121). In a study that focused on extracting content-descriptive metadata from spoken lecture videos, researchers
sought to determine keywords, which were extensively described or defined in a lecture to help both annotate and summarize the lecture. To extract the metadata, the researchers suggested an approach that utilized slides from the video and audio transcripts. The researchers recognized that previous work that had been done with metadata extraction of spoken lectures using audio transcripts had been limited due to unstructured speech, spontaneous speech, and the variety of speaking styles within the spoken lectures. Because the focus of the study was to support topic search within lecture videos to help annotate the videos, the researchers proposed an extraction system that incorporated both a video-based and an audio-based approach (Balasubramanian et al., 2016, p. 124). For this study, because focus was given to the search of audio-based spoken information within AECT Legends and Legacies Project video interviews, it was anticipated that video interview transcripts would be used during the study.

**Search Technologies**

 Across the context of search engines and search tools, the process of keyword-based search is similar in that users search for a keyword or phrase in all fields, or a specific document field, with all targeted fields containing the search keyword or phrase listed on a results page (Beel, Gipp, & Wilde, 2010, p. 2). The metadata of electronic files is important for user search and must be identified for a search tool to recognize information contained within a file. For example, when given a PDF file, if a user is provided a text-based PDF, the user will be able to extract data by highlighting-copying-pasting the information into a text document. In comparison, if the user is provided an image-based PDF, the user will not be able extract data without the use of additional tools such as optical character recognition (University of Kentucky Institute for Digital Research in the Humanities, n.d.). In order for a search system to recognize information, data must be extracted from a file (Adobe, 2019; Beel, Gipp, & Wilde, 2010, p. 2).
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Though oral history associations believe there is no satisfactory transcription software for interviews and recommend transcription be done by professional companies or individuals, (Columbia Center for Oral History Research, 2017a), companies provide services for search for “millions of hours” of videos found on the Web through the use of speech recognition technology (Jurafsky & Martin, 2008, p. 8). Although not error-free, speech recognition technology, a machine-based process that decodes and transcribes oral speech (Levis & Suvorov, 2012, p.1) is used in speech and language processing.

Speech and Language Processing

Because speech and language processing has been used differently in the fields of computer science, electrical engineering, linguistics, and psychology/cognitive science, there has been overlapping of fields such as natural language processing in computer science and speech recognition in electrical engineering (Jurafsky & Martin, 2008). Language processing applications, such as speech recognition technology, are distinguished from other types of data processing systems in that language processing applications utilize a knowledge of language as well as what it means to be a word rather than simply a letter (Jurafsky & Martin, 2008, p.2)

Foundations. In the book, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, authors Jerafsky and Martin (2008) summarize historical threads that have contributed to speech and language processing. Abbreviated information from the authors’ historical summary spanning from foundational insights to the rise of machines (Jurafsky & Martin, 2008, p. 9-13) follows. Note: To assist in readability, some terms have been briefly defined within brackets by the researcher of this study. Terms as identified by Jerafsky and Martin (2008) are placed with quotes inside parentheses.
**Speech acoustics**: Following WWII and the rise of the computer, work occurred on the automaton and probabilistic models. The automaton, with work arising from Turing’s 1936 model of algorithmic computation, is considered to be the foundation of modern computer science. Early work on probabilistic models led to the field of formal language theory, decoding work for the transmission of language through media such as speech acoustics, and the measure of the entropy of English. During this time, foundation research in instrumental phonetics and first machine speech recognizers occurred (Jurafsky & Martin, 2008).

**Keyword search**. During the period from 1957 to 1970, speech and language processing had divided. Symbolic research focused on formal language theory, algorithms, and programming, while stochastic research focused on reasoning, logic, and the new field of artificial intelligence (AI) [Artificial intelligence is the term given to the general study of making intelligent machines (Google AI, 2019b)]. During this time, early natural language understanding systems were built which worked by pattern matching and keyword search (Jurafsky & Martin, 2008).

**Relationship of speech acts**. During the period from 1970 to 1983, there was a significant increase in speech and language processing research, which led to speech recognition algorithms development. During this time, the natural language understanding field grew, a series of language understanding programs were built which gave focus to conceptual knowledge such as human memory organization, and focus was placed on logic-based work such as speech acts (Jurafsky & Martin, 2008).

**Part-of-speech tagging**. During the period from 1983 to 1993, probabilistic models regained attention though speech and language processing work and brought a return of empiricism [the knowledge from sensory experience]. Data driven methods included part-of-
speech tagging and semantics [study of meaning], with a large amount of work on natural language generation. (Jurafsky & Martin, 2008, p. 4).

**Commercial speech recognition.** During the period from 1994 to 1999, there was an increase in the memory and speed of computers, which brought on commercial use of speech and language processing in areas of spelling/grammar correction and speech recognition. Speech and language processing algorithms applications were extended to Augmentative and Alternative Communication (AAC) [methods used to support communication needs of people], and the growth of Web use brought about a need for language-based information retrieval and information extraction (Jurafsky & Martin, 2008).

**Machine translation.** From 2008, there has been a significant increase in the amount of spoken and written material available, which has included material from text sources layered with different forms of annotations [provisions of metadata attached to data] such as syntactic ("knowledge of the structural relationships between words"), semantic ("knowledge of meaning"), and pragmatic ("knowledge of the relationship of meaning to the goals and intentions of the speaker") annotations. Focus has been given to more complex problems supervised by machine learning, and the availability of high-performance computing systems has influenced the release of systems and approaches such as machine translation. Because of the connection between language and thought, and research on how people interact with complex media, speech and language processing technology will be of extreme importance in the development of future technologies (Jurafsky & Martin, 2008, p. 4, 15)

**Speech recognition technology.** An example of machine translation technology is automatic speech recognition, defined as a machine-based process that decodes and transcribes oral speech (Levis & Suvorov, 2012, p.1). Historically, speech recognition technology has
presented challenges because speech itself is a challenging task which relies on intelligent behavior to include processes such as operation in real time, utilization of knowledge and abstractions, toleration of unexpected input, communication though natural language, and ability to learn from the environment (Reddy, 1999). Speech recognition is different from voice recognition in that speech recognition refers to the ability of a machine to recognize spoken words (i.e., what was said), whereas voice recognition refers to the ability of a machine to recognize speaking style (i.e., who said what) (Levis & Suvorov, 2012, p. 1). Though speech recognition technology is still considered by some to be far from perfect, there are now large quantities of everyday speech online from a variety of materials and environments, which have provided an abundant source of speech data to provide opportunities for advancing speech recognition technology (Haung, 2014, p. 100).

Though only a few years ago, it was projected that web-based tools “could” be made available to collect, annotate, and process large quantities of speech in a cost-effective manner for use with many languages (Haung, 2014, p. 100), today, advancement in web-based tools and technologies for speech recognition are available for public use. For example, by using streaming speech recognition technology, users can stream audio to Google’s Cloud Speech-to-Text, a paid service, to receive stream speech recognition results in real time while the audio is being processed (Google Cloud, 2019b). With the Cloud Speech-to-Text service, users can indicate a value of accuracy (termed confidence level) for transcription words, and the degree of response accuracy (word-level confidence) is measured (Google Cloud, 2019a). It is believed by some that in less than 40 years, speech recognition will pass the Turing Test (Haung, 2014, p. 103); a method to assess if a machine can be regarded as intelligent, and one of the most disputed topics
surrounding artificial intelligence, cognitive science, and philosophy of mind (French, R. M., 2000; Saygin, Cicekli, & Akman, 2000).

**Machine generated transcription.** Language based data can come from interview transcripts (Saldaña, 2016), which are constructed texts (Lapadat & Lindsay, 1999, p. 76). Though early mechanical recording and transcription of communicative interactions gave focus to how technology expanded the precision of language data, there has been a lack of attention given to the role of transcription in the methodology or transcription processes, with the topic of transcription typically absent from discussion in both methodological and empirical reports (Lapadat & Lindsay, 1999, p. 66). And though it is common for research practices that use language as data to incorporate audio or video recordings of communicative interaction followed by transcription with focus on accuracy, in clinical and instructional practice with limitations on time, there is debate whether less rigorous approaches in working with data can be substituted with satisfactory results (Lapadat & Lindsay, 1999, p. 66).

Artificial intelligence (AI) provides new ways to approach existing problems and reduces barriers to many daily activities such as assisting in language, assisting in communication, and searching for information, (Google AI, 2019a). Through the use of speech recognition technology, AI options allow video owners to automatically create captions for videos from spoken information, which can be auto-synced to include a starting time code for content segments (YouTube Help Center, 2019a). Because the video captions use both text information and synced time codes, the captions can be considered time coded transcripts (Watson, 2010).

**Summary**

Interviews play an important role in collecting data and the increase in use of existing videos for research has created a need to search spoken information within video interviews.
Prior to searching for specific words or phrases within a digital video interview, it is helpful to create a searchable version of the interview. Such a searchable version is likely to contain spoken words that have been converted to visible text along with associated metadata, e.g. time codes, derived from, and associated with, the original version of the digital video interview. (Boyd, Gabbard, Price, & Boltz, 2019; Higgins, 2016; Smiraglia, 2005, p. 3; Society of American Archivists, 2018a). Recent advancements in speech recognition technology and machine generated transcription have provided web-based offerings to support the search for specific words and phrases within digital recordings. Chapter 3 presents the research methods and procedures employed for a small-scale study to develop a working prototype of a search tool to enable a more comprehensive and flexible search for AECT Legends and Legacies Project video interviews.
Chapter 3: Method

Introduction

This chapter identifies and describes the design and development process and procedures used in this small-scale study to create a more comprehensive and flexible search tool for AECT Legends and Legacies Project video interviews. The chapter includes Design and Development Research background information, the alignment of the study to the research purpose, and the significance of the application to the field of instructional design and technology. The chapter describes the design of the study and research procedures, the processes of tool design and tool development, the analysis of data, and the evaluation of tool usability and workability. The chapter additionally discusses the ethical considerations of participants and the measures taken to help ensure validity and reliability for the study. Within the rest of this chapter, the small-scale study will be referred to as the study.

Purpose

Significant to the field of instructional design and technology, the study employed a systematic method to design and develop a more comprehensive and flexible search tool to allow a user to find spoken information within AECT Legends and Legacies Project video interviews.

Design and Development Research

The study planned and conducted design and development research. Centered in the field of instructional design and technology, design and development research is a systematic method of design, development, and evaluation processes, which uses traditionally recognized research methods to establish new procedures, techniques, and tools (Richey & Klein, 2007, p. 1, 41).

Foundations. The design and development knowledge base has been shaped by foundational research unique to instructional design and development, as well as other
disciplines (Richey & Klein, 2007, p. 2, 3). The methods of design and development research holds scientific value as the need for models and tools are addressed while building upon existing knowledge from replicated, empirical research which require solutions to problems to be supported by data (Richey & Klein, 2007, p. 2, 3). In addition to research, different theories have informed foundational work of the design and development knowledge base such as theories of learning, instruction, and communication (Richey & Klein, 2007, p. 3, 22). Design and development research has lead to an increased understanding and knowledge production while giving focus to two types of research projects: (1) model research, and (2) product and tool research (Richey & Klein, 2007, p. 8).

**Alignment.** Design and development research was appropriate for this study as this type of research provides guidance for methods and strategies for product and tool research, and supports focus on tool planning and tool evaluation during a study (Richey & Klein, 2007). Adapted from Klein’s representation of types of design and development research (Klein, 2014), Table 1 shows the alignment of the research type, research emphasis, and anticipated outcome for this study.

Table 1

*Design and Development Research: Tool Research Alignment*

<table>
<thead>
<tr>
<th>Research Type</th>
<th>Research Emphasis</th>
<th>Anticipated Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product and Tool Research</td>
<td>Studied a specific tool design and development project.</td>
<td>Lessons learned from developing a specific tool and analyzing features to facilitate tool use.</td>
</tr>
</tbody>
</table>
When studying the design and development of tools, a researcher will often focus on two areas: (1) product and tool design, and development processes, and (2) product and tool use (Richey and Klein, 2007, p. 132). Tool-use studies often address products used for educational settings (Richey & Klein, 2007, p. 133). This study focused on tool features and functions to facilitate tool use.

**Importance.** Design and development research was important to this study, as the research methods provided research processes and procedures to improve search tool capabilities to allow users to locate spoken information within AECT Legends and Legacies Project video interviews. The focus area of product and tool use was important to the field of instructional design and technology, as consideration was given to the anticipated users of the tool who would be searching within AECT Legends and Legacies Project video interviews, which contain conversations, stories, and personal insight from practitioners and scholars who have helped shape the field of instructional design and technology through their work (Association for Educational Communications and Technology, 2018a).

**Project Profile**

In design and development research studies, the in-progress project itself can be considered a type of participant with the project profiled by product characteristics such as the information content; the type of product and delivery; and the intended use (Richey & Klein, 2007, p. 100). When designing the tool for this study, the **content** was identified as the information within AECT Legend and Legacies Project video interviews; the **type of product and delivery** was identified as a search tool delivered to users though a web-based platform; and the **intended use** was identified as the ability for public users to search AECT Legends and Legacies Project video interview spoken information.
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Process

This study describes systematically how the tool design and development process and procedures were implemented. As the process of design and development is a form of problem solving (Richey & Klein, 2007, p. 24), the literature was reviewed throughout the study to guide the process. In comparison to a traditional Instructional Systems Design model of ADDIE, the processes for this study were adjusted design, development, analysis, and evaluation. As iterative design methods can improve the usability of a product (Bailey, 1993), the study anticipated repetition within the design and development phases. The study followed a process of: (1) tool design, (2) tool development (3), analysis, and (4) tool evaluation.

Preparation. To become familiar with AECT Legends and Legacies Project video interview content and digital recording format, three video interviews were viewed from the AECT Project website. Because the purpose of this study sought to allow users to search spoken information within the video interviews, transcript files with video codes were anticipated.

Tool Design

To determine tool design procedures, the literature was reviewed to align tool design to the research problem and to examine procedures related to tool usability. Usability refers to the quality of a user's experience when interacting with products (Usability.gov, 2018b). The tool design process consisted of the determination of features and functions to be used to search content within AECT Legends and Legacies Project video interviews; and a description of research procedures used to address anticipated design concerns.

Features and functions. When deciding on tool features and functions, consideration was given to features already in place which have allowed users to navigate to embedded video
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interviews by interview index, discover responses to interview questions from different interviewees, and navigate to playback position by interview question (Lockee & Song, 2016; Leary & Lockee, 2018). Planned features and functions were designed to address the research problem and need to extract transcribed data from existing AECT Legends and Legacies Project video interviews to permit users the ability to search spoken information in text form. It was decided that the roles for the search tool would be: administrator – with ability to monitor access, information, and tool management systems, and ability to approve or reject suggested transcription; contributor – with ability to use the search tool and suggest transcription; and user – with ability to use the search tool and no ability to suggest transcription without signing in prior. It was decided that search tool features and functions would be: search or view choice, to provide a user the ability to search interviews for keywords or to view a full transcription for an interview; keyword search, to allow a user to search for a word or phrase from single, multiple, or all video interviews; search results page, organized by number of results found, interviewee number, interviewee name, associated starting video time codes; data from machine generated transcription (AI Transcription); location to accept and house edited transcription (Contributor Transcription); navigation to the AECT Legends and Legacies Project website (http://aectlegends.org/); and delivery of the tool through a public website. Features and functions of the search tool are represented in Table 2.

Table 2

<table>
<thead>
<tr>
<th>Tool Design: Search Tool Features and Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feature</td>
</tr>
<tr>
<td>ACCESS: Administrator</td>
</tr>
</tbody>
</table>
## DEVELOPMENT OF A SEARCH TOOL FOR DIGITAL VIDEOS

<table>
<thead>
<tr>
<th>Access: Contributor</th>
<th>A <em>Contributor</em> will have the ability to use the search tool and suggest transcription.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access: General</td>
<td>A <em>User</em> will have the ability to use the search tool and sign in as a Contributor.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Search/View Choice</th>
<th>A user will have the choice to search interviews for keywords or to view a full transcription for an interview.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search Keyword</td>
<td>A user will be able to search for a word or phrase from single, multiple, or all video interviews. Following the search, the user will be directed to a Search Results page to view results as found from AI transcription.</td>
</tr>
<tr>
<td>View Transcription</td>
<td>A user will be able to view a full transcription for an interview. Following interview selection, the user will be directed to a Search Results page to view the full transcription as found from AI transcription.</td>
</tr>
</tbody>
</table>

| Results Categories | The Search Results page will be organized within the following categories: No. (number of results found); ID (interviewee number); Interviewee (first, last name); Time (starting video time code); AI Transcription (YouTube generated transcription); and Contributor Transcription (edited transcription). |

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Contributor Invitation  A general user will be invited to suggest transcription.

Suggest Transcription  Contributing users will be able to suggest transcription.

Approve Data Entry  An administrator will be able to approve or reject suggested transcription.

AECT Project Website  A user will be able to navigate from the search tool to the AECT Legends and Legacies Project website (http://aectlegends.org/).

Video Time Code  A user will be able to navigate from a time code to playback position of AECT Legends and Legacies video content.

Search Tool Website  A user will have the ability to use the search tool through a public website.

**Design concerns.** As recommended by Richey and Klein (2007, p. 58), approaches were taken to address research design concerns of validity, anticipated problems, and causal inferences. To address validity, the following approaches were taken: verified AI generated transcripts with synced time codes against related AECT Legend and Legacies Project video interviews spoken information; created a search tool prototype; used unedited data rather than processed or interpreted data; consulted with expert programmer for tool development and review; selected participants to test the tool to collect usability data; and collected verification of reports of tool use from participants. To address anticipated problems, the following approaches
were taken: recognized real-world constraints of technology needs (e.g., hardware, software, internet connectivity, and power) for tool use; planned for independent tool use; used familiar language in search tool instructions; and minimized assumptions of the existing knowledge of users. To address causal inferences, the design of the tool was related to tool usability and the effectiveness of the tool was determined.

Adapted from Richey and Klein’s highlights of how design concerns have been dealt with in product and tool research (Richey & Klein, 2007, p. 58), approaches used to address concerns in this study are summarized in Table 3.

Table 3

<table>
<thead>
<tr>
<th>Approach</th>
<th>Anticipating Problems</th>
<th>Causal Inferences</th>
<th>Validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimized assumptions of user existing knowledge</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planned for independent tool use</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recognized technology constraints for tool use</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used familiar language in instructions</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Determined the effectiveness of the tool</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Related tool design to tool usability</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collected verification of tool use</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compared AI transcripts against spoken information</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consulted expert programmer</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Created tool prototype</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used unedited data, rather than interpreted data</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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Note. X = the research concern addressed by the approach. A blank cell represents data that was not applicable (VandenBos, 2010, p. 137).

Tool Development.

To determine tool development procedures, relevant literature was reviewed to help align the functionality and interactivity features of the search tool to the research problem. Preparation for the tool development process consisted of identifying the following tasks: deciding on the data source, quality control, planning for data back up, consulting with a tool development expert, identifying a delivery platform to demonstrate the tool effectiveness, and in-progress design and development revisions.

Data Source. Throughout this study, the design and development of the tool gave consideration to future use of AECT Legends and Legacies Project video interviews. It was determined that the AECT Legends and Legacies Project video interviews could be publically accessed to stream from either the AECT Legends and Legacies Project website, published by AECT, or from a YouTube channel maintained by an AECT Legends and Legacies Project manager. Confirmed by the AECT Legends and Legacies Project manager, the AECT Legends and Legacies Project video interviews on the YouTube channel were the same videos as presented on the project’s website as the videos on the project website were embedded from the YouTube channel (K. Song, personal communication, September 18, 2018).

From a search of the literature and conversations with the AECT Legends and Legacies Project administrator, it was confirmed that there were no existing generated transcripts available for study use. It was discovered for videos published on YouTube, there was a means to obtain video transcripts. Because the YouTube channel owner of the published AECT Legends and Legacies Project video interviews had permitted “subtitles or CC”, public users were able to
view transcriptions with text lined up to the video speech (YouTube Help Center, 2019a). Automatic transcription by YouTube was recommended by Assistive Technology experts from Virginia Tech, who stated Google was considered to have the best voice recognition technology to date. In the communication relaying this recommendation, it was emphasized that even paid transcribing services rely on human intervention to increase accuracy (W. Fox, personal communication, February 20, 2018). It was decided to utilize Google’s technology as offered through YouTube to generate transcription files with aligned time codes for AECT Legends and Legacies Project video interviews.

Aligned to the study’s Institutional Review Board approval for existing data, the originating data source of the AECT Legends and Legacies Project video interviews in the process of generating transcript files was the project’s public website (http://aectlegends.org/).

To generate AECT Legends and Legacies Project video interview transcript files, the following steps were taken: (1) The researcher navigated to the AECT Legends and Legacies Project website, aectlegends.org; (2) from the website the interview of choice was selected through the Video Index navigation option, and the YouTube logo was selected (“clicked”) on the embedded video image for navigation to the related video on the YouTube channel; (3) from the YouTube page containing the video interview, the “more options” (represented by three horizontal dots) option was chosen to view and select the “Open transcript” option, and the AI generated transcript with time codes was copied and pasted into a Word document file. Table 4 summarizes the steps taken to create transcription files for AECT Legends and Legacies Project video interviews.

Table 4

*Summary of Steps Taken to Create a Transcript File with Time Codes from YouTube.*
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<table>
<thead>
<tr>
<th>Steps</th>
<th>Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1:</td>
<td>Started from the AECT Legends and Legacies Project website (<a href="http://aectlegends.org/">http://aectlegends.org/</a>).</td>
</tr>
<tr>
<td>Step 2:</td>
<td>Selected the interview of choice from the Video Index and clicked the YouTube logo located on the bottom of the embedded video to view the video from YouTube.</td>
</tr>
<tr>
<td>Step 3:</td>
<td>From YouTube, navigated to more options under the video to open the transcript and copied and pasted the text and time codes for the full transcript into a Word file.</td>
</tr>
</tbody>
</table>

**Data inspection.** Inspection is a process used to measure, examine, and test characteristics of a product and to compare characteristics to determine conformity (American Society for Quality, 2019). To determine availability of transcripts for AECT Legends and Legacies Project video interviews, inspection was used to measure the number of videos with available transcription, to examine availability of transcription use, and to test the ability to obtain transcription information for the search tool.

**Data backup.** At the beginning of the study, identical versions of the AECT Legends and Legacies Project video interviews were embedded on the project’s public website and on YouTube. Because of this, copies of the video interviews were not pursued for data backup. During the study, the AECT Legends and Legacies Project video interviews remained accessible, without change, on both the project’s website and YouTube. The video interviews were accessed through streaming. Transcripts and associated study data were stored on password-protected computers with access limited to the researcher.

**Development expert.** As discussed in the tool design process, to address the design concern of validity, an expert programmer specialized in tool development was consulted, and
services from the programmer were used to activate the search tool features and functions on web-based delivery platform.

**Tool delivery.** An information base functions to provide users with meaningful information by storing content and interacting with users through a management system (Song, K, 2014). Because interactions between information bases and other information change over time, information bases are designed with flexible structure to allow changes so that users can be provided with new information (Song, K, 2014). This study considered existing features of an online interface in place for AECT Legends and Legacies Project video interviews (Lockee & Song, 2016). For this study, an information base was developed to store data from AECT Legends and Legacies Project video interviews and interact with users as a search tool delivered through a website hosted by Virginia Tech, as activated by a Virginia Tech programmer. The activation of the search tool permitted search tool prototypes for in-progress work and revisions, as well as provided search tool delivery to users for usability testing and final tool evaluation.

**Iterative process.** The study demonstrated an iterative process in which revision work did not fall into distinctly different design and development processes, and that the repetition of work of both processes would drive tool revisions to bring the researcher closer to a final working tool version. Table 5 summarizes the processes and procedures used for tool research. Though an iterative process was anticipated, the processes used during the study are summarized separately to assist in understanding.

Table 5

*Study Processes and Procedures for Tool Research*

<table>
<thead>
<tr>
<th>Processes</th>
<th>Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>Development</td>
</tr>
</tbody>
</table>
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| X | Aligned the research type, research emphasis, and anticipated outcome for the study. (Table 1) |
| X | Determined the features and functions of the search tool required to satisfy the purpose the search tool. (Table 2) |
| X | Identified anticipated design concerns and described approaches to address research concerns. (Table 3) |
| X | Made final design adjustments driven by in-progress design and development work. |
| X | Decided on the data source: transcript with time code. (Table 4) |
| X | Developed a plan for data backup |
| X | Consulted with a tool development expert. |
| X | Activated search tool prototype for in-progress revisions. |
| X | Identified a delivery platform to demonstrate working tool. |
| X | Made final development adjustments driven by in-progress design and development work. |

Note. X = the process during which the majority of the procedure was completed. Iterative design and development work occurred as determined by in-progress findings. A blank cell represents data that was not applicable.

In-progress work. In-progress work during the iterative design and development processes refined focus to three purposes for the tool in relation to AECT Legends and Legacies Project video interviews: (1) to permit search of word data within video interviews from AI generated transcript data, (2) to permit view of transcript data for video interviews from AI generated transcripts, and (3) to accept contributed video interview data from contributing users.

Analysis
In design and development research, certain types of data are more relevant than in other types of research due to the variation of problems and projects (Richey & Klein, 2007, p. 101). As stated previously in the project profile, when designing the search tool, variables of interest included: content (the information within AECT Legend and Legacies Project video interviews), type of product and delivery (a search tool delivered through a web-based platform), and intended use (the ability for public users to search AECT Legends and Legacies Project video interview information). Data required by a design and development project is dependent upon the project, and though many researchers collect retrospective data, it is advised to collect in-progress data to help determine the success of the project (Richey & Klein, 2007, p. 103). For this study, both in-progress data and evaluation data focused on AECT Legends and Legacies Project video interview content, intended use of the search tool, and functions of search tool features.

**Interview Content.** Through descriptive comparison, this study examined the differences between AECT Legends and Legacies AI-generated transcriptions and video interview spoken information. Descriptive comparison is used when a researcher seeks to describe occurrences of a situation and how the occurrences may vary between situations (Esser & Vliegenthart, 2017, p. 12). This study did not attempt to quantify the differences but did view video interviews to determine if there were differences in words and phrases significant in meaning to the field of instructional design and technology.

Both structural and descriptive metadata of AECT Legends and Legacies Project video interviews were analyzed. Structural metadata was compared between the synced times codes from AI generated transcripts and the video time codes as observed from video interviews as presented on the AECT Legends and Legacies Project website. Descriptive metadata was compared between the words from AI generated transcripts and the spoken words as observed
from video interviews as presented on the AECT Legends and Legacies Project website. This study did not attempt to analyze the rate of word error of content between the AI generated transcripts and the AECT Legends and Legacies Project video interviews.

**Intended Use.** As the intended use for the search tool was to provide users the ability to perform a more comprehensive and flexible search to AECT Legends and Legacies Project video interviews, focus was given to tool features and functions to permit a more comprehensive and flexible search tool. In design and development research, try-out data can include data that describes the performance of learners or explains the success or failure of the product (Richey & Klein, 2007, p. 106). For this study, usability testing was used and tasks were developed to seek performance data and effectiveness of the search tool to improve search capabilities to allow users to search spoken information within AECT Legends and Legacies Project video interviews.

**Usability Testing.** Usability testing refers to the evaluation of a product determined by testing the product with participants to help identify problems before the product is put to use (Usability.gov, 2018d). Benefits of usability testing include learning if participants are able to complete a task successfully, analyzing tool effectiveness, and identifying changes to be made to improve tool usability (Usability.gov, 2018d). Though tool development research uses many of the methods employed in product development, tool development relies greatly on evaluation techniques (Richey & Klein, 2007, p. 54), and one of the outcomes from research is to analyze conditions that facilitated tool use (Klein, 2014). For this study, tool usability focused on three areas: (1) the effectiveness of the search tool to permit a user to search word data within digital video interviews, (2) the effectiveness of the search tool to permit a user to view transcript data for a digital video interview, and, (3) the effectiveness of the search tool to permit user to
DEVELOPMENT OF A SEARCH TOOL FOR DIGITAL VIDEOS

contribute data for administrator review. Testing instruments were designed to help answer the question: Does the search tool do what it was intended to do?

**Sampling.** Purposeful sampling was employed to intentionally sample a group of participants who could best inform of tool effectiveness (Creswell & Poth, 2018, p. 148). Purposeful sampling can be used to collect information from participants who are easily accessible to the researcher (Palinkas et al., 2015, p. 19). As with qualitative inquiry, which can focus on relatively small samples to include single cases (Patton, 1990, p. 169), Richey and Klein (2007, p. 38) state that in design and development studies, purposeful sampling combined with non-biased observations is able to bring about sound interpretation and inference from small samples. Whereas the purpose of probability sampling is to apply generalization, the purpose of purposeful sampling is to seek information rich in data to learn a great deal about something important to the research purpose (Patton, 1990, p. 169). When resources limit a study to a single site, critical case sampling, a type of purposeful sampling, can be used to make a point from something important in the scheme of things (Patton, 1990, p. 175). With critical case sampling, researchers often seek to assess the following implications: if a problem is present, then the problem would be present elsewhere; and if something did not happen, then it shouldn’t happen elsewhere (Patton, 1990, p. 175). Though studying few critical cases does not always permit broad generalization, “logical generalizations” can be made from the findings from a single, critical case (Patton, 1990, p. 175). Patton (1990) states that there are many comparable critical cases in social science if a researcher searches, and provides an example of national policy makers looking to make a change in local programs without the assurance that all communities will understand governing regulations. In this example, Patton (1990) identifies the critical case as the evaluation of understanding by well-educated citizens in order to generalize findings to
less-educated citizens, with the logic that if the well-educated citizens did not understand the regulations, then the less-educated citizens would also not understand the regulations (Patton, 1990, 175). For this study, usability testing sought to evaluate search tool workability to apply the following logical generalizations to public users as follows: if usability participants had a problem with the search tool during tasks of viewing transcription, searching key words, and/or entering data, then future users would also have the same problem in one or more of the uses.

Participants. As recommended by Richey and Klein (2007, p. 97), participants were identified and selected based on research sampling techniques and in consideration of the research problem. Based on the research problem and the anticipation of use, usability participants consisted of ten people with varying levels of experience in the field of instructional design and technology. Participants were not required to use personal information to access the search tool. For usability testing purposes, reviewer accounts were generated for participants with each participant receiving an assigned username and an assigned password for tool access and use during testing. The participant reviewer accounts permitted participants the ability to contribute data with permissions equal to the role of a Contributor.

Ethical Standards. Prior to conducting the study, permission was obtained from the School of Education Chairperson and approval was obtained from a registered Instructional Review Board. Informed consent was not required from interview participants as the video interviews were provided on the AECT Legends and Legacies Project public site (http://aectlegends.org/) and already provided the names of people interviewed within the title of the video as well as within the video interview. Usability participants were informed of: the purpose of the study, the approval of the study by Virginia Tech’s IRB, a choice in the decision to take part in usability testing, the ability to leave usability testing at any time, no affect on
participant standing at Virginia Tech, no anticipated benefits to the participant, contributions will be used for collection of data for study purposes only, and that contributions will be kept in a confidential environment (see Appendix A.1 for informed consent). Following usability testing, data was stored on password-protected computers with access limited to the researcher to ensure anonymity and maintain confidentiality of the usability testing participants. Table 6 summarizes the process and procedures employed for the selection of usability testing participants.

Table 6

*Selection of Usability Participants*

<table>
<thead>
<tr>
<th>Processes</th>
<th>Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Followed sampling techniques to identify participants.</td>
<td>Participants selected through critical case sampling to inform about tool usability and to allow logical generalizations to public users.</td>
</tr>
<tr>
<td>Identified and selected participants based on the research problem.</td>
<td>Participants consisted of people with varying levels of experience in the field of instructional design and technology.</td>
</tr>
<tr>
<td>Implemented ethical standards to protect participants.</td>
<td>Permission obtained from School of Education assigned Chairperson. Approval obtained from the Instructional Review Board (IRB). Informed consent obtained from participants. Data stored on password-protected computer to maintain confidentiality of testing participants.</td>
</tr>
</tbody>
</table>

*Instrument.* For usability testing, the following tasks were created to collect information on the effectiveness of the search tool to: search word data, search transcript data, and to accept contributed data.
DEVELOPMENT OF A SEARCH TOOL FOR DIGITAL VIDEOS

Task #1 (view transcript). Participants viewed a machine generated transcription for AECT Legends and Legacies Project video interviews and completed the following tasks: (1) used the search tool to view AI Transcription for three interviews as directed; and (2) used the search tool to view AI Transcription for three interviews as personally chosen. Purpose: To evaluate the effectiveness of the search tool to view transcription data.

Task #2 (search keyword). Participants searched keywords from multiple AECT Legends and Legacies Project video interviews and completed the following tasks: (1) used the search tool to search for three words from all interviews, given a word bank; (2) used the search tool to search for three word phrases from all interviews, given a phrase bank; and (3) used the search tool to search for one word or one phrase from two interviews at the same time. Purpose: To evaluate the effectiveness of the search tool to search word data.

Task #3 (enter data). Participants entered data into the search tool by entering correct data as provided from an interview segment with time code. Purpose: To evaluate the effectiveness of the search tool to accept contributed data.

Location. As resources limited this dissertation study to a single site, it was recommended to choose a study location that would have the largest impact on the development of knowledge and yield the largest amount of information (Patton, 1990, p. 175). The setting for usability testing was the campus of Virginia Polytechnic Institute and State University as testing participants, the expert programmer, and study evaluators were associated with the university.

Use of Data. Following usability testing, collected information on the effectiveness of the search tool to permit participants to view transcript data, search transcript data, and enter data was analyzed. Findings from usability testing were used to determine needs for tool revision to improve tool usability and tool performance. Associated testing data was stored on password-
protected computers with access limited to the researcher. The results from usability testing are reported in Chapter 4 and discussed in Chapter 5.

**Search Tool Features**

The search tool was designed and developed to report the order of words as presented from AI transcription. When performing a search for a keyword or phrase, the search tool reported results for the arrangement of the words as entered. The search tool did not report identical results for a *bag of words* — a representation of the words regardless of order (Google AI, 2019c). For example when the phrase “grocery truck analogy” was entered into the search tool, the search tool results page only reported results for the word sequence of “grocery truck analogy” and did report results for sequences of “analogy grocery truck”, “truck analogy grocery”, or “grocery analogy truck”.

**Study Setting**

The setting for the study was the campus of Virginia Polytechnic Institute and State University as the research problem was evaluated by participants associated with university, the aspects and applications of the tool studied was accessible at the university, and it was feasible and practical to conduct the study at the university.

**Validity**

As recommended by Richey and Klein (2007, p. 58), to help ensure the search tool would perform as it was designed and developed to perform, a technician (expert programmer) was consulted to authenticate tool construction decisions. Additionally, tasks for usability testing were created to assess the effectiveness of the three purposes of the search tool: search word data, search transcript data, and accept contributed data.

**Reliability**
DEVELOPMENT OF A SEARCH TOOL FOR DIGITAL VIDEOS

To help ensure the search tool would be consistent in searching spoken information from AECT Legends and Legacies Project video interviews, the tool was designed to search unedited AI generated transcript data rather than interpreted (e.g., coding to categories) data. To support increased reliability over time, the tool was designed to allow human processing of transcript data to correct wording errors of spoken information.

Tool Evaluation

An expert programmer in the field of instructional design and technology and an experienced IDT faculty member acting as a subject matter expert evaluated the search tool. From tool evaluation, two major types of tool use conclusions in design and development research (Richey & Klein, 2007, p. 135) were presented to the researcher: conditions that promoted successful use of the tool, and suggested improvements for the tool. The results of the tool evaluation are reported in Chapter 4 and discussed in Chapter 5.
Chapter 4: Results

Introduction

This chapter reports the findings of the small-scale study based upon methods used to gather information during the design and development of the search tool. Analysis for this study focused on AECT Legends and Legacies Project video interview content, intended use of the search tool, and functions of search tool features for the search tool. Interpretation of the results will be discussed in Chapter 5.

Interview Content

This study sought to obtain searchable, transcribed data from AECT Legends and Legacies Project video interviews. The videos ranged in time from 11:22 to 1:08:58, with an average running time of approximately 23 minutes. To determine feasibility of transcription of AECT Legends and Legacies Project video interviews for use in this study, inspection was used to determine: the number of videos, the permission to use data from the videos, and the availability of transcription for the videos.

Quantity of interviews. Of the 50 AECT Legends and Legacies Project audio/video interviews as posted on the AECT Legends and Legacies Project website, 36 of the audio/video interviews were published on one YouTube channel and 14 of the audio/video interviews were published on a second YouTube channel. Outside the scope of this study, it was additionally determined that the seven audio only interviews as embedded on the project’s website were published by the second YouTube channel owner.

Permission for use. Permission was granted to use data for this study from the YouTube channel owner with 36 published AECT Legends and Legacies Project video interviews. As it was believed that the 36 videos would provide sufficient data to determine the effectiveness of
the search tool, permission for data use was not pursued from the other YouTube channel owner. Of the 50 AECT Legends and Legacies Project video interviews as posted on the project’s website, 14 video interviews were excluded from this study due to lack of permission to use.

**Transcription availability.** Though the use of Google’s speech recognition technology, many videos on YouTube were automatically transcribed to include a time code aligning the transcript text with video speech. For this study, transcriptions as generated by YouTube’s speech recognition technology will be referred to as AI (artificial intelligence) Transcriptions. If the video owner of a YouTube video has set the video to transcribe and auto-sync, and the video had transcribed (presenting no technical issues), then a transcription file with an aligned time code could be created for study use. Technical issues preventing transcription may stem from the speech recognition technology not supporting the language used in the video or presented poor sound quality (Google, 2019b; YouTube Help Center, 2019b). Of the 36 AECT Legends and Legacies Project video interviews studied, two of the 36 videos with permission to use did not have AI transcription files available due to technical issues (K. Song, personal communication, March 21, 2019).

The search tool was developed to search spoken information from the 34 AECT Legends and Legacies Project video interviews available to this study as summarized in Table 7.

<table>
<thead>
<tr>
<th>Video Interviews Availability</th>
<th>YouTube Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity of AECT Project video interviews</td>
<td>36</td>
</tr>
<tr>
<td>Permission to use video interviews</td>
<td>Yes</td>
</tr>
</tbody>
</table>

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Transcription alignment. From analysis of viewing AECT Legends and Legacies Project video interviews, it was determined that the synced times codes of the transcriptions, as generated by YouTube, did align to the observed video time codes of spoken words as presented from the AECT Legends and Legacies Project public website (http://aectlegends.org/).

Transcription difference. While this study did not attempt to quantify all differences between AECT Legends and Legacies AI Transcriptions and video interview spoken words, analyses from viewing of video interviews found there were differences in words and phrases significant in meaning to the field of instructional design and technology. For example, upon searching for the word “truck”, or “grocery truck”, a user would not be directed to the location stating “…article 1983 and the grocery Trek…” from AI transcription as shown in the second row of Table 8 below. The analysis of transcription differences contributed to the decision during in-progress study work to add the feature of Contributor Transcription to permit the future correction of interview data, to help prevent subsequent users from missing significant interview information. Examples of these differences are represented in Table 8.

Table 8

Analysis of Words and Phrases: AI Transcription v. Video Analysis

<table>
<thead>
<tr>
<th>Interpreted Interview Context</th>
<th>AI Transcription</th>
<th>Video Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interviewee discussing journal article.</td>
<td>…was called ABC our audio-visual…</td>
<td>… was called AVCR audio_visual…</td>
</tr>
</tbody>
</table>
**Intended Use**

For this study, tool usability tasks were created to assess three areas: (1) the effectiveness of the search tool to permit a user to view transcription data for a digital video interview, (2) the effectiveness of the search tool to permit a user to search keyword data within digital video interviews, and, (3) the effectiveness of the search tool to accept contributed data from a user for search tool administrator review.

**Usability testing participants.** The participants who partook in the usability testing were taking courses in the field of instructional design and technology and were in a range of progress within the graduate program. Two groups of participants were tested, each within a single session on the campus of Virginia Polytechnic Institute and State University in a classroom setting. The duration of the test ranged from 20 minutes to 40 minutes. All participants used personal devices. Workability tasks remained the same between the two groups with the exception of the task of data entry. For task entry, the first group of participants entered random data (e.g., “hello”) at a chosen time code of an interview of their choice to help the researcher determine if the Contributor Transcription functioned effectively, i.e., to allow users to enter and submit data. The second group of participants entered correct transcription data (i.e., what was spoken by the interviewee as determined by observations by the researcher) aligned to a specific interview and specific time code as provided by the researcher during usability testing. Of the
people asked to partake in usability testing, 100% chose to participate. Results of participation for Group 1 and Group 2 are summarized in Table 9.

Table 9

*Usability Testing: Participation Results*

<table>
<thead>
<tr>
<th>Usability Task</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td>6</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Classroom Test (researcher present)</td>
<td>5</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Outside of Classroom Test (researcher absent)</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Participation Percentage</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

*Tool workability to view transcription.* The purpose of Task #1 was to evaluate the effectiveness of the search tool to view transcription data from AECT Legends and Legacies Project video interviews. Task #1 consisted of the following objectives: (1) the participant will view AI Transcription for three interviews as assigned by the researcher, and (2) the participant will view AI Transcription for three interviews as chosen by the participant. For Task #1.1, results found that nine of the 10 participants were each able to view transcription for the three assigned interviews. One of the 10 participants successfully viewed two of the three assigned interviews but gave no indication that the third assigned interview was viewed. For Task #1.2, results found that 10 of the 10 participants were each able to view transcription for the three chosen. The results of tool workability to view transcription are provided in Table 10.

Table 10

*Task #1: Tool Workability to View Transcription*

| Full Transcription Viewed | Participants Obtaining Correct Results |
Tool workability to search keywords. The purpose of Task #2 was to evaluate the effectiveness of the search tool to search word data from AECT Legends and Legacies Project video interviews. Task #2 consisted of the following search objectives: (1) the participant will search three words from all interviews, (2) the participant will search three phrases from all interviews, and (3) the participant will search one word or one phrase from multiple interviews. Testing found that when searching three words from all interviews, eight of the 10 participants were able to search three words from all interviews and report the correct results for each of the three words. Testing found that two of the 10 participants did not report the correct results for one of the three words. When searching three phrases from all interviews, 10 of the 10 participants were able to search three phrases from all interviews and report the correct results for each of the three phrases. Testing found that seven of the 10 participants were able to search a word or a phrase from two interviews at a time. The results of tool workability to search keywords from all interviews and from multiple interviews are provided in Table 11.

Table 11

<table>
<thead>
<tr>
<th>Keywords Searched</th>
<th>Participants Obtaining Correct Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
</tr>
</tbody>
</table>

Note. UTD = Unable to Determine. UTD was reported for data that could not be verified (e.g., non completion, illegible writing).
Tool workability to accept and report data entry. The purpose of Task #3 was to evaluate the effectiveness of the search tool to accept additions or modifications to the transcriptions of AECT Legends and Legacies Project video interviews and report the data entered to the tool administrator. Task #3 consisted of the following objective: the participant will enter data to test if the search tool will accept data entry. Testing found that 10 of the 10 participants were able to enter text data in the Contributor Transcription box, and that 10 of the 10 data entries could be viewed by a tool administrator for review. The results of tool workability to accept and report data entry are provided in Table 12 (see Appendices A.1 and A.2 for images of search tool administrator view).

Table 12

Task #3: Tool Workability to Accept Additions to Transcription and Report Data Entry

<table>
<thead>
<tr>
<th>Addition Accepted and Reported</th>
<th>Participants Obtaining Correct Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Participants Obtaining Correct Results</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Entered data into Contributor box</td>
<td>10</td>
</tr>
<tr>
<td>Data entry reported to tool administrator</td>
<td>10</td>
</tr>
</tbody>
</table>

Note. UTD = Unable to Determine. UTD was reported for data that could not be verified (e.g., non completion, illegible writing).
Summary of tool workability. Results from testing tool workability showed that the tool worked as intended for five of the six tasks assigned. The tool worked as intended for the following tasks: view transcription; search phrases for all interviews; search word or phrase from two interviews; and entering data to save for administrator review. The tool did not work as intended for the task of search three words from all interviews. Following usability test results, the results were examined further to determine possible contributing reasons that may have prevented the search tool from working as intended; resulting in a “No” or an “UTD” (unable to determine). The results from tool workability are discussed in Chapter 5 and summarized in Table 13.

Table 13

Tool Workability Summary

<table>
<thead>
<tr>
<th>Addition Accepted and Reported Workability Summary</th>
<th>Participants Obtaining Correct Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Viewed transcription for 3 assigned interviews</td>
<td>9</td>
</tr>
<tr>
<td>Viewed transcription for 3 chosen interviews</td>
<td>10</td>
</tr>
<tr>
<td>Searched 3 words from all interviews</td>
<td>8</td>
</tr>
<tr>
<td>Searched 3 phrases from all interviews</td>
<td>10</td>
</tr>
<tr>
<td>Searched 1 word or 1 phrase from 2 interviews</td>
<td>7</td>
</tr>
<tr>
<td>Entered data into Contributor box</td>
<td>10</td>
</tr>
</tbody>
</table>

Note. UTD = Unable to Determine. UTD was reported for data that could not be verified due to non-completion.
**Testing Problems.** One participant from Group 1 was not able to use the testing credential provided. Though the participant was given a second set of credentials, the participant still was unable to sign in to the tool in the classroom. The participant was provided a third set of credentials with test directions for testing outside of the classroom. The participant was able to complete the test offsite and testing information was submitted to the researcher following.

**Test revisions.** Based upon the testing feedback from Group 1, the written directions were revised for Group 2 to assist in tool use guidance. Between usability testing sessions of Group 1 and Group 2, the addition of AI Transcription was added to the Contributor Transcription category (see Appendix B.13 to view transcription addition). Based upon the successful testing results of data entry from Group 1, Group 2 was tasked to enter directed text as spoken by an interviewee in the correlating time code text box; whereas Group 1 participants had entered a choice of word/s in a random time code location. Differences between usability testing for Group 1 and Group 2 are summarized in Table 14.

Table 14

*Usability Test Differences: Group 1 vs. Group 2*

<table>
<thead>
<tr>
<th>Context</th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written Directions</td>
<td>-</td>
<td>added numbers to clarify the quantity of answers required</td>
</tr>
<tr>
<td>Contributor Category</td>
<td>-</td>
<td>addition of AI transcription displayed</td>
</tr>
<tr>
<td>Task #3: data entry</td>
<td>• choice of interview</td>
<td>• directed interview</td>
</tr>
<tr>
<td></td>
<td>• choice of text</td>
<td>• directed text</td>
</tr>
</tbody>
</table>

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Search Tool Features

As the intended use for the search tool was to provide users the ability to perform a more comprehensive and flexible search for AECT Legends and Legacies Project video interviews, the function of search tool features was analyzed. Search tool features were assessed from both in-progress work and usability testing. During usability testing, sign-in feature was not activated and testing participants were provided temporary credentials to sign in for tool use. Activated outside of this study, a future tool user would be directed to email an acting administrator to request contributor privileges (i.e., username, password). Findings of search tool features were categorized into the following three user roles: administrator, general user, and contributor user.

The administrator had the ability to:

- sign in to use the search tool,
- monitor user access,
- monitor tool management systems,
- suggested transcriptions,
- and approve or reject suggested transcription.

A general user had the ability to:

- use the search tool,
- choose to search single, multiple, or all interviews for keyword search,
- were able to choose to view a full transcription for a single interview,
- search keywords from single, multiple, or all interview,
DEVELOPMENT OF A SEARCH TOOL FOR DIGITAL VIDEOS

- view category titles on the Search Results page,
- locate where to add/modify transcription,
- view pending submission waiting administrative approval,
- link to the AECT Legends and Legacies Project website,
- link to playback position of video content on YouTube,
- use the search tool through the tool web URL,
- view suggest transcription invitation,
- and register as a Contributor user.

A contributor had the ability to:

- perform the same functions as General users,
- sign in to use the search tool,
- and suggest transcription changes.

To avoid distraction to the reader (VandenBos, 2010, p. 38), images of search tool features have been placed in the appendix of this report (See Appendices B.1 through B.11 for images of search tool features).

To verify the tool worked as intended, the tool was assessed by: the researcher during in-progress work; the programmer as consulted; and participants during usability testing. Usability participants were not asked to test the following: administrator access, general access, approval of data entry, link to AECT Legends and Legacies Project website, or link to playback position of video content. Reasons for features exemption from usability testing were: administrator role, verified working links, and non-applicability to assess workability of keyword search,
transcription view, and data entry. The results for verification of functioning search tool features are summarized in Table 15.

Table 15

*Results: Search Tool Functions*

<table>
<thead>
<tr>
<th>Function Results</th>
<th>Researcher</th>
<th>Verified by:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Expert Programmer</td>
<td>Usability Participant</td>
<td></td>
</tr>
<tr>
<td>Access: Administrator</td>
<td>Yes</td>
<td>Yes</td>
<td>Not relevant</td>
<td></td>
</tr>
<tr>
<td>Access: Contributor</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Access: General</td>
<td>Yes</td>
<td>Yes</td>
<td>Not relevant</td>
<td></td>
</tr>
<tr>
<td>Search/View Choice</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Search Keyword</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>View Transcription</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Results Categories</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Contributor Invitation</td>
<td>Yes</td>
<td>Yes</td>
<td>Not relevant</td>
<td></td>
</tr>
<tr>
<td>User Registration</td>
<td>The feature for user registration was not activated during this study.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suggest Transcription</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Approve Data Entry</td>
<td>Yes</td>
<td>Yes</td>
<td>Not relevant</td>
<td></td>
</tr>
<tr>
<td>AECT Project Website</td>
<td>Yes</td>
<td>Yes</td>
<td>Not relevant</td>
<td></td>
</tr>
<tr>
<td>Video Time Code</td>
<td>Yes</td>
<td>Yes</td>
<td>Not relevant</td>
<td></td>
</tr>
<tr>
<td>Search Tool Website</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>
Chapter 5: Discussion

With design and development of tool studies, researchers usually have an interest in either the tool design and development process or the tool use (Richey & Klein, 2007, p. 132). This small-scale study gave focus to tool use. In tool-use studies, researchers draw conclusions for conditions that promote successful use of the tool, and suggested improvements for the tool (Richey & Klein, 2007, p. 135). It is recommended to describe how tool research findings can be used to expand the knowledge base of the field, determine the generalizability of the research findings, and form conclusions from tool research to relay lessons learned (Richey & Klein, 2007, p. 132, 143). This chapter will discuss interview content results, intended use results, search tool feature results, contributions to the field of IDT, and how the results can be used to expand the knowledge base and be generalized. This chapter will close with lesson learned from the study and limitations to the study.

Interview Content

Permission To Use. Of the 50 AECT Legends and Legacies Project video interviews as posted on the AECT Project website, 14 video interviews were excluded from this study due to lack of permission to use. It is likely that permissions may not have been required for the video interviews for this study under fair use for the following reasons: the use was for nonprofit educational purposes; the published works are factual; and the use has purpose to add new meaning (YouTube, 2019) with the correction of AI transcription to accurately represent spoken words. However, as it was believed that the sample of 36 videos would provide sufficient data to determine the effectiveness of the tool, permission was not pursued from the other YouTube channel owner.
Transcription availability. Of the 36 AECT Legends and Legacies Project video interviews with permission to use, two of those videos did not have transcription files available due to technical issues (K. Song, personal communication, March 21, 2019). It was found that there are reasons that a video may not generate an automatic caption such as: the language or speech used in the video is not supported by automatic captions, the video presented poor sound quality, there are multiple speakers with speech overlapping, the video is too long, or there is a long period of silence at the beginning of the video (YouTube Help Center, 2019b). From observations, it is likely that length was not an issue for either of the two videos as the videos had recording times of 29:21 and 50:15; with other project videos having longer duration with transcription available. It is also likely that a period of silence did not contribute to technical issues as observations found there was no significant period of silence at the beginning of either of the videos.

Intended Use

Results from usability testing found that three tasks resulted in a “No” or an “UTD” (unable to determine) for some of the participants. An exploration of the findings determined user error for all occurrences. For Task #1 (view three assigned interview transcriptions), though one participant searched three interviews, only two of the interviews searched had been assigned. For Task #2.1 (search three words from all interviews), two participants searched a different form of the word, e.g. trend instead of trends, yielding an incorrect number of search results. For Task #2.3 (search from two interviews at the same time), three participants searched from a single interview rather than from two different interviews at the same time. Descriptions of user error are summarized in Table 16.

Table 16
**Usability Testing: User Error**

<table>
<thead>
<tr>
<th>Usability Test Task</th>
<th>Test Directions</th>
<th>Error Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not Followed</td>
<td>Followed</td>
</tr>
<tr>
<td>Task 1: Viewed transcription for three</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>assigned interviews.</td>
<td></td>
<td>One participant searched two interviews rather than three interviews.</td>
</tr>
<tr>
<td>Task 2: Searched three words from all</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>interviews.</td>
<td></td>
<td>Two participants searched a different form of the word, yielding an incorrect number of search results.</td>
</tr>
<tr>
<td>Task 2: Search one word or one phrase</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>from two interviews at the same time.</td>
<td></td>
<td>Three participants searched from one interview rather than from two interviews.</td>
</tr>
</tbody>
</table>

**Usability Test Problems**

A single participant experienced a problem when attempting to sign in with testing credentials (i.e., username, password) as provided by the researching during Group 1 usability testing. Following the testing of Group 1 and prior to the testing of Group 2, the researcher consulted with the expert programmer regarding the testing problem. Following usability testing in which the only change made was the use of a new set of credentials, the participant was able
to sign in to the tool. The participant then completed all usability tasks. Following completion of test, the participant stated that the same personal device was used for the third attempt permitting test completion. The reason for the participant testing problem during Group 1 testing was not determined.

**Search Tool Features**

During in-progress work, the researcher and the expert programmer verified features of the search tool. Usability test participants verified features of the search tool to permit users to view transcription, search keywords, and enter data. Final tool evaluation by the experts mentioned in Chapter 3 determined that the features of the search tool functioned successfully to improve search capabilities to allow users to search information significant to the field of instructional design and technology as found within AECT Legends and Legacies Project video interviews.

**Design Concerns.** During this study, approaches were taken to address research design concerns of validity, anticipated problems, and causal inferences (Refer to Table 3). To address validity, the use of AI generated transcription allowed users to search data as spoken; consultation with the expert programmer ensured features functioned for tool use; and the creation of prototypes for researcher use in multiple roles (user, contributor, administrator) as well as for participant use in usability testing allowed problems to be identified to drive tool revisions. To address anticipated problems, usability testing tasks were created for independent tool use to provide feedback regarding tool workability to permit a user to view transcriptions, search keywords, and enter data. Of the technology problems anticipated during the planning for the study, loss of Internet connectivity and power did occur periodically, but not at a level to significantly affect study progress. To address causal inferences, usability testing tasks were
created to determine the tool workability and provided participants an opportunity to communicate feedback to the researcher regarding suggested changes for the tool. Based upon in-progress data from researcher use, collected data from participant use, suggestions from the subject matter expert, and consultation with the expert programmer, design changes were made to the tool. In-progress revision occurred across three tool versions as summarized in Table 17.

Table 17

**In-Progress Search Tool Versions: Design Revisions**

<table>
<thead>
<tr>
<th>Revisions</th>
<th>Version 1</th>
<th>Version 2</th>
<th>Version 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interview arrangement</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category titles</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>View vs. search options arrangement</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Added administrative approval notification</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improved search guidance to minimize user confusion</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Color/contrast change</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Search option for multiple interviews: added check box</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Notification to user upon no results to verify keyword entry</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ability for user to continue same search upon keyword change</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Search with punctuation updated</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Addition of AI Transcription in Contributor Transcription Category</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

**Tool Evaluation.** From tool evaluations, conclusions were drawn for conditions that promoted successful use of the tool, and suggested improvements for the tool. Evaluation from the expert programmer determined that the features and functions of the search tool successfully
DEVELOPMENT OF A SEARCH TOOL FOR DIGITAL VIDEOS

worked to permit users to view transcriptions, search keywords, and enter data. The expert programmer also determined that the search tool successfully worked to allow users to navigate to playback position within a video interview by time code information as found on the search results page. Evaluation from the subject matter expert determined that the search tool addressed the research problem by extracting information from digital interview videos to allow users search capabilities of spoken information significant to the field of instructional design and technology. The subject matter expert also determined that the AI generated transcription represented AECT Legends and Legacies Project video interview spoken words with sufficient accuracy to allow users to effectively search information significant to the field of instructional design and technology. As the tool evolved, it was decided to include AI transcription within the Contributor Transcription region to provide a more complete, in-progress processed transcription. Upon consultation with the expert programmer, a third version of the tool was developed to include AI transcription within the Contributor Transcription category and used in Group 2 usability testing (see Appendix B.13 to view transcription addition). Following final revisions to the search tool, it was determined that the 3rd version of tool addressed the research problem and provided a more comprehensive and flexible search of spoken information within AECT Legends and Legacies Project video interviews.

Expansion of the Knowledge Base

It is anticipated that search tool use could expand the knowledge base by facilitating users in search, find, and the discovery of content, significant to the field of instructional design and technology. Additionally, it is anticipated that users may choose to contribute and that use of the Contributor Transcription feature may increase data accuracy of spoken information over time, which would further contribute to the knowledge base. It is possible that Contributor
Transcription feature may support the future direction of the AECT Legends and Legacies Project in that the project states dependence upon input from the instructional design and technology community to help contribute (e.g., suggest transcription) to the AECT repository (AECT Legends and Legacies, 2018a). Additionally, use of the search tool may facilitate users with search, find, and discovery of content within AECT Legends and Legacies Project video interviews, which may introduce users to instructional design and technology boundaries to better understand, as suggested by Rita Richey: our practice base, our theory base, who we are, and who we are not (Larson, 2012, 29:58-30:16).

**Generalization of the Findings**

A large amount of design and development research is exploratory in nature and may not produce widely generalized answers to other settings (Richey & Klein, 2007, p. 131) as it can be context-bound such as with the study of a specific tool (Klein, 2014, p. 2). However, from this study, it is hopeful that the design and development processes and procedures as described in this study may provide direction to others to assist them in creating an online search tool for digital recordings or learning how to generate transcription files of spoken information through the use of current speech recognition technology offerings to increase availability of data for research or learners.

**Availability.** It is likely that the extraction of spoken information from AECT Legends and Legacies Project video interviews (from both AI transcription and contributor transcriptions) may permit the text data to be read by search engines (e.g., Google). Additionally, by linking the search tool website to an already indexed page (e.g., YouTube, AECT Legends and Legacies Project website), the extracted text data from within the interviews may have an increased ability
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to be crawled and indexed, which may expand the availability of AECT Legends and Legacies Project content to a wider audience.

**Indexing.** The indexing of instructional videos has become important with the increased use of recorded audiovisual material in university courses (Haubold & Kender, 2004), and it is suggested to organize information through indexing to support the accessibility of oral history interviews (Oral History Association, 2009). When working with transcripts, it is recommended to extract significant text during indexing as embedded metadata must be extracted into external systems (Haubold & Kender, 2004; Riley, 2017, p. 15). It is possible that accurate interview data from suggestions as permitted by the Contributor Transcription search tool feature could facilitate organizing information and contribute to future indexing of AECT Legends and Legacies Project video interviews.

**Learners.** As captioned media reduces the barriers to communication access (Virginia Tech, 2019), a corrected transcript as offered by the search tool for AECT Legends and Legends Project video interviews could be used to correct video interview captions to increase communication access for all users. When viewing AECT Legends and Legacies Project video interviews for learning, users may be served more effectively with use of transcripts and captioned media (Linder 2016; University of Colorado Boulder, 2018c). In a reported study conducted by Oregon State University, data was collected from 2,124 student participants from fifteen private and public universities and colleges. The study showed that both transcripts and closed captions were being used in a variety of ways to facilitate student learning – to include use by students that did not require either for accommodation need. The researchers suggested opportunities based upon the findings that included ensuring students know about transcript and caption options and know how to access the support. The researchers also suggested to inform
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students of how to use transcripts and closed captioning as learning aids to assist with accuracy, comprehension, engagement, and retention of information. The study reported that 70.8% of respondents that did not have hearing difficulties used closed captions at least some of the time. (Linder, 2016).

**Across disciplines.** As all disciplines aim to apply past knowledge to new findings and examinations, it is likely that the methods used in this study and a subsequently modified search tool could be applied to any discipline for the purpose of extracting data from within recordings to promote the finding, discovery, and application of significant information.

**Lessons Learned**

In design and development research, it is important for a researcher to collect in-progress data to help focus on difficulties that arose during a project (Richey & Klein, 2007, p. 103). The wide range of findings that can come from tool design and development studies provide a source of information that can inform design and development practice (Richey & Klein, 2007, p. 128). Product and tool research can provide direction to others, with lessons learned applied by those who may be addressing similar design and development studies (Klein, 2014, p. 2).

**Research shift.** Initially, through methods of coding, focus was placed on reviewing the data, making sense of the data, and organizing the data into categories (Creswell, 2014, p. 234). From viewing and listening to AECT Legends and Legacies Project video interviews, it was discovered that there was information significant to the field of instructional design and technology that if directed to, could provide users with additional information than what existed by text on the project website, aectlegends.org. Additional information within interviews included content that could be organized into topic categories. Early in this study, focus was given to analyzing video interview content through a process of qualitative coding to identify
emerging categories a process of content analysis began to with aim to describe the project video interviews as a written source following the extraction of conversations within the video to allocate the qualitative content into emerging categories and interpret the outcome quantitatively (Creswell, 2018; Payne & Payne, 2004, & Saldana, 2016). Through a process of descriptive coding, printed AI generated transcription with aligned time codes were marked to identify descriptive metadata significant to the field of instructional design and technology. Plans were in place to both quantify and interpret the extraction of conversation. As descriptive metadata emerged, words and sentences were segmented and identified as topic codes. Related topics received an assigned descriptive word or phrase and were further identified as category codes. Interpreted topic codes included: degrees, early influences, career path, stimulus to professional growth, research focus, organizations, publications, contributions/accomplishments, future plans, trends, words of advice and field outlook. Interpreted category codes included: interviewer, interviewee, background, field focus, field contributions, and field advancement.

During the study process, it was determined that a search tool, aligned to the purpose for this study, should be designed and developed around unedited data (e.g., AI generated transcriptions with time codes) rather than interpreted data (e.g., coding to identify topics and categories) to allow a users to search spoken (not interpreted) information from within AECT Legends and Legacies Project video interviews.

Limitations to the Study

One limitation to this study is that the AI transcriptions, as generated by YouTube, did not represent spoken information within video interviews with 100% accuracy. Another limitation to this study is that though logical generalizations can be made regarding the functionality of the tool, the same cannot be said about reactions to the use of the tool. Although
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the tool consistently functioned as intended, the purposeful sampling used during usability testing in this study does not permit broad generalization regarding user reactions to the tool (Patton, 1990, p. 175).
References


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Appendix A: Usability Testing

A.1 Usability Testing: Informed Consent

Dear Participant,

Thank you for agreeing to test the usability of my research tool.

During this test, you will assess 3 features of the search tool: view, search, and entry.

For this test, you will need:

• Access to: https://www.educate.vt.edu/aect_legend/ (the search tool)
• Sign-in credentials (provided by the researcher)
• Paper test (to write on)

Before you begin this test, please read the following description of the study. By signing in to the search tool, you indicate that you have read the description of the study, and that you give your consent to participate in the study.

Test on Usability of AECT Legends and Legacies Search Tool

This study is collecting data for a design and development study to create a more comprehensive search tool for AECT Legends and Legacies Project video interviews. This study has been approved by Virginia Tech’s IRB. Your decision to take part in this test or to not take part in this test will not affect your standing at Virginia Tech. There are no anticipated benefits to you from participating in this test.

If you choose to participate, you will be asked to complete tasks on an web-based platform, which should take approximately 30 minutes. Personal information is not used during the testing process. Following the test, you will have the option to email the researcher to offer feedback about the search tool for tool revision purposes.

Your participation in this test is completely voluntary. You may choose to leave the test at any time. If you complete the test, your answers will be reported directly to the researcher for the collection of data to assess search tool effectiveness.

The researcher has attempted to minimize risk to you as a usability test participant. All data collected will be used for the study and will be kept in a confidential environment.

Thank you for giving your time to participate in the Test on Usability of AECT Legends and Legacies Search Tool.

Annemarie K. Radke
Researcher; PhD Candidate, Instructional Design & Technology
Virginia Tech
A.2 Usability Testing: Test

---

**Access the Search Tool**

**Directions:**

1. **Open the search tool by going to:** https://www.educate.vt.edu/aect_legend/

2. **From the homepage, Sign In (top right) with the following information:**
   
   Username: (obtain from researcher)
   
   Password: (obtain from researcher)

3. **Complete Tasks #1-3. A red arrow is placed in areas where you will write information.**

   *You can ask questions at any time during this test.*

---

**TASK 1 - View Transcription**

**Objective:**
The user will view a machine generated (AI) transcription for AECT Legends and Legacies Project video interviews.

**Directions:**
Using the search tool, please complete Tasks 1.1 and 1.2.

**Task 1.1**

Use the search tool to **view AI Transcription for 3 interviews as assigned.**

The list has been provided to you. Raise your hand if you do not have a list.

**Steps:**

1. **go to the search tool homepage by selecting “search” in the top navigation bar**
2. **select View full transcription for an interview (the 3rd option)**
3. **click on the text box to open a dropdown menu (default will be on Appelman)**
4. **select one of your assigned names, then click the “SEARCH” button**
   
   ✓ write the name of the interview in the Task 1.1. Question section below
5. **view the AI Transcription (column 5) on the Search Results page**
   
   ✓ you should see segments of words to the right of time codes
   
   ✓ circle your answer in the Task 1.1. Question section
6. **go back Step 1 and repeat the process for your remaining 2 assigned interviews**
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**Task 1.1 Question**

Were you able to view the AI Transcription for each of the assigned interviews?

<table>
<thead>
<tr>
<th>Interview (write last name from provided list)</th>
<th>Viewed AI Transcription</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>yes / no</td>
</tr>
<tr>
<td></td>
<td>yes / no</td>
</tr>
<tr>
<td></td>
<td>yes / no</td>
</tr>
</tbody>
</table>

**Task 1.2**

Use the search tool to view AI Transcription for 3 interviews of your choice.

**Steps:** (you will use the same steps as in Task 1.1)
1. go to the search tool homepage by selecting “search” in the top navigation bar
2. select **View full transcription for an interview** (the 3\textsuperscript{rd} option)
3. click on the text box to open the dropdown menu
4. select one of your chosen names, then click the “SEARCH” button
   - ✓ write the name of the interview in the Task 1.2. Question section below
5. view the AI Transcription on the Search Results page
   - ✓ you should see segments of words to the right of time codes
   - ✓ circle your answer in the Task 1.2. Question section
6. go back Step 1 and repeat the process for your remaining 2 chosen interviews

**Task 1.2 Question**

Were you able to view the AI Transcription for each of the chosen interviews?

<table>
<thead>
<tr>
<th>Interviews (write last name of choice)</th>
<th>Viewed AI Transcription</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ________________________________</td>
<td>yes / no</td>
</tr>
<tr>
<td>2. ________________________________</td>
<td>yes / no</td>
</tr>
<tr>
<td>3. ________________________________</td>
<td>yes / no</td>
</tr>
</tbody>
</table>
TASK 2 – Search Keyword

Objective:
The user will search keywords from multiple interviews.

Directions:
Using the search tool, please complete Tasks 2.1, 2.2, and 2.3.

Task 2.1
Use the search tool to search 3 words from all interviews.
You use the following word bank to choose 3 words.

- artifacts
- associations
- behavior
- camera
- cognitive
- computer
- construct
- design
- develop
- digital
- farm
- film
- future
- grocery
- history
- journal
- memory
- military
- models
- pencil
- proud
- reading
- stone
- systems
- television
- trends
- truck

Steps:
1. chose 3 words from the word bank above
   ✓ write the word in the Task 2.1. Question section below
2. go to the search tool homepage by selecting “search” in the top navigation bar
3. select Search all interviews by keyword(s) (the 1st option)
4. locate the text box that states Enter keyword(s)
5. type your first chosen word into the textbox, then click the “SEARCH” button
6. identify how many total results were reported on the Search Results page
   ✓ write the number in the Task 2.1. Question section below

   Include all reports on the page: The tool will also search for a sequence of letters within a word. For example, if you search for the word “media”, the results page will display results for words containing the sequence m-e-d-i-a.
   E.g., remediate. If this occurs during your search, it’s OK. Count the results.

7. go back Step 1 and repeat the process for your remaining 2 words
**Task 2.1 Question**

Did your search of a word report findings on the Search Results page? If so, how many results were reported?

*Need Help? On the Search Results page, find the first column ("No.") and then view the last row in that first column. Report the number. An example has been provided below.*

<table>
<thead>
<tr>
<th>Word Choice (write word)</th>
<th>Search Results</th>
<th># of results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ______________________</td>
<td>yes / no ______</td>
<td></td>
</tr>
<tr>
<td>2. ______________________</td>
<td>yes / no ______</td>
<td></td>
</tr>
<tr>
<td>3. ______________________</td>
<td>yes / no ______</td>
<td></td>
</tr>
</tbody>
</table>

*Example: “street” yes 6*

**Task 2.2**

Use the search tool to **search 3 phrases from all interviews**.

You use the following word bank to choose 3 phrases.

- audio visual
- career path
- computer science
- distance education
- distance learning
- educational technology
- graduate students
- greatest accomplishment
- instructional design
- instructional media
- message design
- personal interests
- professional associations
- professional growth
- online learning
- working memory

**Steps:**

1. chose 3 words from the word bank above
   - write the word in the Task 2.2. Question section below
2. go to the search tool homepage by selecting “search” in the top navigation bar
3. select **Search all interviews by keyword(s)** (the 1st option)
4. locate the text box that states **Enter keyword(s)**
5. type your first chosen word into the textbox, then click the “SEARCH” button
6. identify how many total results were reported on the Search Results page
   - write the number in the Task 2.2. Question section below
   - as with Task 2.1, include all results
7. go back Step 1 and repeat the process for your remaining 2 phrases
## Task 2.2 Question

Did your search of a phrase report findings on the Search Results page? If so, how many results were reported?

<table>
<thead>
<tr>
<th>Word Phrase Choice (write phrase)</th>
<th>(circle answers)</th>
<th>(write numbers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. _____________________________</td>
<td>yes / no</td>
<td>_____</td>
</tr>
<tr>
<td>2. _____________________________</td>
<td>yes / no</td>
<td>_____</td>
</tr>
<tr>
<td>3. _____________________________</td>
<td>yes / no</td>
<td>_____</td>
</tr>
</tbody>
</table>

*Example:* “third street” yes 1

## Task 2.3

Use the search tool to either (choose 1 of the below)

- search for 1 word from 2 interviews (at the same time)
- search for 1 phrase from 2 interviews (at the same time)

**Steps:**
1. go to the search tool homepage by selecting “search” in the top navigation bar
2. select *Search single or multiple interviews by keyword(s)* (the 2\textsuperscript{nd} option)
3. navigate to the Select Interviews box with list of interviewee names
4. select 2 interviews
5. locate the text box that states “Enter keyword(s)”
6. type your chosen word or chosen phrase into the textbox on the screen
7. click the “SEARCH” button below the text box
8. identify which interviews you selected and how many total results were reported on the Search Results page

## Task 2.3 Question 1

Which interviews did you select? *(enter interview last names)*

Interviews: 1. ____________________________ 2. ____________________________
Task 2.3 Question 1

Were you able to see any results on the Search Page?

<table>
<thead>
<tr>
<th>Word or Phrase Choice</th>
<th>Search Results?</th>
<th># of results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>yes / no</td>
<td></td>
</tr>
</tbody>
</table>

TASK 3 Enter Data

Objective:
The user will enter data into the AECT Legends and Legacies tool.

Directions:
Using the search tool, complete Task 3.1 below.

Task 3.1
Use the search tool to enter corrected data.

Without human correction, machine transcription reports with error. The AI Transcription segments that you have seen during this test do not always accurately represent the actual spoken words of interviewees.

You will use the search tool to enter corrected data to test to see if this tool will accept your entry. For this task, refer to the following example.

Example:

Interviewee: Richey, Rita
Time Code: 00:06:46
AI Transcription Segment: “edited on Robert Kanye Oh on Gagne well”
Error Word(s): Kanye
Correct Word(s): Gagne

Type in Box:  edited on Robert Gagne Oh on Gagne well
Steps:
1. refer to the interview information given to you by the researcher
2. go to the search tool homepage by selecting “search” in the top navigation bar
3. select View full transcription for an interview (the 3rd option)
4. click on the text box (default Appelman, Robert) to open a dropdown menu
5. select the Interviewee name (as assigned on the paper above)
6. click the “SEARCH” button below the text box
7. view the AI Transcription (column 5) on the Search Results page
   ✓ you should see segments of words to the right of associated time codes
8. navigate to the Time Code (as assigned on the paper above)
9. enter the correct data by:
   a. navigating to the Contributor Transcription column for the given time code
   b. click the Add/Modify Transcription” button
   c. refer to the wording in the AI Transcription Segment; then make the correction
      in the Contributor text box by typing all segment wording with the Correct Word(s). Refer to the following example:

   Example:
   |
   AI Transcription:  I lived in iteybo  (correct word: Idaho)
   |
   Corrected Transcription:  I lived in Idaho (complete entry)  Well done!
   |
   Idaho (incomplete entry)  Oops!

   d. click the Submit button (you will be directed back to the search results page and
      your submission will be in pending status; there is nothing more to do)
10. sign-out (top right) of the AECT Legends and Legacies tool

Submit Test

To complete your test, please submit the below items to the researcher:

✓ completed test paper
✓ all paperwork used during testing (e.g., list of interviews)

Thank you very much for your time.

Usability Experience?

How could you have had a better experience with the tool?
Your feedback will provide valuable information for tool revision. Please take a moment to
email your feedback to akradke@vt.edu. Your communication will be kept confidential and
your name will not be shared.
A.3 Usability Testing: Group 1 Choice-Entry Results

<table>
<thead>
<tr>
<th>No.</th>
<th>Interviewee</th>
<th>Time</th>
<th>AI Transcription</th>
<th>Contributor Transcription</th>
<th>Suggestion Time</th>
<th>Admin Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Richard Mayer</td>
<td>00:00:47</td>
<td>pictures and how we can help them learn</td>
<td>Good.</td>
<td>04-03-2019</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>00:33:07</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Robert Appelman</td>
<td>00:00:03</td>
<td>my name is Bob Appelman I go by dr. Bob</td>
<td>hello dear, good luck and wish u the best.</td>
<td>04-02-2019</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15:44:20</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Xiaoqing GU</td>
<td>00:00:04</td>
<td>I'm Mike Specter and I'm at the East</td>
<td>Hello, this is cool!</td>
<td>04-02-2019</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15:43:50</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>John K. Burton</td>
<td>00:12:53</td>
<td>tell me how much money I have and I'll</td>
<td>You're doing great!</td>
<td>04-02-2019</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15:38:40</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Mike Hannafin</td>
<td>00:00:06</td>
<td>at the 2012 convention I'm a UCT and</td>
<td>hey</td>
<td>04-02-2019</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15:38:31</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Robert Appelman</td>
<td>00:20:10</td>
<td>where yeah where did message design go i</td>
<td>Thanks a lot</td>
<td>04-02-2019</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15:35:22</td>
<td></td>
</tr>
</tbody>
</table>

A.4 Usability Testing: Group 2 Directed Entries

Interviewee: Clark, Richard  
Time Code: 00:27:56  
AI Transcription Segment: “contacts and we forget that way too”  
Error Word(s): contacts  
Correct Word(s): contexts  
Type in Box: contexts and we forget that way too

Interviewee: Mayer, Richard  
Time Code: 00:06:35  
AI Transcription Segment: “Sable's that guide meaningful learning”  
Error Word(s): Sable’s  
Correct Word(s): principles  
Type in Box: principles that guide meaningful learning
Interviewee: Peck, Kyle
Time Code: 00:06:33
AI Transcription Segment: “John Nesbitt and chapter 4 was called”
Error Word(s): Nesbitt
Correct Word(s): Naisbitt
Type in Box: John Naisbitt and chapter 4 was called

Interviewee: Richey, Rita
Time Code: 00:02:14
AI Transcription Segment: “what it stands for so when it’s tippy”
Error Word(s): when it’s tippy
Correct Word(s): IBSTPI
Type in Box: what it stands for so when IBSTPI

Interviewee: Smaldino, Sharon
Time Code: 00:00:06
AI Transcription Segment: “introduce yourself I’m sure it’s valino”
Error Word(s): sure it’s valino
Correct Word(s): Sharon Smaldino
Type in Box: introduce yourself I’m Sharon Smaldino

A.5 Usability Testing: Group 2 Directed-Entry Results

<table>
<thead>
<tr>
<th>No.</th>
<th>Interviewee</th>
<th>Time</th>
<th>AI Transcription</th>
<th>Contributor Transcription</th>
<th>Suggestion Time</th>
<th>Admin Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Richard Clark</td>
<td>00:27:56</td>
<td>contacts and we forget that way too</td>
<td>contexts and we forget that way too</td>
<td>04-06-2019 17:17:34</td>
<td>REJECT</td>
</tr>
<tr>
<td>2</td>
<td>Sharon Smaldino</td>
<td>00:00:06</td>
<td>introduce yourself I’m sure it’s valino</td>
<td>introduce yourself I’m Sharon Smaldino</td>
<td>04-06-2019 17:16:29</td>
<td>REJECT</td>
</tr>
<tr>
<td>3</td>
<td>Kyle Peck</td>
<td>00:06:33</td>
<td>John Nesbitt and chapter 4 was called</td>
<td>John Naisbitt and chapter 4 was called</td>
<td>04-06-2019 17:16:16</td>
<td>REJECT</td>
</tr>
<tr>
<td>4</td>
<td>Richard Mayer</td>
<td>00:06:35</td>
<td>Sable’s that guide meaningful learning</td>
<td>principles that guide meaningful learning</td>
<td>04-06-2019 17:15:20</td>
<td>APPROVE</td>
</tr>
</tbody>
</table>
Appendix B: Search Tool Features

B.1 Search Tool Features: Sign in Location

B.2 Search Tool Features: Search Interview(s) or View Transcription
DEVELOPMENT OF A SEARCH TOOL FOR DIGITAL VIDEOS

B.3 Search Tool Features: Search all Interviews

- Search all interviews by keyword(s).
- Search single or multiple interviews by keyword(s).
- View full transcription for an interview.

Enter keyword(s) to search.

Enter keyword(s).

SEARCH

B.4 Search Tool Features: Search Single or Multiple Interviews

- Search all interviews by keyword(s).
- Search single or multiple interviews by keyword(s).
- View full transcription for an interview.

Select one or more interviews. Then, enter keyword(s) to search.

- Appelman, Robert
- Burns, Bill
- Burton, John
- Clark, Richard
- Cornell, Richard
- Davies, Ivor
- Fleming, Malcolm
- Gagne, Robert
- Gu, Xiaqing
- Hannafin, Mike
- Harris, Phil
- Herring, Mary
- Jonassen, Dave
- Kaufman, Roger
- Kemp, Jerrold
- Kinsinger, Addie
- Mayer, Richard
- McIsaac, Marina
- Merrill, David
- Mizrall, Al
- Molenda, Mike
- Moore, Mike
- Morgan, Roy
- Peck, Kyle
- Perschitte, Kay
- Reeves, Thomas
- Reiser, Robert
- Ren, Youqun
- Richey, Rita
- Sherman, Mendel
- Smaldino, Sharon
- Spector, Mike
- Wittich, Walt
- Yam, Leo

Enter keyword(s).

SEARCH
B.5 Search Tool Features: View Transcription

B.6 Search Tool Features: Category Titles

B.7 Search Tool Features: Add/Modify Transcription Location
### B.8 Search Tool Features: Suggest Transcription for Transcription ID #14 00:02:11

<table>
<thead>
<tr>
<th>ID</th>
<th>Transcriber</th>
<th>Time</th>
<th>Suggestion</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>Rita Richey</td>
<td>00:02:11</td>
<td>instruction did an 8 because I remember</td>
<td>ADD/modify transcription</td>
</tr>
<tr>
<td>43</td>
<td>Rita Richey</td>
<td>00:02:14</td>
<td>what it stands for so when it's tippy</td>
<td>ADD/modify transcription</td>
</tr>
<tr>
<td>44</td>
<td>Rita Richey</td>
<td>00:02:19</td>
<td>started it had membership specifically</td>
<td>ADD/modify transcription</td>
</tr>
<tr>
<td>45</td>
<td>Rita Richey</td>
<td>00:02:22</td>
<td>from people in the business community</td>
<td>ADD/modify transcription</td>
</tr>
<tr>
<td>46</td>
<td>Rita Richey</td>
<td>00:02:26</td>
<td>large corporations usually consultants</td>
<td>ADD/modify transcription</td>
</tr>
<tr>
<td>47</td>
<td>Rita Richey</td>
<td>00:02:29</td>
<td>and then higher ed and there were sort</td>
<td>ADD/modify transcription</td>
</tr>
<tr>
<td>48</td>
<td>Rita Richey</td>
<td>00:02:33</td>
<td>of official representatives from each of</td>
<td>ADD/modify transcription</td>
</tr>
<tr>
<td>49</td>
<td>Rita Richey</td>
<td>00:02:35</td>
<td>these areas so I was asked to be the</td>
<td>ADD/modify transcription</td>
</tr>
<tr>
<td>50</td>
<td>Rita Richey</td>
<td>00:02:38</td>
<td>instruction I get an A because I remember</td>
<td>Suggest transcription</td>
</tr>
</tbody>
</table>

### B.9 Search Tool Features: Pending Transcription Contributor View

<table>
<thead>
<tr>
<th>ID</th>
<th>Transcriber</th>
<th>Time</th>
<th>Suggestion</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>Rita Richey</td>
<td>00:02:08</td>
<td>standards for training performance and</td>
<td>ADD/modify transcription</td>
</tr>
<tr>
<td>42</td>
<td>Rita Richey</td>
<td>00:02:11</td>
<td>instruction did an 8 because I remember</td>
<td>Pending [instruction I get an A because I remember]</td>
</tr>
<tr>
<td>43</td>
<td>Rita Richey</td>
<td>00:02:14</td>
<td>what it stands for so when it's tippy</td>
<td>Pending [what it stands for so when IBSTPI]</td>
</tr>
<tr>
<td>44</td>
<td>Rita Richey</td>
<td>00:02:19</td>
<td>started it had membership specifically</td>
<td>ADD/modify transcription</td>
</tr>
</tbody>
</table>

### B.10 Search Tool Features: Pending Transcription User View

<table>
<thead>
<tr>
<th>ID</th>
<th>Transcriber</th>
<th>Time</th>
<th>Suggestion</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>Rita Richey</td>
<td>00:02:08</td>
<td>standards for training performance and</td>
<td>ADD/modify transcription</td>
</tr>
<tr>
<td>42</td>
<td>Rita Richey</td>
<td>00:02:11</td>
<td>instruction did an 8 because I remember</td>
<td>Pending [instruction I get an A because I remember]</td>
</tr>
<tr>
<td>43</td>
<td>Rita Richey</td>
<td>00:02:14</td>
<td>what it stands for so when it's tippy</td>
<td>Pending [what it stands for so when IBSTPI]</td>
</tr>
<tr>
<td>44</td>
<td>Rita Richey</td>
<td>00:02:19</td>
<td>started it had membership specifically</td>
<td></td>
</tr>
</tbody>
</table>
B.11 Search Tool Features: New Suggestion Alert Administrator View

<table>
<thead>
<tr>
<th>No.</th>
<th>Interviewee</th>
<th>Time</th>
<th>AI Transcription</th>
<th>Contributor Transcription</th>
<th>Suggestion Time</th>
<th>Admin Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rita Richey</td>
<td>00:02:14</td>
<td>what it stands for so when it's tippy</td>
<td>what it stands for so when IBSTPI</td>
<td>03-31-2019 16:04:57</td>
<td>REJECT</td>
</tr>
<tr>
<td>2</td>
<td>Rita Richey</td>
<td>00:02:11</td>
<td>instruction I get an A because I remember</td>
<td>instruction I get an A because I remember</td>
<td>03-31-2019 16:00:37</td>
<td>APPROVE</td>
</tr>
<tr>
<td>3</td>
<td>Rita Richey</td>
<td>00:00:47</td>
<td>and I then went to a local community</td>
<td>TESTTSTSTST</td>
<td>03-22-2019 00:03:32</td>
<td>REJECTED</td>
</tr>
<tr>
<td>4</td>
<td>Rita Richey</td>
<td>00:06:46</td>
<td>edited on Robert Kanye Oh on Gagne well</td>
<td>edited on by Robert Gagne Oh on Gagne well</td>
<td>03-21-2019 22:36:22</td>
<td>APPROVED</td>
</tr>
</tbody>
</table>

B.12 Search Tool Features: Verify Keyword Search Alert

Notification to user: Sorry! There are no search results. Here are some tips to help you search: (1) check spelling, (2) check spaces (3) check punctuation. Please try again below.
## B.13 Search Tool Features: Contributor Transcription Version #3

<table>
<thead>
<tr>
<th>No.</th>
<th>ID</th>
<th>Interviewee</th>
<th>Time</th>
<th>AI Transcription</th>
<th>Contributor Transcription</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14</td>
<td>Rita Richey</td>
<td>00:00:02</td>
<td>welcome to the history makers project</td>
<td>welcome to the history makers project</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
<td>Rita Richey</td>
<td>00:00:04</td>
<td>could you please introduce yourself yep</td>
<td>could you please introduce yourself yep</td>
</tr>
<tr>
<td>3</td>
<td>14</td>
<td>Rita Richey</td>
<td>00:00:06</td>
<td>I'm Rita Richie from wayne state in</td>
<td>I'm Rita Richie from wayne state in</td>
</tr>
<tr>
<td>4</td>
<td>14</td>
<td>Rita Richey</td>
<td>00:00:10</td>
<td>detroit right and can you tell us a</td>
<td>detroit right and can you tell us a</td>
</tr>
<tr>
<td>5</td>
<td>14</td>
<td>Rita Richey</td>
<td>00:00:14</td>
<td>little bit about your career path from</td>
<td>little bit about your career path from</td>
</tr>
<tr>
<td>6</td>
<td>14</td>
<td>Rita Richey</td>
<td>00:00:16</td>
<td>where you started or how you got to win</td>
<td>where you started and how you got to Wayne</td>
</tr>
<tr>
<td>7</td>
<td>14</td>
<td>Rita Richey</td>
<td>00:00:18</td>
<td>state okay well i started off like many</td>
<td>state okay well i started off like many</td>
</tr>
</tbody>
</table>
Appendix C: IRB Approval

MEMORANDUM
DATE: September 12, 2018
TO: Ken Potter, Annemarie Katherine Radke
FROM: Virginia Tech Institutional Review Board (FWA00000572, expires January 29, 2021)
PROTOCOL TITLE: Design and Development of a Metadata Entry Tool for Supporting Efficient Search and Discovery of Video Interview Information
IRB NUMBER: 18-784
Effective September 12, 2018, the Virginia Tech Institution Review Board (IRB) approved the New Application request for the above-mentioned research protocol.
This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.
Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.
All investigators (listed above) are required to comply with the researcher requirements outlined at:
http://www.irb.vt.edu/pages/responsibilities.htm
(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:
Approved As: Exempt, under 45 CFR 46.101(b) category(ies) 4
Protocol Approval Date: September 12, 2018
Protocol Expiration Date: N/A
Continuing Review Due Date*: N/A
*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:
Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal/work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.
The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.