Restoring Rivers in the American Southwest: Sharing Knowledge Using Webisodes

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Abstract

The purpose of this practicum is to expand e-learning opportunities to advance knowledge sharing and use within the Bureau of Land Management (BLM). Central to the mission of the BLM's National Training Center (NTC) is providing education, information, and training to a geographically distributed workforce of nearly 10,000 employees (Bureau of Land Management, 2013). The NTC uses technology to effectively and efficiently promote learning and a culture of knowledge sharing. This practicum explores the use of short, web-based videos, called webisodes, presented on a social media platform to broadly communicate some of the BLM's river restoration experiences in the American Southwest. These webisodes are digital stories designed to share case studies and inventive tools to support collective learning among BLM employees across disciplines, work units, and watersheds. Additional learning resources accompany the webisodes on a restricted access, cloud-based social media platform limited to United States Department of the Interior employees: Google Apps for Government (also known as BisonConnect). The final products are delivered on an interactive website, developed using Google Sites, within the BisonConnect environment. The website encourages employees to contribute their stories; share information, resources, and documents; and provide feedback. Webisodes and the interactive BisonConnect platform are e-learning tools available to the NTC to promote knowledge exchange and use across a geographically dispersed workforce.

Keywords: e-learning, webisodes, river restoration, riparian restoration

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Chapter 1–Introduction

The Bureau of Land Management (BLM) manages over 99,000,000 hectares (245 million acres) of public lands with a workforce of approximately 10,000 employees, spread primarily across the Western United States and Alaska (Bureau of Land Management, 2012). When an organization's workforce is geographically dispersed, e-learning adds value through sharing expertise and knowledge on demand to deliver learning resources without limitations of time or geographic proximity (Cheng, Wang, Mørch, Chen, & Spector, 2014; Sun, Tsai, Finger, Chen, & Yeh, 2008; Wang, Vogel, & Ran, 2011). E-learning is a general term that applies when we use technology (such as computers and networks) in some manner to promote the learning process (Shepherd, 2013; Sun et al., 2008; Welsh, Wanberg, Brown, & Simmering, 2003). This practicum project presents five web-based videos, hereafter called webisodes, to share knowledge and information about the BLM's riparian restoration experiences in the American Southwest, hosted on a restricted access social media platform. The webisodes and cloud-based delivery platform were developed to advance e-learning opportunities to promote collective learning within the organization.

This introductory section will first describe riparian areas and their significance. Second, a summary of major human influences and widespread changes to these zones will be explained. Third, the importance of conserving and restoring these riparian systems will be explored. Fourth, the value of communicating knowledge and information widely within an organization is introduced as a means to enhance learning and spur innovation, in this case, related to complex river restoration issues. The importance of sharing knowledge and using technology to share knowledge will be investigated in the literature review section of this paper. Fifth, following the

presentation of the problem statement and objectives, the scope and justification of this project are further explained.

Riparian Areas

Rivers and their floodplains play an essential role in ecosystem structure and functions (Naiman, Decamps, & McClain, 2005; National Research Council, 2002; Shafroth & Briggs, 2008). Riparian systems are described as transitional corridors along the banks of streams or rivers and around the perimeter of water bodies (Bureau of Land Management, 1992; Ffolliott, Baker, BeBano, & Neary, 2004; National Research Council, 2002). Spatially, these are the areas where terrestrial and aquatic systems interact (Naiman et al., 2005).

Functioning ecosystems provide a wide range of benefits to people (Daily, 1997). These ecosystems provide goods and services that can enhance the economic livelihood (National Research Council, 2005) and social fabric of nearby communities (Egan, Abrams, & Hjerpe, 2011). The ecosystem goods and services can include everything from food and clean water to medicines and protection from devastating natural events (Kareiva & Marvier, 2012). Most ecosystem services are not commodities that directly enter into the markets (National Research Council, 2012). However, human longevity as well as that of many other species depends on many of these services being provided (Kareiva & Marvier, 2012).

Riparian areas, where the land and water interface, are especially valuable because they support more physical and biological functions per unit area than uplands (National Research Council, 2002). These functions can include water purification, recharging of groundwater, nutrient processing (National Research Council, 2005), filtering contaminants and pollutants (Palmer et al., 2009), decomposition of wastes, regulation of climate, food production, flood control, shoreline and river bank stabilization, storm protection and maintenance of biodiversity

(Corvalan, Hales, & McMichael, 2005; Cowx & Portocarrero Aya, 2011; Naiman et al., 2005; National Research Council, 2012). While riparian vegetation in the West occupies less than 1% of the landscape, it supports more bird species than all other habitat types combined (Anderson, Russell, & Ohmart, 2004; Knopf, Johnson, Rich, Samson, & Szaro, 1988; van Riper III, Paxton, O'Brien, Shafroth, & McGrath, 2008). Furthermore, in arid and semiarid lands, riparian zones furnish habitat or haven for a disproportionally large number of species (Zavaleta, 2000). These zones provide crucial corridors for many species within the larger landscape (National Research Council, 2005) and regionally reflect a much higher biodiversity (van Riper III et al., 2008).

Although it is challenging to provide an explicit link, these ecosystem functions are known to support economic values such as commercial fishing, clean drinking water, agriculture, and recreational activities (National Research Council, 2005). Not only are the health and abundance of these systems important to sustaining certain economic and well-being benefits (Corvalan et al., 2005), these systems also interact with our social and cultural values (Ewing & Gold, 2011). Our perceptions, attitudes and actions directly shape our environment and the condition of the resources we leave for future generations (Kareiva & Marvier, 2012).

Major Changes to Riparian Areas

Though humans have altered their habitats for thousands of years (Adler, 2007; Anderson et al., 2004; Chew, 2009; Naiman et al., 2005; Stromberg et al., 2004), more recent land use practices have resulted in significant habitat fragmentation, degradation, and destruction (McGraw & Thom, 2011). Riparian areas are some of the most severely modified landscapes (National Research Council, 2002). It is estimated that at least two-thirds of all riparian plant communities in the United States have been converted to other land uses (Swift, 1984), primarily for agriculture. Alterations in these zones include flooding due to impoundments constructed

downstream, channel modifications, surface and groundwater withdrawals, vegetation removal for agriculture, grazing, timber harvesting, mining and urban development (National Research Council, 2002; Palmer et al., 2009; Swift, 1984).

As the population in the arid Southwest has increased, so too has the desire for access to more water (Stromberg, Beauchamp, Dixon, Lite, & Paradzick, 2007; Stromberg et al., 2004). In response to this increasing demand for water in the West, the federal government began building dams and water distribution systems in the early 1900s (Anderson et al., 2004; Chew, 2009). More and more dams were built to meet the growing water storage requirements to sustain agriculture, provide drinking water and hydropower to large urban areas, and protect communities from flood events (Adler, 2007; Chew, 2009; Stromberg et al., 2004). Arizona, alone, has over 431 registered dams (DeBano & Schmidt, 2004). Dam building and other land use practices have significantly influenced the hydrologic, geomorphic, and biological structure and function of riparian areas (National Research Council, 2002), especially through the alteration of the natural flow regimes of these rivers (Douglass, Nissen, & Hart, 2013; Mortenson, Weisberg, & Stevens, 2012).

Human settlement and alterations of riparian environments have resulted in a loss of some of these ecological zones (Naiman et al., 2005; National Research Council, 2002). In the Southwest, riparian zones account for less than 2% of the land area (Ffolliott et al., 2004). Of the riparian areas still remaining today, the frequent presence of non-native woody species such as Tamarisk (*Tamarix* spp.) and Russian olive (*Elaeagnus angustifolia)* have been recorded across the West (Friedman et al., 2005; Hultine, Belnap, et al., 2010).

Tamarisk, a shrub or small tree, and Russian olive, a small tree, are both species native to Eurasia and introduced into the United States in the 1800s (Bean, Norton, Jashenko, Cristofaro,

& Schaffner, 2008; Chew, 2009; Katz & Shafroth, 2003; Nagler P. L., Glenn, Jarnevich, & Shafroth, 2011; Robinson, 1965; Stromberg, Chew, Nagler, & Glenn, 2009). In the Southwest, Tamarisk had reportedly spread from 4,000 hectares (10,000 acres), in 1920, to 607,000 hectares (1.5 million acres) by 1987 (DeBano & Schmidt, 2004). Russian olive is well established in the western states, especially in the waterways of the Great Plains and along mid-elevation rivers in the Southwest (Nagler et al., 2011). However, Russian olive is present in all of the continental states except for the southeastern states (Katz & Shafroth, 2003; Nagler et al., 2011). While there is no credible, comprehensive dataset showing the true extent and abundance of Tamarisk or Russian olive in the West (Shafroth, Brown, & Merritt, 2010), it is estimated that at least 360,000 hectares (900,000 acres) have been colonized by Tamarisk (Nagler et al., 2011; Zavaleta, 2000). Since many data sets and studies have focused more on Tamarisk than on Russian olive, a precise estimate of the occupation of Russian olive is not presently available (Nagler et al., 2011; Shafroth et al., 2010). The spread of non-natives into riparian areas is reported to be one of the top factors, behind habitat loss, influencing the overall biodiversity decline and change in composition within these communities (Naiman et al., 2005).

Concerns over the perceived loss of water, loss of native vegetation, and degraded habitat values (Nagler & Glenn, 2013) led to significant investments by municipalities, states and the United States government to control and remove Tamarisk (Hultine, Belnap, et al., 2010; Hultine, Nagler, et al., 2010). Beginning in 2001 a biological control agent for Tamarisk, the leaf beetle (*Diorhabda carinulata),* was first released (DeLoach et al., 2003; Pattison, D'Antonio, & Dudley, 2011). Widespread releases of the defoliating beetle coupled with the insects rapid spread resulted in the presence of these insects over large areas in western watersheds of the United States (Nagler & Glenn, 2013; Nagler et al., 2014). However, in 2010,

concerns over the leaf beetle's potential negative impact on habitat for the endangered southwestern willow flycatcher (*Empidonax trailli extimus*) prompted the United States Department of Agriculture (USDA) to halt releases of the beetle (Dudley & Bean, 2012). While the influence of the leaf beetle is not well understood, recent studies suggest Tamarisk may be resistant to the beetles' annual cycles of defoliation (Nagler & Glenn, 2013). Currently no Russian olive biocontrol agents have been approved for use in the United States; however, research is underway (Bean et al., 2008).

Conservation and Restoration of Riparian Areas

In the last few decades, the importance of the many benefits provided by riparian areas as well as the need to protect, conserve and in many cases enhance them has been widely recognized (Naiman et al., 2005; National Research Council, 2002; Palmer & Allan, 2006). The BLM manages approximately 231,745 kilometers (144,000 miles) of riparian-lined streams and an estimated 5,260,913 hectares (13 million acres) of wetlands (VanAsselt & Layke, 2006). These areas provide especially crucial habitat and habitat connectivity in the arid Southwest (DeBano & Schmidt, 2004).

Protecting healthy riparian zones and repairing degraded riparian areas is directly related to successfully achieving at least five federal mandates including: water quality protection, safeguarding wetlands, conserving threatened and endangered species, reducing damage from floods and managing public lands to sustain their health, diversity and productivity (National Research Council, 2002). Kareiva and Marvier (2012) suggest that the health and future fate of the natural community is intensely interwoven with the health and well-being of human communities. Palmer and Allan (2006) describe the significance of restoring damaged riparian systems for the purpose of improving both ecological and social functions. Furthermore, Egan et

al. (2011) suggest the integral role that participating in repairing these systems can play in connecting human communities and ecosystems.

Communicating to Learn and to Innovate

River restoration is socially and ecologically complicated, encompassing multiple disciplines and diverse stakeholders (Naiman, 2013). The practice includes considerable scientific uncertainty and challenging, value-laden choices (Adler, 2007). In addition, the world as we know it, is rapidly changing, as never before in human history (Hobbs, Hallett, Ehrlich, & Mooney, 2011). Factors such as invasive species, climate change, land use change, loss of species, and the deposition of toxic chemicals are resulting in novel ecosystems (Hobbs et al., 2011; Williams & Jackson, 2007). Adaptive solutions require innovation, learning from each other, and communication, among other conditions (Kania & Kramer, 2011).

Encouraging an agency culture of learning and innovation requires broadly communicating information and knowledge from the organization's experiences to its employees (McNabb, 2006). Mumford asserts "…solutions to novel problems do not arise in a vacuum" (2000, p. 314). In other words, for new ideas to emerge from knowledge spillovers it is essential to interact and share knowledge and information widely (Stolarick & Florida, 2006). Science has long been fragmented into disciplines and separated from application (Roux, Rogers, Biggs, Ashton, & Sergeant, 2006), further compounding the exchange of knowledge with transdisciplinary and diverse audiences. Moreover, knowledge and information within the public sector may be confined within silos due to the hierarchy, procedures, and laws that often restricts the flow (Mergel, 2011). Kondolf (2007) and Bernhardt et al. (2007) contend that in order to improve our understanding of these riparian ecosystems and the practice of riparian restoration, we must learn from our experiences, together.

Background

In 2012, four BLM National Training Center (NTC) employees (Art Ferraro, Brian Myers, Ryan Dent, and the author) visited five BLM field offices in Utah and Colorado. Interviews with natural resource specialists and partners involved in successful river restoration efforts were documented. These offices had been selected, in part, for their national recognition within the Department of the Interior for expanding recreational opportunities, providing employment, and conserving and restoring rivers using partnerships (U.S. Department of the Interior, n.d.). The author conducted over 18 interviews recorded on more than 30 hours of videotape (A. Ferraro, personal communication, January 24, 2013). These interviews were digitized and then cataloged by the NTC's audio visual specialists. The purpose of capturing these interviews was to create a "virtual field trip" for the Biennial Interagency River Management Workshop, held March 11-15, 2013, on the campus of Colorado Mesa University. On March 13, 2013, the NTC presented a 25-minute documentary highlighting restoration efforts underway along several key rivers in the Southwest (Webb, 2013). The interviews collected and edited for the documentary were repurposed for this practicum project.

Problem Statement

The purpose of this practicum is to advance e-learning opportunities to promote knowledge sharing and use within the BLM. This project encourages a culture of learning and innovation among BLM river restoration practitioners by broadly sharing experiences, knowledge and information across disciplines, work units and watersheds within the organization using webisodes presented on a social media platform. Digitized interviews with BLM and National Park Service (NPS) specialists, and their partners, document the stories of river restoration practitioners working along the Dolores, Escalante, and Colorado Rivers. These

interviews, conducted by the BLM's National Training Center in 2012, were edited into digital stories to share case studies and inventive tools and support collective learning among BLM employees. Additional learning resources are provided with the webisodes on a restricted access, cloud-based social media platform limited to United States Department of the Interior employees: Google Apps for Government (also known as BisonConnect). The final products are delivered on an interactive website, developed using Google Sites within the BisonConnect environment.

Objectives

1. Identify BLM internal review process of webisode and delivery platform content using subject matter experts in relevant disciplines.
2. Develop webisode and delivery platform content from existing or repurposed interview material to share case studies and innovative tools.
3. Validate webisode content using BLM internal expert review process.
4. Deliver webisodes on cloud-based, social media platform available to employees of the Department of the Interior: Google Apps for Government (BisonConnect).

Scope

The scope of this practicum is limited to developing the webisode content from existing or repurposed digitized and cataloged interviews collected by the NTC in 2012. The interviews conducted relate to the BLM administered segments of the Escalante and Dolores River watersheds, as well as the Ruby-Horsethief and Westwater Canyon sections of the Colorado River. The intent of this practicum is not to review or add to the scientific literature or debate over riparian restoration. Rather, the focus of this practicum is to expand e-learning opporunities

to promote knowledge sharing and use within the organization for the purpose of enhancing collective learning and the use of innovation among the BLM's river restoration practitioners.

The webisodes produced in conjunction with this project are for educational purposes only. As a result, the views, opinions, or positions expressed by individuals or organizations in the webisodes do not necessarily reflect the views, opinions, or positions of the Department of the Interior or the Bureau of Land Management. Nor does the mention of commercial products, trade names, companies, websites, or other references constitute endorsement or recommendation for use by the federal government. Furthermore, any intent to utilize river water for restoration work would require authorization from the local water commissioner (J. Robertson, personal communication, July 25, 2013).

Justification

In January 2009, President Obama issued a memorandum calling for the use of new technologies to build a more open government system that is transparent, participatory and collaborative (Transparency and open government memorandum, 2009). To implement this initiative, many federal agencies are now using web-based third-party technologies such as Facebook, Twitter, YouTube and Flickr to engage with the public, improve collaboration and access to knowledge (Mergel, 2013a; Mergel, 2013b; Snead, 2013). In 2012, Google Apps for Government (known as BisonConnect) was picked to provide restricted access, cloud-based email and other collaboration tools such as Google Docs and Google Sites to the entire Department of the Interior in order to empower employees with state-of-the-art communication technology (U.S. Department of the Interior, 2012).

Later, in January 2014, the Secretary of the Interior signed a Secretarial Order affirming the Department's commitment to the important role community-based watershed partnerships

play in the stewardship and conservation of significant rivers and their watersheds (U.S. Department of the Interior, 2014). As the BLM continues to strengthen and sustain watershed partnerships in an increasingly unpredictable and complex landscape, the agency's ability to share and learn from their collective experiences is becoming more and more important (Bernhardt et al., 2007). The NTC is devoted to developing more distance learning opportunities to provide an efficient, practical and cost effective means to share knowledge and information with all employees (Bureau of Land Management, 2013). This practicum project was developed in partnership with the BLM's National Training Center to explore the use of new technology, webisodes hosted on Google Sites within BisonConnect, for the purpose of broadly communicating information and sharing knowledge about riparian restoration efforts in the Southwest while expanding the potential of e-learning opportunities within the BLM.

Chapter 2–Literature Review

Novel approaches employing creativity, innovation and flexibility are needed when addressing complex issues such as ecological restoration amid rapid change in dynamic systems (Harris, Hobbs, Higgs, & Aronson, 2006). Pohl (2008) suggests the importance of learning from one another across disciplines as we work cooperatively towards societal goals involving complicated social, ecological and economic systems. Dodgson (1993) highlights the increased need for learning where uncertainties exist in great quantity, as is the case within changing ecological systems. Research conducted by Alegre and Chiva (2008) and Jiménez-Jiménez and Sanz-Valle (2011) suggest that an organization's capability to innovate and implement creative ideas is dependent on its ability to learn and develop new knowledge, ideas and processes. In a "knowledge economy," a phrase coined by Peter Drucker in 1969 (Drucker, 1969), an organization's success relates to its ability to manage and utilize its knowledge resources using technology (Joia, 2007; McNabb, 2006). The following is a review of the literature to explore key terms, concepts, and relationships of knowledge sharing and using technology to share knowledge. This practicum project builds on these concepts to promote a culture of learning and innovation within the BLM's riparian restoration community through the use of technology to share knowledge.

Knowledge Sharing

Several definitions of knowledge sharing are presented in the literature (Yeşil et al., 2013). Argote, Ingram, Levine, and Moreland define *knowledge transfer* as "the process through which one unit (e.g., individual, group, department, division) is affected by the experience of another" (2000, p. 3). Willem and Buelens (2007) use the knowledge transfer definition presented by Argote et al. (2000) to define the term *knowledge sharing*. However, Wang and

Noe (2010) suggest that knowledge sharing is quite different than the transfer or exchange of knowledge. In their review of the knowledge sharing literature, Wang and Noe describe knowledge sharing as providing "task information and know-how to help others and to collaborate with others to solve problems, develop new ideas, or implement policies or procedures" (2010, p. 117). This same definition is later carried forward in Amayah's (2013) examination of the factors affecting knowledge sharing in the public sector. In comparison, Wang et al. (2014) propose knowledge sharing centers more on the interaction, communication and configuration process, as suggested in an earlier study by Haas and Hansen (2007). For the purpose of this paper, knowledge sharing is described as "the sharing of relevant experiences and information between organizational members" (Lin & Joe, 2012, p. 439).

Human capital, or knowledge, is one of the most valued assets in public sector entities (Willem & Buelens, 2007). While several studies claim that knowledge lives in people's minds (Amayah, 2013; Becerra-Fernandez & Sabherwal, 2008; Bhatt, 2001; Paroutis & Al Saleh, 2009), there is no consensus in the literature on a clear definition of knowledge (Wang & Noe, 2010; Willem & Buelens, 2007). Furthermore, numerous definitions of *innovation* exist. These ambiguities contribute to challenges in understanding and conducting scientific study (Baregheh, Rowley, & Sambrook, 2009). Research supports that sharing knowledge is related to improved organizational performance and innovativeness (Calantone, Cavusgil, & Zhao, 2002; Darroch, 2005; Du, Ai, & Ren, 2007; Jiménez-Jiménez & Sanz-Valle, 2011; van Wijk, Jansen, & Lyles, 2008; Wang, Wang, & Liang, 2014; Yeşil, Koska, & Büyükbeşe, 2013; Yu, Yu, & Yu, 2013). Nonetheless, due to the complexities of identifying and measuring variables, empirical studies linking direct outcomes such as innovation or improved organizational performance to effective knowledge sharing are lacking (Chen, 2010; Darroch, 2005; Hassan & Al-Hakim, 2011;

Jiménez-Jiménez & Sanz-Valle, 2011; Wang & Wang, 2012). At the same time, a recent analysis of the relationships between knowledge sharing, organizational climate and innovative performance suggests that knowledge sharing is a factor that encourages organizational learning (Yu et al., 2013).

Many of the studies on knowledge sharing focus on private industry (Wang & Wang, 2012; Wang et al., 2014; Yeşil et al., 2013) or educational institutions (Rahimi, Arbabisarjou, Allameh, & Aghababaei, 2011; Yeh, Yeh, & Chen, 2012). While there are some studies addressing knowledge sharing in the public sector (Willem & Buelens, 2007; Yang & Maxwell, 2011), research within public organizations is limited (Amayah, 2013). Knowledge in government entities is often kept in silos, unavailable to others in the organization or system (Mergel, 2011). As a result, Mergel (2011) suggests this can and does lead to agencies "reinventing the wheel." Reusing knowledge, to learn from past experiences, is one of the primary purposes for managing and sharing organizational knowledge (Dalkir, 2005; Martins & Meyer, 2012; McNabb, 2006). Innovation is derived from previous experiences of what worked and what did not (Dalkir, 2005). Furthermore, most organizations pursue a structure for managing knowledge to ensure continued creation of new knowledge (Hassan & Al-Hakim, 2011).

Methods to Share Knowledge

Several mechanisms exist for spreading employee know how or knowledge (Whyte & Classen, 2012). Various studies describe knowledge sharing methods such as the use of analogies and metaphors, interviews and storytelling (Whyte & Classen, 2012), apprenticeships, direct observation, dialogs (Panahi, Watson, & Partridge, 2012), employing a wiki (web-based application where users can collaboratively post and edit information), setting up town hall

meetings, mentoring, and establishing programs to reward employees who demonstrate knowledge sharing (Mayfield, 2010). It has been argued that narrative storytelling is one of the most effective ways to share knowledge, culture and wisdom because the information is presented with a richer context that is more meaningful and relevant (Dalkir, 2005; Gandelman & Santoro, 2010b; Swap, Leonard, Shields, & Abrams, 2001; Tobin & Snyman, 2008). Stories can be a powerful way to enliven information that may have been theoretical (Haigh & Hardy, 2011).

In contrast, a recent study of narrative knowledge sharing among colleagues by Geiger and Schreyögg (2012) reveals weaknesses in the argument that this method is effective in providing coherence and reducing complexity (Tsoukas & Hatch, 2001). In their study of online discussions in an oil company's virtual community of practice, Geiger and Schreyögg observed varying and sometimes opposing narrative claims led to conflict and additional complexity. This study raises questions about the validity of narratives when incompatible or contradictory claims arise. The study concludes that the use of narratives for sharing knowledge is truly not well understood (Geiger & Schreyögg, 2012).

One study by Gandelman and Santoro (2010a) suggests that training content within an organization should include employees sharing stories of real work events. The authors propose a design method to ensure the narrative stories portraying real work situations meet the organization's training needs (Gandelman & Santoro, 2010b). In their model, stories with dramatic content and decision points leading to multiple and varied outcomes are desired elements. The authors suggest employees can learn from mistakes as well as good choices at these decision points. Furthermore, the viewpoints and contributions of several employees were

encouraged to construct the stories using a web-based collaborative tool (Gandelman & Santoro, 2010a).

Factors Influencing Knowledge Sharing

Many factors, both positive and negative, influence the sharing of knowledge in public organizations (Amayah, 2013). A model developed by Kathiravelu, Mansor, Ramayah, and Idris (2014) proposes that the organizational culture has a powerful influence on knowledge sharing among employees. While further research is needed to assess the validity of this model, it was, nevertheless, developed based on earlier studies conducted by Rai (2011) and Nguyen and Mohamed (2011). Within public organizations, Yang and Maxwell (2011) suggest complex factors such as personal beliefs, workplace structure, culture, systems, and networks are often interrelated.

In the framework suggested by Yang and Maxwell (2011), power games, social networks, and employee rewards are examples of factors shaped by the structure and culture of the organization. These elements, in turn, enable, motivate, or hinder an employee's willingness to share knowledge (Yang & Maxwell, 2011). Rai (2011) suggests a conceptual model of knowledge generation and sharing that recognizes the simultaneous and sometimes competing functions or values within an organization. In this model, modified from the work of Quinn and Rohrbaugh (1983) and Ruppel and Harrington (2001), trust and an ethical work environment are identified as key factors that influence knowledge sharing. Similarly, Yang and Maxwell's (2011) framework presents social networks and trust as significant determinants of knowledge sharing, adding that social networks can build trust. Moreover, a meta-analysis on 52 research articles exploring culture's impact on knowledge management from 2000-2010 found that trust and openness are the two most influential variables within an organization (Jacks, Wallace, &

Nemati, 2012). Jacks et al. (2012) suggest creating a culture of trust and openness within organizations requires effective leadership rather than a technological solution.

In a study by Serenko, Bontis and Hardie (2007), the authors argue that managing knowledge within an organization extends beyond identifying the assets of employees to cultivating and maintaining a supportive work environment that promotes knowledge sharing. This viewpoint was later validated in a study by Martins and Meyer (2012). Nonetheless, results from a recent study conducted in a public academic institution found that as personal benefits increased, knowledge sharing decreased (Amayah, 2013). This finding illustrates the complexity of elements operating within an organization. The author speculates a supportive knowledge sharing climate was likely not present in that particular institution (Amayah, 2013).

Using Technology to Share Knowledge

Using technology to enhance learning began as early as the 1970's with the advent of computer-based training or CBT (Shepherd, 2013). These early technology-enhanced learning resources consisted of one-way delivery of information (Hildrum, 2009). Over the last few decades, the paradigm has expanded from CBT to e-learning, a much broader and diverse concept (Sun et al., 2008). In the following sections of the literature review, using technology to share knowledge as a form of e-learning will be defined and relevant e-learning literature examined.

E-learning

E-learning refers to the use of technology (such as computers and networks) in some manner to promote the learning process (Shepherd, 2013; Sun et al., 2008; Welsh, Wanberg, Brown, & Simmering, 2003). In today's dynamic, technology-driven society, employees interact with extraordinary amounts of information (Cheng, Wang, Mørch, Chen, & Spector, 2014;

Wang, Vogel, & Ran, 2011). Although knowledge is plentiful, "the ability [of employees] to use it is scarce" (Dalkir, 2005, p. 2). Compared to the conventional methods of knowledge sharing such as mentoring, apprenticeships, face-to-face interactions, and direct observation, Panahi, Watson, and Partridge (2012) suggest today's workplace model requires a more efficient and cost effective flow of knowledge to facilitate faster learning. In response, organizations have adopted e-learning methods to improve workplace learning (Cheng et al., 2014; Šumak, HeričKo, & Pušnik, 2011). Computer-based self-study, simulations, virtual classrooms, online resources (including web articles, videos, podcasts, digital files, presentation slides, and simple demos), and online collaboration are some examples of e-learning (Cheng, Wang, Moormann, Olaniran, & Chen, 2012; Shepherd, 2013).

The use of technology to supply training has increased dramatically over the last two decades (Brown & Charlier, 2013). The Association for Talent Development (ATD) reports e-learning was used to deliver 38% of formal instruction based on a survey of 340 participating organizations (Association for Talent Development, 2014). According to Sun et al. (2008), the e-learning global market growth rate is almost 36%. Organizations are investing in e-learning for many reasons including improved accessibility, consistency in quality of training, ease of updating information or repurposing, flexibility and convenience provided through employee control over content, sequence, pace, place and time (Brown & Charlier, 2013; Ruiz, Mintzer, & Leipzig, 2006; Shepherd, 2013; Wang et al., 2011; Welsh et al., 2003). As stated in the introduction of this paper, when an organization's workforce is geographically dispersed, e-learning adds value through sharing expertise and knowledge on demand to deliver just-in-time learning resources without time or geographic restrictions (Cheng et al., 2014; Lee, Hsieh, & Ma, 2011; Sun et al., 2008; Wang et al., 2011). Moreover, Ruiz et al. (2006) describe how e-learning

allows a shift from a teacher-focused to a learner-focused process. In other words, Ruiz et al. suggest e-learners are enabled to actively shape their learning outcomes.

Corresponding with the increased use of e-learning in the workplace, the literature on e-learning has grown in the past 10 years (Cheng et al., 2014). While most e-learning research has been focused on the academic setting (Chen, 2010; Lee et al., 2011; Wang et al., 2011), investigations into workplace e-learning have significantly expanded (Cheng et al., 2014). As a result, a bibliometric analysis was performed by Cheng et al. (2014) on 324 workplace e-learning articles published from 2000 to 2012 to examine the various perspectives, intellectual structures, and organizations. Building on the relationship of the six themes identified, Cheng et al. formed four broad e-learning research categories: continuing education and professional development, healthcare (due to the abundance of published articles), social media, and lastly, the connection to knowledge management. Cheng et al. (2014) suggest workplace knowledge creation and exchange has increased through the social interaction and networking enabled by social media tools. Further analysis by the authors suggests a close association between the use of social media tools and knowledge management within an organization (Cheng et al., 2014).

Social technologies or *social media* are described as wed-based services or applications enabling users with profiles to access, share, and contribute information (Boyd & Ellison, 2007; Mergel, 2013b). Examples of social media technologies include social networking sites such as Facebook, cloud-based collaborative writing platforms such as Google Docs, and video-sharing sites such as YouTube or Vimeo where users can converse and share multimedia content (García-Peñalvo, Colomo-Palacios, & Lytras, 2012; Mergel, 2012; Panahi et al., 2012). While knowledge sharing through face-to-face interaction has traditionally been the ideal, in today's workplace it is not always feasible (Panahi, Watson, & Partridge, 2013).

Many of the first approaches to capture and share knowledge within an organization focused heavily on information technology based solutions (Al-Alawi, Al-Marzooqi, & Mohammed, 2007). These former knowledge management systems were generally ineffective because they lacked the involvement of people as a central component (Panahi et al., 2012; Wang & Noe, 2010). More recently the focus has shifted to emphasize natural human ways of knowledge sharing such as sharing stories (Whyte & Classen, 2012). Tynjälä and Häkkinen (2005) found effective adult learning builds on the learner's past experiences, includes a process of reflection, is directed at solving problems, seeks both personal and organizational benefits, and involves social interaction. A study by Hildrum (2009) described that it is possible to share knowledge through e-learning tools employing methods such as demonstration using video, sharing relevant workplace experiences, and connecting virtually to perform simulations in remote classrooms or labs. However, a review of the literature by Panahi et al. (2013), points out missing social cues such as body language, eye contact and feelings can be drawbacks to communicating using information technology. Nevertheless, meta-analytic findings published by Brown (2013) show few differences in learning outcomes between face-to-face and technology delivered learning, when controlled for potential confusion. While earlier research suggested that organizations have the capacity to enable continued learning and professional development through online networks where members can exchange information and interact with each other (Hara & Hew, 2007), García-Peñalvo et al. (2012) question whether organizations have discovered the potential to leverage social media tools for learning, in concert with traditional training approaches.

Social Media for Learning

Panahi et al. (2012) created a conceptual model indicating social media can provide the space for many of the social and reflective processes important for adult learning (Tynjälä & Häkkinen, 2005) to occur. For instance, the model suggests social media provides opportunities and tools to build trust, exchange information, and share experiences (Panahi et al., 2012). Gordeyeva's master's thesis (2010) explored a theoretical model of the interaction between knowledge sharing and the use of collaborative social media tools in organizations. Her research found four main areas where social media tools used in the workplace may positively influence knowledge sharing: communication and trust through convenient and diverse means to connect, the process of acquiring knowledge through co-creation, organizational culture through emphasis on knowledge sharing behaviors, and lastly, employee motivation to share knowledge through visibility of contributions and relationship to online reputation (Gordeyeva, 2010). In both of these studies (Gordeyeva, 2010; Panahi et al., 2012), the authors acknowledge the complexity of influences on knowledge sharing and the difficulty to define and measure concepts such as trust, learning, and knowledge. Moreover, both studies indicate that more empirical research is needed to better understand and assess the use of social media technology in advancing knowledge sharing within organizations.

Meanwhile, there are several organizations applying e-learning and using popular social media platforms as a means to achieve reflective learning (Shepherd, 2013). For instance, one recent study found online social networking software created a better learning environment with enhanced levels of interaction leading to higher levels of engagement, satisfaction and learning for distance learners, compared to students using the tools available through the university's learning management system software (Thoms & Eryilmaz, 2014). In another example, Google

Sites was successfully used as a social media platform for university and high school students to connect and collaborate during a semester-long oral history project partnership (Lemley & Martin, 2015). Lemley and Martin (2015) describe how the innovative Google Sites platform promoted relationship building, peer-to-peer learning, and the co-production of knowledge. Similarly, another university course using Google Sites as a platform to support learning found advantages such as an easy to use framework to create webpages, inviting layout, and the capability to host large amounts of information (Moldes, Deive, Pazos, & Sanromán, 2012). In yet another illustration of using social media as a platform for learning, a middle school teacher developed a model that uses digital storytelling, or short instructional movies, posted on YouTube to connect with and engage students while instructing mathematical concepts (Dreon, Kerper, & Landis, 2011). Furthermore, a recent study suggests that social media use in the public sector can be a useful tool for finding workplace information easily (Khan, Swar, & Lee, 2014). For instance, Kahn et al. (2014) describe how citizens can provide feedback, share issues, or post complaints related to a government agency using social media. Khan (2015) describes how using social media can lead to knowledge creation through the two way communications or use of real time collaboration tools.

Video for Learning

Dalkir (2005) suggests that sharing stories can tremendously raise organizational learning and can be an outstanding instrument for capturing and transferring valuable knowledge. Digital storytelling can be an impressive educational tool to instruct or inform viewers (Robin, 2008). Video, in fact, is a medium so full of richness and context that an entire peer-reviewed scientific journal in video form has emerged (JoVE: Journal of Visualized Experiments) to help researchers learn, in greater detail than text can provide, specifically how experiments were

conducted (Journal of Visualized Experiments, 2014). Use of video-sharing sites, such as YouTube, by adult internet users in the United States has grown from 33% in 2006 to 72% in 2013 (Pew Research Center, 2013). While the Pew Research Center survey (2013) found 56% of online adults reported that they have looked at "how-to" videos and 50% have viewed educational videos, results indicate that humorous videos are the most watched genre (58%). Shepherd (2013) suggests e-learning can be passive and still provide compelling opportunities for learning similar to potential learning outcomes of reading books, watching documentaries or listening to a radio program.

Challenges for E-learning

While it is widely recognized that technology can enable knowledge sharing (Panahi et al., 2013; Riege, 2005; Rosenberg, 2005; Welsh et al., 2003), Brown and Charlier (2013) warn "the availability of an e-learning resource does not ensure its use, let alone its effectiveness as a tool to change employee behavior" (p. 37). For instance, an empirical study by Luor, Hu and Lu (2009) of workplace e-learning examined beliefs, purpose, actual usage and satisfaction from the perspective of employees of a finance company. The authors found employees perceived implementation of e-learning as meaningful and positive only when employees possessed both online learning competence and motivation. Similarly, the findings of Klein, Noe and Wang (2006) in their longitudinal study of 600 students suggest a learner's confidence in using computers as well as their learning goal orientation influence motivation and intention to use e-learning tools in the academic setting. Likewise, in a different study on factors influencing engineers' acceptance of e-learning in six international companies, findings indicated that computer self-efficacy appeared important (Ong, Lai, & Wang, 2004).

Besides the influence of organizational culture and personal beliefs on knowledge sharing discussed in the previous section of this literature review, studies by Wang et al. (2011) and Cheng et al. (2012) examine workplace environment requirements for implementing meaningful e-learning. Wang et al. (2011) suggest effective e-learning products should consider the interaction of four central factors: the employee (individual learning needs, styles and expectations), the content (tied to organizational needs), social landscape (day to day work activities and interactions), and other invested or interested parties such as the organization or community (how knowledge is shared with others). In addition, research conducted by Cheng et al. (2012) found support from management, support from the organization, and job support through perceived opportunities to improve job performance are all important motivators for acceptance of workplace e-learning.

Potential technology barriers to knowledge sharing include: financial investment of organization, scarcity of interaction among peers (Welsh et al., 2003), learners' lack of available time (Hildrum, 2009), technical problems, misunderstanding of needs from an individual's perspective, shortfall of technical support, little communication about benefits, expected outcomes are not realistic, resistance to use technology because it is unfamiliar or intimidating, unclear or incompatible link between technology systems and work-related processes, and perception of technology or knowledge sharing as an impediment rather than adding value (Luor, Hu, & Lu, 2009; Riege, 2005; Serenko, Bontis, & Hardie, 2007). Wang et al. (2011) found most e-learning products were rarely developed using a pedagogical foundation. Furthermore, e-learning has often been deployed without consideration of the organizational mission (Wang, Vogel, & Ran, 2011), therefore unable to meet the employee's or organizational needs to improve work performance. Lastly, two research articles (Wang et al., 2011 & Sun et al., 2008)

point to an earlier study by Arbaugh and Duray (2002) indicating e-learning may actually cost more than traditional classroom courses in a university setting.

Frameworks for E-learning

The technological pedagogical content knowledge (TPACK) conceptual model has attracted much attention and research within the educational technology community (Archambault & Barnett, 2010; Graham, 2011; Robin, 2008). Mishra and Koehler (2006) introduced the technological pedagogical content knowledge concept (originally referred to as TPCK) to identify the critical knowledge areas required for instructors to purposefully integrate technology into their teaching methods. The authors' theoretical framework describes three main elements of learning environments and additional knowledge areas where they overlap (Graham, 2011; Mishra & Koehler, 2006). The three core knowledge areas are: content, pedagogy, and technology (Mishra & Koehler, 2006).

Graham's (2011) examination of the TPACK model found a lack of common understanding and application stemming from varying definitions of the core elements and unclear boundaries described in the literature (Angeli & Valanides, 2009; Cox & Graham, 2009). For instance, a review of definitions found in the literature revealed 89 distinct ways of defining what is technological pedagogical content knowledge – the very core of this framework where knowledge of content, pedagogy and technology overlap (Graham, 2011). Moreover, the imprecise TPACK model does not indicate direction of influence among several components of the model (Archambault & Barnett, 2010). With uncertain boundaries and unclear definitions, it is difficult to use this framework in research to categorize using a common language (Cox & Graham, 2009; Graham, 2011). Archambault and Barnett (2010) tested the validity of the TPACK model through an online survey of instructors. The authors found it very difficult to

measure knowledge of pedagogy, content, or technology separately. Consequently, Archambault and Barnett (2010) suggest the TPACK model is ineffective in predicting results. While the TPACK model offers potential for future researchers to establish a sound theoretical foundation, in its current state, the TPACK model is not adequate for guiding the use of technology in education (Graham, 2011).

The technology acceptance model (TAM) was first suggested by Fred D. Davis, Jr. in his doctoral dissertation (1986). Davis' model presents a framework for understanding motivation of the information system user based on perceived usefulness and perceived ease of use (Davis, 1989). Recognizing what motivates an individual to actually use an information system could improve system designs (Davis, 1986). Several studies have recorded empirical evidence supporting and validating the TAM (Legris, Ingham, & Collerette, 2003). However, its focus is very specific to predicting information technology usage behavior (Taylor & Todd, 1995) in a simple environment that does not address external variables well (Lee, Hsieh, & Ma, 2011; Legris, Ingham, & Collerette, 2003). In other words, workplace e-learning outcomes are difficult to measure using this model because learning is often motivated by very individual attitudes and beliefs (Hildrum, 2009; Ruiz et al., 2006) in addition to the complex influences present within organizations (Ong et al., 2004). Cheng et al. (2014) highlight the need for a more research and a systematic method for assessing outcomes of e-learning. Nonetheless, measuring e-learning users' reactions can be accomplished according to Luor et al. (2009). In their study, Luor et al. identified three main areas, adapted from Brown (2005), to assess reactions to e-learning: utility, technology satisfaction and overall satisfaction with the program.

Chapter 3–Methodology

Conceptual Model

The conceptual model developed for this project is underpinned by the comprehensive review of the e-learning and knowledge sharing literature. At this time, the BLM National Training Center's Knowledge Resource Center (http://www.ntc.blm.gov/krc/) is a public web portal designed to serve "as an online platform for distance learning courses, secondary distribution of [satellite] broadcasts and audio forums, and a library for instructional tutorials, case studies, links to important online references, and for course training documents" (Bureau of Land Management, 2013, p. 166). In other words, in its current state, the BLM's Knowledge Resource Center functions as a one-way delivery of knowledge and information. Moreover, while the web portal does host multimedia content, viewing this content from some devices such as smartphones or tablets is not yet possible (C. Humphrey, personal communication, March 21, 2015). The conceptual framework described below seeks to leverage the interactive capabilities of a social media platform to encourage knowledge exchange and use within the agency.

E-learning products are being designed and applied in practice at a much faster pace than theories can be developed (Brown & Charlier, 2013). No clear framework exists for integrating technology into teaching methods (Graham, 2011). In the absence of an accepted framework, I developed a conceptual model (see Figure 1) adapted from the "Conceptual model of tacit knowledge sharing in social media" (Panahi et al., 2012, p. 878) to serve as the delivery platform model for the webisodes.

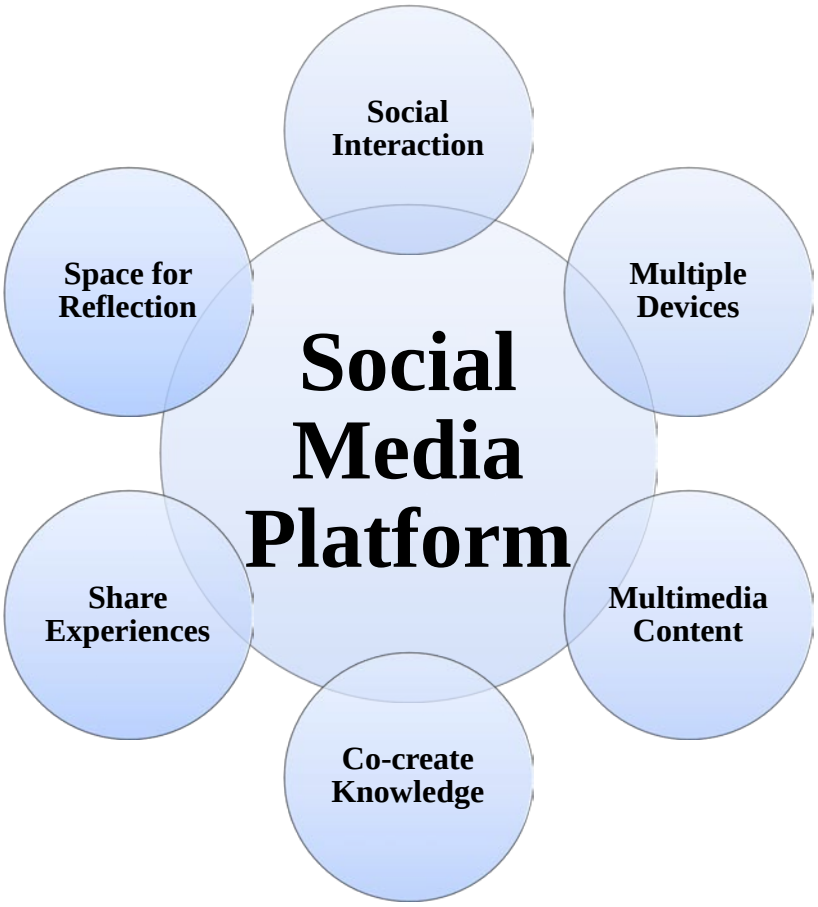

Figure 1. Social media platform to share knowledge conceptual model. This model is adapted from "Conceptual model of tacit knowledge sharing in social media," by S. Panahi, J. Watson, and H. Partridge, 2012, *World Academy of Science, Engineering and Technology*, *6*(4), p. 887. Copyright 2012 by World Academy of Science, Engineering and Technology. Adapted with permission.

Panahi et al.'s model identifies the potential of social media space to assist in the sharing of tacit knowledge through: "Social interactions; Experience sharing possibilities; Informal relationship & networking; Observation & listening; [and] Mutual swift trust" (Panahi et al., 2012, p. 878). The new conceptual model (see Figure 1) incorporates two elements specifically

presented in Panahi et al.'s model (social interaction and share experiences). "Space for reflection" is a term used in the new model that relates to what Panahi et al.'s model refers to as "Observation & listening" (2012, p. 878). The new model suggests using a social media platform to share knowledge enables users to:

- view and contribute content using various devices,
- view and post multimedia content,
- share experiences,
- reflect,
- co-create knowledge, and
- interact with other users.

The webisodes illustrate the sharing of experiences and multimedia components of the conceptual model (Figure 1).

The elements adapted from Panahi et al.'s model (social interaction, reflection, and sharing experiences) depict some of the components necessary for effective adult learning (Tynjälä & Häkkinen, 2005). Added to these elements from Panahi et al.'s model are:

- access to the social media platform from any device including smartphones or tablets,
- storage and playback ability for multimedia content (González-Martínez, Bote-Lorenzo, Gómez-Sánchez, & Cano-Parra, 2015), and
- tools for knowledge co-creation (Khan, 2015).

Integrated throughout all of the components of this new model are the theoretical underpinnings of the Technology Acceptance Model (TAM): e-learning products are only used if they are both perceived as useful and easy to use (Davis, 1986). This new conceptual model, however, does not address the many factors that may influence an individual's learning outcomes

(Hildrum, 2009). An individual's desire to learn (Klein et al., 2006) or the presence of a supportive workplace learning environment (Cheng et al., 2012; Wang et al., 2011) are examples of factors not included in this model.

Project Design and Implementation

This section describes the project design and implementation. Google Sites is a social media platform with straightforward tools to setup attractive webpages (González-Martínez et al., 2015; Jeffryes & Johnston, 2013; Moldes et al., 2012). In addition, Google Sites can host multimedia and offers tools for knowledge co-creation across multiple devices (Lemley & Martin, 2015). Furthermore, Google Sites is the only social media platform available to NTC training coordinators to develop independently at this time (C. Humphrey, personal communication, January 15, 2014). Therefore, Google Sites was selected as the social media delivery platform for the webisodes.

The Bureau of Land Management's most recent policy on the use of Google Sites, part of the suite of Google Apps available in BisonConnect, was issued in April 2013 (Bureau of Land Management, 2013). This internal and temporary policy directs employees on the use of Google Sites. This policy, designated as internal, is prohibited from release to the public unless reviewed under the Freedom of Information Act (Bureau of Land Management, 2014). The project design complies with the controls listed in the internal directive.

To create and implement this project, a workflow plan was developed (see Figure 2). This project utilized recorded interviews with subject matter experts conducted in five BLM Field Offices over two weeks in the summer and fall of 2012. The intent was to capture and share digital stories of relevant, real work events for the purpose of sharing knowledge and experiences within the organization. BLM and National Park Service resource specialists in

multiple disciplines including botany, fuels management, weed management, and recreation management were interviewed and videotaped by the BLM's National Training Center staff. Interview topics included planning, active and passive restoration techniques, herbicide application in remote areas, building partnerships, inventing tools to meet site-specific challenges, maintenance, monitoring, and evaluation. Similarly, private land owners, watershed restoration board members, non-governmental organization staff, volunteers, and youth corps members were also interviewed. Together, this collection of interviews was the primary source of visual and audio materials for the webisodes.

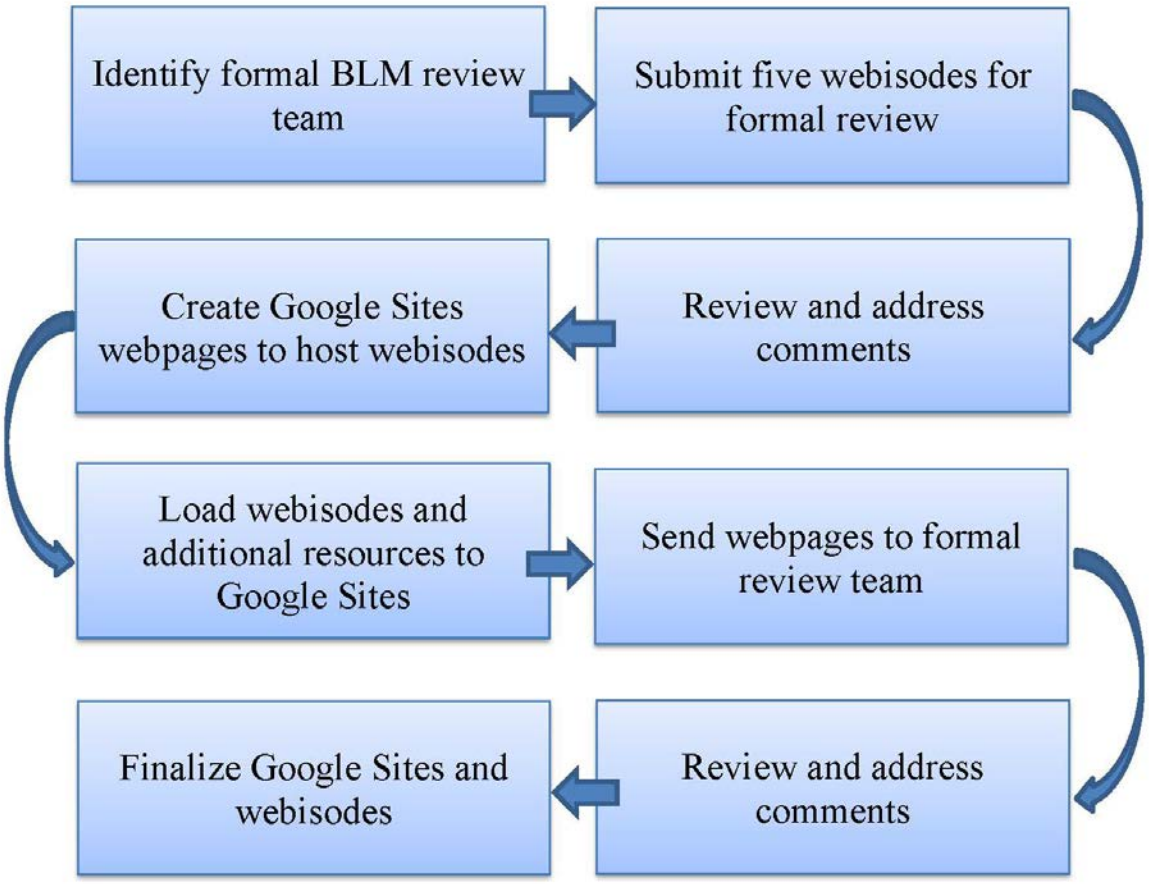

Figure 2. Workflow model to develop and finalize webisodes and Google Sites webpages.

The Google Sites webpages:

- communicate stories and share experiences from riparian restoration experts in the Southwest using video,
- provide tools for employees to connect and interact,
- display additional learning resources and references,
- present a space for reflection, and
- encourage knowledge co-creation.

Development and validation of the webisodes and webpages followed the workflow model (Figure 2). This model was developed based on input collected from multiple subject matter experts within and external to the BLM organization (A. Ferraro, personal communication, January 24, 2013; J. Jimenez, personal communication , March 14, 2013; J. Jones, personal communication, August 10, 2013; B. Keating, personal communication, February 13, 2013; J. Knudson, personal communication, March 14, 2013; A. Krake, personal communication, July 25, 2013; A. Sher, personal communication, March 14, 2013; S. Smith, personal communication, February 6, 2013; M. Taber, personal communication, August 12, 2013; L. Young, personal communication, February 6, 2013). The information revealed a need for an internal agency review process including multiple disciplines at all levels within the BLM prior to the release of the webisodes and webpages.

The first step in the workflow model, accordingly, identified the members of the interdisciplinary review team representing all levels within the BLM organization. The rest of the steps in the workflow model were established to validate the content of the webisodes and webpages through a formal review process using the interdisciplinary team. The team consisted of experts in the fields of audio visual production, riparian management, fisheries and wildlife

management, integrated weed management, wildland fuels management, wildland recreation management, safety and health, aquatic ecology, and wetland ecology.

The webisodes were created using the Final Cut Pro® application with the OS X® operating system software on Apple computers. Two NTC audio visual interns assisted with building the video timelines, creating graphics, adding text such as name and titles, inserting still images where needed, and adjusting audio quality. The interdisciplinary team reviewed the content of ten webisodes and ten webpages for scientific soundness as well as consistency with applicable laws, regulations, and policies. Feedback from the review team was addressed and adjustments were made to both webisode and webpage content during this phase in the workflow. Primarily, review comments related to the website layout, organization of the webisodes, additional links and documents, contact information, and language introducing the appropriate use of tools and references displayed for planning riparian restoration activities.

Finalized webisodes were uploaded to Google Drive and then inserted into Google Sites and organized. Timed closed caption files were created by a service contractor and then reviewed for accuracy. These caption files were added to Google Drive and then associated with the video files. Short descriptions for each webisodes were added. Quick links to connect to other useful websites such as the interagency National Riparian Service Team (http://www.blm.gov/or/programs/nrst/index.php) or the National Wild and Scenic Rivers System (http://rivers.gov/) were created on the left side of the webpages. Three key words were identified as the website's category tags: river restoration, riparian restoration, and NTC. Optimization for mobile viewers was enabled in the site settings. A search box tool was added to the top of each webpage. A calendar was inserted and learning opportunities with links added as calendar events.

The "River Restoration" website (https://sites.google.com/a/blm.gov/river-restoration/home) was announced to BLM employees through email. The email briefly introduced why the site was created; provided links and a short overview to nearly each of the webpages; encouraged employees to contribute their stories, lessons learned, innovations, planning documents, and other resources; and requested users to fill out the short questionnaire. The email was sent to the national BLM program lead for wild and scenic rivers, BLM national program lead for rivers not designated under the Wild and Scenic Rivers Act, BLM riparian coordinators in every state office, center, and at the Washington Office. Generally, BLM state office coordinators are responsible for forwarding informational emails to resource specialists located in the field and district offices within each of their respective states (C. Humphrey, personal communication, February 6, 2013).

The final website included a webpage with a short questionnaire built using Google Forms (see Appendix A). The purpose of the informal questionnaire was to assess the reaction of the website users related to the core constructs of the Technology Acceptance Model (TAM). All responses collected were anonymous. Four multiple choice questions were presented with text only answers to the following questions:

- How useful is the knowledge and information shared on this site?
- Was this website (Google Sites) easy to use?
- Did you experience problems or issues with the technology used on this site?
- Overall, how satisfied were you with this site?

Chapter 4–Results and Discussion

This chapter presents the project's final products. The results section explains each of the final products. The discussion section explores the outcome of the project related to the objectives and conceptual framework. Barriers and limitations are described in the discussion section.

Results

Six new webisodes were created to share experiences from river restoration efforts underway in the Southwest within the agency. Two of these webisodes examine inventive designs for irrigating native plantings in revegetation sites after the removal of non-native vegetation. The other four webisodes investigate a whitewater raft design being used primarily on the Colorado River for transporting and applying herbicide to treat non-native vegetation along remote stretches. In addition, four video case studies originally presented together in a documentary produced by the National Training Center called *Southwest Rivers – Case Studies on Restoration* (Bureau of Land Management, 2013) were repurposed into case study webisodes.

The first irrigation innovation webisode features an interview with Mark Taber, BLM Weed Management Specialist, explaining a prototype system being used along the Dolores River in Colorado. The six-minute video illustrates how a solar panel is used to recharge a battery which powers a small bilge pump. The pump, controlled by a timer, draws water from the Dolores River to irrigate recently planted willow pole cuttings using soaker hoses (M. Taber, personal communication, May 19, 2012). In the second irrigation innovation webisode, BLM River Ranger Alan Grubb presents a low maintenance design to irrigate cottonwood trees along remote sections of the Colorado River. The design utilizes human power from volunteers and

staff to refill a 55-gallon plastic water barrel, which slowly releases water to the trees through a network of buried irrigation tubing (A. Grubb, personal communication, May 21, 2012).

A series of four webisodes highlight the tools and applications of a specialized whitewater raft originally designed by Mark Taber and BLM Lead River Ranger Troy Schnurr. The first video in this series provides an overview of the raft's features. Using a 16-foot whitewater raft as the foundation, they developed a containment system for transporting and mixing herbicide. Containers carrying freshwater can be mixed with the herbicide onboard the raft. Utilizing two 150-foot hoses connected to the mixing tank, herbicide applicators can spray roughly two acres of non-native vegetation. A pump designed to draw water from the river to mix with the herbicide is available, should the treatment area exceed the fresh water capacity onboard the raft. Two electric hose reels can be remotely activated by the herbicide applicators to automatically rewind any extra hose length while they are spraying. The three pumps and the electric hose reels are all powered by a 12-volt marine battery (M. Taber, personal communication, May 18, 2012).

The other three webisodes in the restoration raft series present more specifics and technical factors about the raft design and use. The second webisode, for instance, delves more deeply into the inner workings of this inventive raft to reveal valves, pumps, electrical connections and other finer details. The third webisode demonstrates the raft's herbicide mixing process and remote operation of the hose reels. Key points to remember when you are planning a treatment project using the raft are also presented in the third webisode. The final webisode in this series explores differences between the original "weed raft" design developed by Taber and Schnurr for use in Colorado and the two "restoration rafts" designed and built for use in Utah. Brian Keating, BLM Fuels Program Manager, explains the main differences are the size of the

raft and the capacity of the storage tanks. The rafts built for operation in Utah use a 14-foot whitewater raft and therefore are not able to transport as much herbicide product and fresh water as the original weed raft. However, these smaller rafts are able to navigate rivers with lower streamflow conditions (B. Keating, personal communication, May 21, 2012).

The six new webisodes and four repurposed case study webisodes were all presented through Google Sites webpages, developed in the BisonConnect environment. The website, called River Restoration, includes one homepage and nine subpages (see Figure 3). While the user may watch the webisodes in any order, text on the webpages and the layout of the website navigation menu on the left side indicate the suggested viewing order. The longest webisode is approximately eight minutes and the shortest is less than three minutes. The website was shared with the entire Department of the Interior.

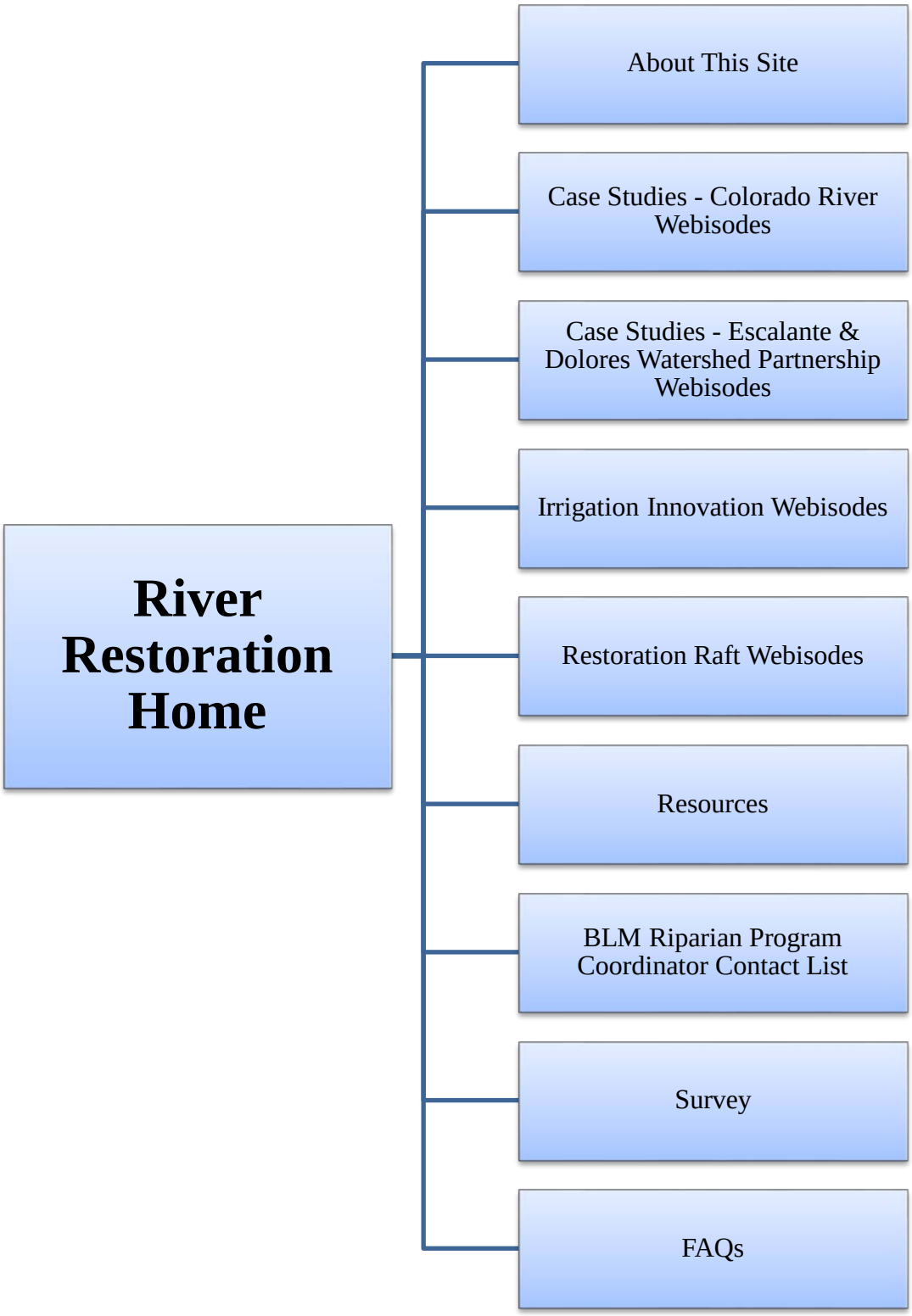

Figure 3. Sitemap of Google Sites "River Restoration" website

The nine subpages are arranged in the website navigation panel in the same order they appear in Figure 3. The purpose of the website is described briefly on the homepage and covered in more detail on the webpage called "About This Site." Over 30 resources were uploaded to the "Resources" webpage. These resources cover a wide range of topics from partnerships and adaptive management to assessment, inventory, and monitoring. The resources include technical references, strategy documents, links to educational videos, and other tools. Users are enabled to edit this webpage. Text on the top of the webpage encourages employees to share their riparian restoration experiences, post their planning documents and monitoring plans, upload images, or add additional resources.

A contact list of riparian program coordinators within the BLM is provided on one of the webpages. Near the top of this webpage, a text box explains that BisonConnect websites are only available to those within the Department of the Interior. Viewers are provided with a link to the Cross Watershed Network, should they wish to connect with other riparian restoration practitioners outside of the Department of the Interior. The Cross Watershed Network is an organization devoted to improving watershed health in the arid west through partnerships, connecting peers, and sharing information (Cross Watershed Network, 2015).

In the navigation panel, after the contact list is presented, the webpage displaying the Google Forms informal survey appears (see Appendix A). While the email announcing the website was initially sent to 24 BLM employees serving in riparian or river program coordination roles, it is unknown how many BLM employees the email was forwarded to. All recipients of the email as well as all viewers of the website were asked to complete the voluntary survey. However, only two responses were received (see Appendix B). Due to the exceptionally

low number of respondents, no indications or conclusions can be inferred. Following the survey webpage, a list of anticipated commonly asked questions is presented with answers.

Discussion

The purpose of this practicum project was to advance e-learning opportunities to promote knowledge exchange and use within the BLM. This project explored the use of webisodes delivered on a social media platform to share some of the BLM's river restoration experiences in the Southwest. A workflow model was identified in Chapter 3 to identify the steps for development and review of the webisodes and the delivery platform content (see Figure 2). Following this workflow plan led to completion of each of the project's objectives presented in Chapter 1. Although the project's objectives were met, the functionality of two of the social media elements identified in the conceptual model was limited: co-creation of knowledge and social interaction. In this section of the paper, limitations and barriers are discussed.

Co-creation of knowledge on the Google Sites webpages was restricted to employees uploading additional resources, reference documents, multimedia content, and posting comments. Within BisonConnect, Google Drive and Google Docs offer opportunities for employees to share documents and collaborate in real time within documents (Google, 2015). However, real time collaboration in documents is generally most useful when a specific team or task is identified (C. Humphrey, personal communication, January 15, 2014).

Furthermore, social interaction, one of the four factors suggested for effective e-learning environments (Wang et al., 2011), is essentially non-existent in Google Sites within the BisonConnect environment. While a list of subject matter experts and their contact information is provided, the two-way communication normally characteristic of a social media platform (Khan, Swar, & Lee, 2014), is not yet enabled within BisonConnect. Outside of the

BisonConnect environment, Google Apps for Work provides a tool called Google+ to quickly connect and communicate with colleagues (Google, 2015). Using this network tool, employees could join online communities of interest to interact, ask questions, and share ideas. Enabling Google+ within the BisonConnect environment could lead to improvements in social interaction, exchanging information with peers, sharing experiences, and collaborating to co-produce knowledge.

This project explored the use of Google Sites as a social media platform to share knowledge about river restoration within the BLM. While the website provided a short survey to assess the reaction of users to the usefulness of the content and ease of use of the website, responses were too few to draw any insights. However, Google Sites has a tool to record website use statistics: Google Analytics (Google, 2015). This tool, unfortuntately, is not yet available to the NTC within the BisonConnect environment. Enabling Google Analytics as a tool to assess how employees are using Google Sites created by the NTC could provide ideas for better utilizing the capabilites of the interactive platform to promote collective learning.

Chapter 5–Conclusion

Webisodes and the interactive BisonConnect platform are tools available to the NTC to expand e-learning opportunities within the BLM. These e-learning tools can be used to promote and encourage knowledge sharing across a geographically dispersed workforce. Google Sites, within the BisonConnect environment, provides a more interactive and collaborative website framework than the NTC's Knowledge Resource Center website.

Websites constructed using Google Sites allow users to contribute their knowledge and information. However, utilizing social interaction and networking tools, such as Google+, may further improve the two-way exchange of knowledge to promote collective learning within the organization. Google+ and website use statistics are not yet available within the BisonConnect environment. Enabling collection of website statistics may indicate if e-learning tools such as Google Sites are being used by employees. Further research is recommended to assess effectiveness and learning outcomes of using social media technology to share knowledge within the agency. Finally, improving opportunities to access, collaborate, and participate in the co-creation of knowledge for the purpose of shared learning across disciplines, work units, and watersheds internally and externally to the Department of the Interior should be considered as technology evolves.

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APPENDIX A

Using Google Sites to Share River Restoration Knowledge Questionnaire

The purpose of this short survey is to assess your perception of the usefulness and ease of use of this Google Site. Providing responses to the questions on this form is completely voluntary. All responses are anonymous. The results of this informal questionnaire will be used to improve the National Training Center's e-learning tools. Should you have any questions or would like to discuss details, contact Maile Adler, Training Coordinator, BLM National Training Center, at (602) 905-5502 or at madler@blm.gov.

How useful is the knowledge and information shared on this site?

- Extremely useful
- Very useful
- Somewhat useful
- Neither useful nor not useful
- Somewhat not useful
- Not very useful
- Not at all useful

Was this website (Google Site) easy to use?

- Extremely user-friendly
- Very user-friendly
- Somewhat user-friendly
- Neither user-friendly nor not user-friendly
- Somewhat not user-friendly
- Not very user-friendly
- Not at all user-friendly

Did you experience problems or issues with the technology used on this site?

Examples of problems with technology include: videos would not load, videos would not play, webpage crashed, could not view site from my tablet, webpage was distorted, etc.

- None
- 1 issue
- 2 issues
- 3 issues
- 4 issues
- 5 to 9 issues
- 10 or more issues
- Other:

Overall, how satisfied were you with this site?

- Extremely satisfied
- Moderately satisfied
- Slightly satisfied
- Neither satisfied nor dissatisfied
- Slightly dissatisfied
- Moderately dissatisfied
- Extremely dissatisfied

APPENDIX B

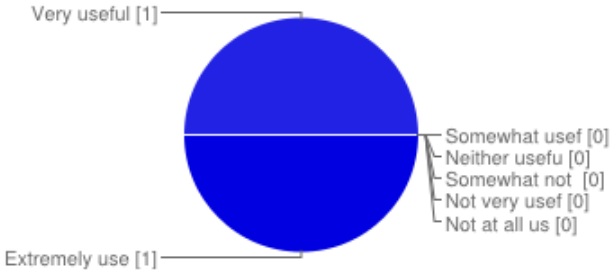
Using Google Sites Questionnaire Results

2 responses

View all responses Publish analytics

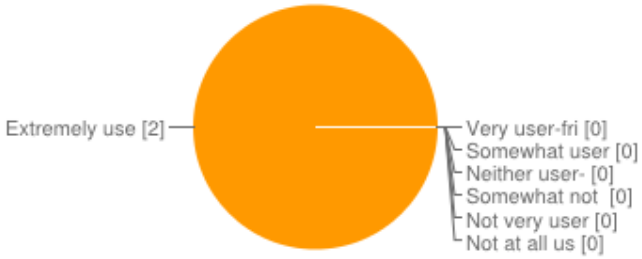
Summary

How useful is the knowledge and information shared on this site?



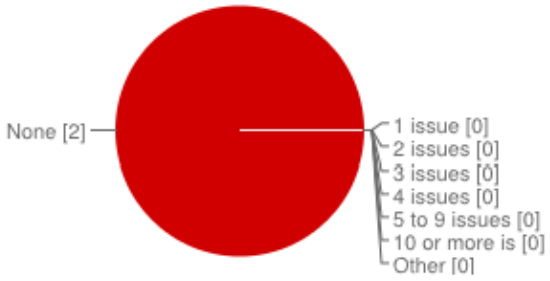
Extremely useful	**1**	50%
Very useful	**1**	50%
Somewhat useful	**0**	0%
Neither useful nor not useful	**0**	0%
Somewhat not useful	**0**	0%
Not very useful	**0**	0%
Not at all useful	**0**	0%

Was this website (Google Site) easy to use?



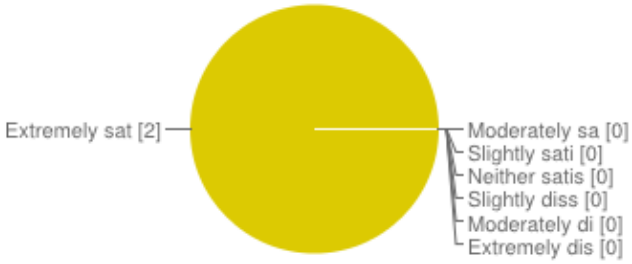
Extremely user-friendly	**2**	100%
Very user-friendly	**0**	0%
Somewhat user-friendly	**0**	0%
Neither user-friendly nor not user-friendly	**0**	0%
Somewhat not user-friendly	**0**	0%
Not very user-friendly	**0**	0%
Not at all user-friendly	**0**	0%

Did you experience problems or issues with the technology used on this site?



None	**2**	100%
1 issue	**0**	0%
2 issues	**0**	0%
3 issues	**0**	0%
4 issues	**0**	0%
5 to 9 issues	**0**	0%
10 or more issues	**0**	0%
Other	**0**	0%

Overall, how satisfied were you with this site?



Extremely satisfied	**2**	100%
Moderately satisfied	**0**	0%
Slightly satisfied	**0**	0%
Neither satisfied nor dissatified	**0**	0%
Slightly dissatisfied	**0**	0%
Moderately dissatisfied	**0**	0%
Extremely dissatisfied	**0**	0%