

CONSTRUCTING NEGOTIATED MEANING AND KNOWLEDGE FOR THE *SOL Y AGUA* PROJECT'S ROLE— PLAYING ADVENTURE GAME FOCUSED ON SUSTAINABILITY PROBLEMS IN THE EL PASO-RIO GRANDE AREA

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with love*

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SUSTAINABILITY PROBLEMS IN THE EL PASO-RIO GRANDE AREA

by

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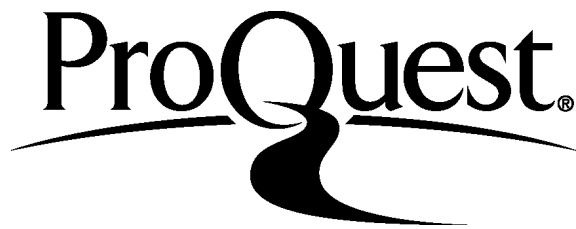
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Abstract

Video games that address environmental sustainability issues could engage students. However, video games make simplifications and establish idealistic expectations that do not resemble real life sustainability challenges and settings. Game developers and scholars believe that depicting the complexity of the real world could help video games become effective educational tools. They call for additional procedures that incorporate information from actual settings and real life situations. Furthermore, scholars have argued that video games addressing sustainability issues can be improved or made more meaningful with the participation of youth from underrepresented populations, e.g., Latinos.

The *Sol y Agua* project at The University of Texas at El Paso exemplifies efforts to create a video game informed by real life circumstances. As a member of this project, I aimed to gather local environmental and cultural information to inform the development of the video game. Through a case study, I examined how the underlying values, beliefs, meanings, and knowledge of six community members in the fields of agriculture, urban systems, ground water systems, desert ecology, and traditional ecological knowledge function as hidden logics that collide, intersect, and aggregate to construct new meaning and knowledge of local sustainability issues.

Study results indicated that some community members added a personal dimension to the professional view of collaboration held by other community members who presented themselves strictly as scientists. Furthermore, the study yielded the concept of the “largest water user.” Community members’ perceptions of the largest water user intersected and created a new viewpoint, in which the largest water user is a changing concept that would continue adjusting as local circumstances fluctuate. Also, community members’ perspectives collided. The majority of community members believed that students could develop a deeper connection with the Rio Grande River by participating in outdoor opportunities that foster insightful understanding of nature. However, some community members sug-

gested that students foster deep connections with nature through everyday activities as part of their own culture and background. Tracking community members' logics revealed their individual values, knowledge, and beliefs. In turn, the individual logics helped construct new knowledge that could inform the development of the video game at a community level.

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Chapter 1

Introduction

One of the major issues of our time is the achievement of environmental sustainability. The term environmental sustainability emerged as a consequence of increasing social concerns about human impact on natural environments. Population growth and industrialization have resulted in increasing environmental issues, such as pollution, loss of habitat, loss of biodiversity, lessening of natural resources, climate change, deforestation, and renewable energy (Sharp, 2002). Consequently, humans have aimed to develop a continuous “human life-support-system” that implements effective practices and mitigates further degradation of Earth’s natural environments. In order to develop an effective system, environmental sustainability seeks to examine “the risk, uncertainty, and inconclusive scientific evidence of environmental issues” (Ashley, 2000, p. 270) as well as complex issues that involve “social, ecological, economic, political and spiritual components” (Moore, 2005, p. 537). Additionally, disciplines focused on environmental sustainability aim to promote unceasing pro-environmental activities that are “...ecologically sound, socially just, economically viable and humane” (Clugston & Calder, 1999, p. 2). Video games have the potential to engage students with environmental sustainability topics. Chang (2013) explained that in educational curricula ecological questions have been communicated as a crisis and moral duty, but video games can help communicate complex environmental issues in a less daunting manner. Despite the potential of video games, Gee (2009) and Goggin (2013) suggested that development of good educational video games that help people gain a deeper conceptual understanding of real life issues remains “more a hope for the future than a realized possibility, though there are some intriguing beginnings here and there” (Gee, 2009, p. 67). Developers of video games and scholars in rhetoric and writing studies have identified discrepancies with the design of video games that prevent them from preparing students

to understand and tackle real life social problems.

Commercial and educational video games that address sustainability issues make simplifications and establish idealistic expectations that do not resemble real life sustainability challenges. Furthermore, video games do not consider the local and unique settings where these issues take place including the cultural and race diversity of the local stakeholders. For example, Dill, Gentile, Richter, and Dill (2005) as well as Glaube, Miller, Parker, and Espejo (2001) concluded that minority characters rarely appear in video games, and when minority characters emerge in virtual spaces they are stereotyped.

Corey May, the main writer of the Assassin's Creed series and the co-founder and President of Sekretagent Productions, a production company based in Los Angeles, California (Lambert, 2013), indicated that video games could become more engaging by "redefining the way we approach video game building" to offer players a complex and authentic experience (May, 2013). His comments call for additional and detailed steps that can help bring real life complexity into virtual spaces. These steps could include developing the storyline using information collected from actual settings and real life situations. The perspective, of course, seems to privilege realism over fantasy. However, a close reading of May (2013) suggest a shift not a way from fantasy, but rather, towards embedding real-life concepts more effectively into education games.

The *Sol y Agua* project at the University of Texas at El Paso exemplifies the efforts of a team to create a video game that draws from real life circumstances. Namely, the *Sol y Agua* project seeks to create a virtual role-playing adventure video game focused on water sustainability issues in the El Paso-Rio Grande area. It is important to note that sustainability has many interpretations. The *Sol y Agua* team considered water sustainability specifically. Their definition of water sustainability focused on activities and knowledge that would help local students manage water resources effectively while protecting and ensuring their wellbeing. Although I referred of different notions of sustainability in this thesis, for purposes of stasis, I relied on the *Sol y Agua* team's definition of water sustainability throughout this thesis. The *Sol y Agua* team hypothesized that integrating

specific, targeted local environmental and cultural information could help increase local students' interest and dispositions toward environmental themes. As a participant of the *Sol y Agua* team, I interviewed six different community members in the fields of agriculture, urban systems, ground water systems, desert ecology, and traditional ecological knowledge to elicit local themes, information, and background that could be incorporated in to the video game's storyline. The community members' insights and ideologies offer fundamental contributions to the production of the video game. Nevertheless, the integration of this information into the video game involves translating community members' insights into meaningful knowledge that can guide the video game's design. The responses of the community members are raw, discrete sets of information that have no specific meaning to the design of the virtual space. Meaning will potentially emerge when the information is examined and related back to the necessities of the video game.

This research uses a case study to examine the diverse perspectives on water issues and sustainability; it explores one aspect of video games design. Local community members shared certain ideas and goals about water sustainability, but their logics behind their notions diverged. I propose that decrypting and negotiating these logics can construct new knowledge and meaning to inform the design of the video game. In doing this research, I speculated that as the community members responded to my questions, they would negotiate their networks of meaning (active ideas, images, experiences in their mind, a web that is in turn part of the individual's large, social shaped network of knowledge) with external forces (social imperatives, prior knowledge, ability, motivation, discourse conventions). They would have to interpret and manage conflicting voices, which would resulted in "provisional resolutions and -at times-in restructured understanding" (Flower, 2003, p. 243). As Flower (2003) suggested tracing their negotiations in the interview transcripts could uncover hidden logics about water sustainability in El Paso-Rio Grande area. Then, the mediation of all of the individual hidden logics could produce new knowledge.

I hypothesize that to bring reality to a video game focused on environmental sustainability, we must understand what the environment, sustainability, and nature means to local

individuals that could be represented in the virtual space. Examining the logics that lead to their answers could provide knowledge about their viewpoints, backgrounds, and the relationship between their different views. Subsequently, the study could help create more coherent characters and accurate stories that represent the local setting. I draw from the concepts of cognitive rhetoric, constructions of negotiating meaning, and meaning analysis to understand community members' logics that underline their perspectives on local water sustainability issues. In order to understand and decipher the underlying perspectives held by the community members, I posit and answer the following two questions:

- How do the community members' individual underlying values, beliefs, meaning, and knowledge result in hidden logics that collide, intersect, and aggregate to construct new meaning and knowledge of local water sustainability?
- How can the constructed new meaning and knowledge of local water sustainability inform the construction of the *Sol y Agua* project's video game?

The subsequent sub-questions helped me answer the main research questions:

- How do the community members view the challenges that El Paso-Rio Grande community faces in maintaining and sustaining the Rio Grande?
- What do the community members consider effective efforts to improve water resource sustainability in the Rio Grande?
- What do the community members believe is key information that educators need to share to help students become more engaged in local water sustainability issues?

In chapter 1, I examine literature on the use of video games for education and social change to stress the significance of the *Sol y Agua* project and my research. I explore studies that have identified the effectiveness and weaknesses of video games to highlight the aspects of video games that must be improved. Additionally, I review discussions about multiple meanings in environmental and sustainability dialogue with stress on rhetoric's disciplinary

perspective. In Chapter 2, I provide details about the design and purpose of *Sol y Agua* case study. In Chapter 3, I present the results, and in Chapter 4, I analyze them and discuss their implications.

Chapter 2

Literature Review

This chapter is divided into subsections that examine literature on video games and the construction of meaning in environmental dialogue. My research and analyses of educational video games comprise in four categories, which I have divided into sub-sections: 1) Video games for education and social change; 2) Video games' discrepancies; 3) Incoherence of environmental video games and their impact on social change; and 4) Efforts to improve video games. In the second part of the chapter, I review literature that explores multiple meanings and negotiating of meanings to understand the real life aspects of environmental sustainability dialogue that are under-considered in the educational video games design. My literature review is divided in four subsections: 1) Multiple meanings and negotiating meaning in environmental dialogue; 2) Multiple meanings and the effect on environmental dialogue; 3) Ambiguity of terms as rhetorical devices; and 4) Rhetoricians' efforts to negotiate meaning. I conclude this chapter with my concluding remarks.

2.1 Video Games for Education and Social Change

Researchers have identified the benefits of video games for learning in areas such as government, education, business, and healthcare (Susi, Johannesson, & Backlund, 2007). Educators and scholars have consistently concluded that digital-based education, such as video games, promotes learning. Examples of publications on the usefulness of video games for education include James Paul Gee's *What Video Games Have to Teach Us about Learning and Literacy* (2003), Clark Aldrich's *Simulations and the Future of Learning: An Innovative (and Perhaps Revolutionary) Approach to e-Learning*(2003), Marc Prensky's *Digital Game-Based Learning* (2005), Prensky's "*Don't Bother Me, Mom, I'm Learning!*": How

Computer and Video Games Are Preparing Your Kids for 21st Century Success and How You Can Help!(2006), Squire's *Video Games and Learning: Teaching and Participatory Culture in the Digital Age Technology, Education* (2011). Scholars have argued that educational and commercial video games have great potential for both communicating complex issues that severely affect our lives and for preparing students of all ages to resolve these problems (e.g. Hawisher & Selfe 2007; Shaffer, Squire, Halverson, & Gee 2005; Shaffer 2007; Raessens & Goldstein 2004; Wolf & Perron 2003; Squire 2006). Furthermore, these studies have collectively identified video games' qualities that could help students become more engaged in learning.

Curricula support students' dependency on adults because "we see children and childhood as interconnected within structural categories similar to class, gender and age" (Arlemalm-Hagser & Davis, 2014, p. 5). However, digital multi-media help students develop a sense of autonomy and an awareness of consequentiality (Barab, Thomas, Dodge, Carteaux, & Tuzun, 2005). Video games provide opportunities to learn and engage students in difficult concepts and situations (Barab et al., 2005). For example, Squire and Jenkins (2003) as well as Corti (2006), argued that video games environments and systems involve students in experiences that are impossible in real life for reasons of safety, cost, and time. Newman et al. (2012) affirmed that video games allow participation of multiple players, engagement with broad audiences, and collection and control of data. Also, Foreman (2004) and Totty (2005) stated that video games offer players competitive scoring, increasingly difficult levels, role-playing, and enjoyable illustrative experiences that are engaging, visually dynamics, and rapidly paced. Video games could be considered communities in which students can judge and negotiate multiple options/ideas and competing information (Squire & Steinkuehler, 2005). Furthermore, students' interest in video games make them effective educational tools. Video game developers have surveyed students about video games, and they have reported that when youth are introduced to educational activities on the computer, they "become more willing to do the work" (Barab et al., 2005, p. 98). Considering all the benefits of video games, developers and scholars have proposed to use

them as social change instruments.

Squire (2005), Averill (2005), and Suler (2001) considered that video games could enter classrooms as interactive learning spaces where students can experience intense emotional and sensory experiences. However, the benefits of video games also have reach beyond the classroom and can help students create social change. Games have collaborative and motivational powers that organizations and individuals can use to solve social problems and improve humans' lives (McGonigal, 2011). McGonigal (2011) envisioned games as "real solutions to problems and a real source of happiness" (p. 13). She added, "I want games to be something everybody learns how to design and develop, because they understand that games are real platform for change and getting things done...that tackle real dilemmas and improve real lives" (McGonigal, 2011, p.15). Despite the potential of video games, other scholars have indicated that they can deprive students from real life experiences, encourage consumerism, and promote irregular behavior.

Researchers have pointed out that there are not enough studies that confirm positive effects on player's cognition. Squire et al. (2005) argued that "[t]o date, we actually know relatively little about the consequences of game play on the cognition of those who play them" (p.34). Similarly, Mitchell and Savill-Smith (2004) rationalized that it is difficult to draw conclusions from studies on computer and video games because of their conflicting outcomes. Although research has not confirmed the negative impact on players, Provenzo (1991, 1992) argued that there could be a relationship between video game use and aberrant social behavior. For example, Mitchell and Savill-Smith (2004) identified a number of possible negative impacts that include headaches, fatigue, mood swings, repetitive strain injuries, depression, social isolation, less positive behavior towards society in general, increased gambling, a substitute for social relationships, aggressive behavior, and negative personality development. Other scholars believe that video games could withdraw players from reality. Robertson (2006) argued that children's outdoors experiences have declined due to the children's rising use of technology for play. Similarly, Louv (2007) argued that the decrease of outdoor experience causes children to acquire "nature deficit disorder."

Aitken (2001) implied that commodification of children and the commercialization of play created by the video game industry has contributed to the cutback in children's independent outdoor experiences. However, McGonigal (2011) argued that people who do not consider video games as powerful tool "will be less prepared to share the future. And therefore, they will miss some of the most promising opportunities we have to solve problems, create new experiences, and fix what's wrong with reality" (p. 11).

Corporations and institutions are using video games as tools to improve pressing social challenges. For example, environmental video games created by corporate public-relations campaigns and academic institutions have increased through the decades in an effort to resolve environmental sustainability issues. Video games could help students feel more appeal to acknowledge environmental issues because they depict abstract data and inconceivable ecological threats as manageable concepts that can be handled by humanity (Chang 2013). Thus, corporations have created video games that focus on environmental themes. The Starbucks Coffee Company, Global Green USA, and *CO₂Fx*, created the *Planet Green Game*, an industry-academic hybrid project funded by the National Science Foundation (Chang, 2013). In *Planet Green Game*, the player supervises the development of a country. The user has to balance economic development with scientific research, conservation, and other initiatives. The game requires the player to negotiate the demands of industry and the environment. For instance, when the player favors industry over environmental health, quality of life suffers. However, protecting natural resources alone results in decline of the gross domestic product (Chang, 2013). Similarly, in Chris Crawford's *Balance of the Planet*, the player takes the role of a resident of the fictitious town of Evergreen. The video game allows players to explore their house, the city park, and the local school to "discover mini-games that helped identify ways to improve the town's green quotient and your own 'ecometer' score" (Chang, 2013, p. 4). Chevron developed the game *Energyville*, in which players learn about the challenges faced in meeting the world's energy needs and the environment, security, and trade-offs associated with different energy sources (Chevron, 2007). Similarly, *Energy City* is a video game where players help city conserve energy by

creating and energy portfolio from renewable and everlasting sources, such as sunlight and wind (Jason Learning, 2015). McGonigal (2011) helped design the game, *World Without Oil*, which promotes a dialogue about alternative energy solutions in case of oil shortage. These games address issues of environmental sustainability, but scholars such as Springer and Goggin (2013), Gee (2009), and McGonigal (2011) have stated that all video games, including environmental theme video games, must improve in order to have a greater impact on player’s attitudes and behavior towards environmental issues. Video games could serve as tools for education and social change, but many discrepancies must be resolved to engage players with difficult social issues.

2.2 Video Games’ Discrepancies

2.2.1 Video games’ ludonarrative dissonance

One of the problems in video game development is that of competing stories— between the protagonist and the player. The protagonist’s story is concerned with the traditional story elements: character, setting, conflict, plot, and theme (May, 2013). The player’s story considers “the rules, the regulations, the mechanics and design that govern interactions in the virtual space where the games take place” (May, 2013). The challenge for production teams is to make these two stories collaborate. Hocking (2007) explained that the player becomes detached from the game when the protagonist’s story tells the players to achieve an action or objective, but the player’s story contradicts it through gameplay. For example, the protagonist’s story could “describe the main character as an altruistic hero that risks anything to protect the innocent” (Johnson, 2011, para. 6), but the player’s story “lets him slaughter said innocent (perhaps you even reward such blood shed)” (Johnson, 2011, para 6). Thus, May (2013) rationalized, “the fictional narrative does not match up with the experience being created for the player.” Hocking (2007) named this discrepancy between the protagonist’s story and the player’s story ludonarrative dissonance. May (2013) believed that the divergence between the two stories does not allow players to have an engaging

experience because the video games are inconsistent with reality. For example, Chauvin, Leveux, Donnart, and Natkin, (2014) explained

...in an emergent game a door will behave in a consistent fashion - it can always be opened. However, in a linear game it is common to have only specific doors being openable; while others are simply textures, not meant to be opened, thus guiding the player but resulting in a feeling of inconsistency. (p. 2)

Video games' discords can prevent players from seeing them as serious learning devices. Currently, some video games portray complex narratives that support collaboration, social relationships, and have high quality graphics, but their use as an educational tools continues to concern educators, game developers, and scholars. Scholars have claimed that most video games have been designed for commercialization and to capture the attention of white males by presenting white male avatars in protagonist roles, presenting sexual representation of women and misrepresentations of minorities (Kolko, 1999; McDonough, 1999; Barab et al., 2005). The inaccurate portrayal of the real world could be a result of game developers who do not prioritize accuracy and equality in game design. Herz (1997) believed, "the people transmitting their stories to the next generation aren't priests or poets or medicine women. They're multinational corporations. And they are not trying to appease the gods. They are trying to appease the shareholders" (p. 170). Similarly, video games that focus on environmental sustainability could become influential tools to ameliorate current environmental challenges. However, as I will explain in the next section, current video games do not provide an experience to help players develop a deep understanding of environmental sustainability issues.

2.2.2 Incoherence of environmental video games and their impact on social change

Springer and Goggin (2013) analyzed the design of *Energyville* and *Energy City*, two video games that promote environmental literacy. They concluded, "nature is depicted

in most multiplayer online games as an inexhaustible dispense of resources” (Springer & Goggin, 2013, p. 122). For example, a river that supplies water to a city could be depicted as a continuous source of water, and the video game could simplify or ignore the complex methods and complications required to supply water to households. The authors described the setting of the games as fairly generic and universal in appearance (Springer & Goggin, 2013). Games could suggest that plant and animal life grows homogenously across the planet without considering the unique flora and fauna of certain regions. According to Springer and Goggin (2013), these video games presumed that energy sources and reduction techniques could be implemented in any city despite the distinctive environment and resources of each city. Games could imply that desalination plants or nuclear plants are the best option to provide renewable energy in all cities without describing the repercussions of their implementation in particular cities. Furthermore, both games ignore or streamline conflicting political ideas that prevent governments from installing change (Springer and Goggin, 2013). For instance, *Energy City* allows players to connect with different stakeholders, but the players’ interactions are “a highly simplified version of the conflicting involvement in these real-world political decisions” (Springer & Goggin, 2013, p. 119). Similarly, *Energyville* overlooks political complications (Springer and Goggin, 2013). The simplification of conflicting involvement and the absence of different stakeholders does not permit players to consider the power relationships that take place in dialogues about sustainability issues and the negotiations that must take place to resolve these issues. Overall, all these incongruities emphasize “a demonstrably false yet frequently held belief about our real-world relationship with the environment” (Springer & Goggin, 2013, p. 122). The authors concluded by stating that games must represent the environment as interactive spaces and places rather than as fixed scenery. Video games must represent “largely intangible problems—ozone holes, global warming, carcinogens in air and water, and so on—in a way that drives home both their existence and their exigency” (Chang, 2013, p. 38). In addition to the misrepresentation of the environment and sustainability issues, video games do not depict cultural and race diversity sufficiently or adequately. A large body

of literature is concerned with the presence and depictions of women and minorities in all video game types. For example, the voices and needs of minority groups are often ignored and dismissed and their contribution to the improvement of sustainability challenges overlooked. Glaubke et al. (2001) analyzed 70 console games and found that Latina women and Native American men were never present in these games. Similarly, Dill et al. (2005) found that in a sample of 20 computer games only a few showed Black and Latino men as main characters and none of the games presented Black or Latina women as secondary characters. In the few instances when minorities are represented in games, the games portray them in a stereotypical manner. For example, Latino characters have appeared in sports games only, Asian characters have appeared in wrestling or fighting roles, and Black characters have appeared as violent protagonists (Glaubke et al., 2001). Along with investigations about representation of minorities in video games, researchers have focused on the effects of these portrayals. Burgess, Dill, Stermer, Burgess, & Brown, (2011) argued that negative stereotypical images of minorities in video games could result in negative social judgments and reactions to minorities in real life situations. Representations of minorities in video games could have an effect on players' identities. Gee (2005) explained that while playing video games users "become committed to the new virtual world in which they live, learn and act through their commitment to their new identity" (p. 34). Thus, players take on the role of a character in the video game, and they develop a commitment to the character that could transfer to their identities in the real world. For example, Gee (2003) explained that a user playing a superhero character could be committed to do good deeds in the game environment. The player would not shoot civilians because the character he or she is playing would not harm innocent civilians. Thus, through virtual identities players can learn new values and behavior (Gee, 2003). Bowman (2010) suggested that engaging in video games encourages pretend play, and playing make-believe can challenge "the rules of reality through imagination, adopting future social roles in game activities, reinventing identity through the creation of alternate selves and personal story lines..." (p.131). Consequently, video games that do not depict minority characters can make it difficult for minority play-

ers to commit to a virtual identity, and therefore the values learned from engaging in the virtual worlds would not project to a real world identity. Conversely, a player could commit to a virtual identity that rationalizes stereotypical images of minorities and project this identity into the real world. The depiction of minorities or lack of representation of minorities could reinforce positive or negative perceptions of them or result in disassociation of minority players. Thus, video games focused in sustainability topics should depict accurate portrayals of minority groups that participate in sustainability issues. The discrepancies of video games do not allow them to serve as tools for deep learning and to encourage social action. For example, “roughly 25% of students in school situations complained that the game was too hard, complicated, and uninteresting, and they elected to withdraw from the gaming unit and participate in reading groups instead” (Squire, 2005, p. 2). For this reason, scholars and game developers continue to improve all aspects of video games.

2.3 Efforts to Improve Video Games

2.3.1 Improving experiences for players

May (2013) argued that game developers must improve the process used to develop video games to create more appealing experiences for players. He identified video games’ ludonarrative dissonance as one of the main obstacles to achieve an engaging experience. May (2013) proposed to resolve this problem by assuring that the protagonist’s story and player’s story collaborate towards achieving a better experience for the player rather than competing with each other. In turn, attaining a better experience entails collaboration between all disciplines on a team, such as animation, mission design, art direction, and script writing (May, 2013). Furthermore, May (2013) argued that experience should be achieved through the credibility of the game. Namely, the inconsistencies between the protagonist’s story and the player’s story do not convey a sense of reality, and the players cannot take the game seriously because the stories do not unfold as expected in real life. Although educational and commercial video games have attempted to design virtual spaces

that appear close to the real world, ludonarrative dissonance could be improved when the two stories collaborate to achieve a credible experience for the player.

Murray (1997) suggested that video games must include information about real-world problems and show storylines and characters that are more human and complex to become more credible. In *HAMLET ON THE HOLODECK The Future of Narrative In Cyberspace*, Murray (1997) examined storytelling in different electronic games to understand how interaction fiction could become a compelling art form. The author suggested that the characters in a video game should achieve more than what they have been programmed to do. Virtual spaces should construct rich worlds of interactive fiction by using literature's centuries-old storytelling techniques such as "formulaic passages and characters like those of the oral tradition" (Sklaroff, 1997). The use of storytelling techniques in the design of video games would embody more complex environments that represent human personalities and behaviors (Murray, 1997). However, the application of such techniques might not be enough to develop games that represent the complexity of the real world and human characteristics. Oscar Wilde affirmed, "literature always anticipates life. It does not copy it, but molds it to its purpose..." (Moser, 1992, p. 256). Literature's techniques require writers to invent fictitious situations and characters that are manipulated to question, to speculate or mock real life. Thus, literature's storytelling does not reproduce real life directly, but utilizes life's settings and circumstances as an inspiration to create fictional narratives that contemplate the real world. Sklaroff (1997) criticized Murray (1997)'s appeal. Sklaroff (1997) asserted that literature is not a direct representation of the real world because it involves interpretation and creation. Consequently, using old storytelling techniques to create video games could not embody real life's intricacy. Hence, recent projects have focused on developing techniques that incorporate real life complexity and help design credible video games that encourage social activism and real-world participation. Murray's (1997) views parallel May's (2013) ideas about developing characters that are more complex and human. Both Murray (1997) and May (2013) believed that characters in video games should demonstrate human personalities and feeling.

The *Quest Atlantis Project* (QA) used social–responsive design to create a video game that combines “education, entertainment, and social action” (Barab et al., 2007, p. 161) to “...engage children ages 9-12 in a form of dramatic play comprising towards social action” (Barab et al., 2007 p. 161). QA achieved its mission by engaging students personally and socially with the storyline. Students contributed “experiences, ideas, and information to the activities of Atlantis” (Barab et al., 2005, p.87). The combination between the Atlantis world and local context intended to encourage students to participate in local social issues. The design process required developers to gather data from multiple sources and continually connect, code, and analyze the data (Scriven, 1983). The data collected included information about social relationships, interactions, conversations, design decisions, and artifacts (Barab et al., 2005). Additionally, the design procedures included participant observations, interviews, and examinations. Video games, such as QA that incorporate local context can successfully engage players and portray more realistic virtual spaces. However, Barab et al. (2005) found that customization of local contexts can go to extremes and result in a complete transformation of innovation. Particularly, they highlighted the conflict between reproducing innovations in local contexts and providing a program that flexibly adapts to multiple contexts. Barab et al. (2005) concluded that video games’ stories must balance the need for local customization and maintaining the game’s integrity. QA exemplifies the need to ground video games design in the experience and knowledge of local stakeholders.

2.3.2 Analysis of video games by scholars in rhetoric and literacy

Scholars in the fields of rhetoric and the literacy have examined video games with different themes to understand and improve their effectiveness, methods, virtual representations, and educational impact. Carole Blair’s notion of material rhetoric explained how video games have an impact beyond their virtual spaces. Namely, Blair believed that “rhetoric (as persuasion, as discourse in action), however, has real effects...” (Fountain, 2008, p. 56). We can understand these effects when we understand the symbolicity and the materiality of rhetoric (Fountain, 2008). Rhetoric has a material effect that surpasses the rhetor’s

intents (Fountain, 2008). Similarly, the material effect of video games surpasses its intents. Springer and Goggin (2013) explained: “although the game’s platform, actions, boundaries, and rules are predetermined by the designers, those rules are contingent, and game play itself has real presence and real consequences which may or may not be what the designer rhetors intended” (p. 118). Comparably, Bogost (2007) rationalized that video games are models of real systems and they express real–life values and practices that players can evaluate. Bogost (2007) argued that video games “represent how real and imaginary systems work, and they invite players to interact with those systems and form judgments about them” (p.vii). Thus, virtual worlds represent real life systems and the players’ interactions in these virtual worlds urge them to reflect on the way that these systems are formed. Bogost (2007) considered that the rules and presentation of video games have an impact on perceptions and attitudes towards real and imaginary systems. Namely, video games persuade “through rule-based representations and interactions, rather than the spoken word, writing, images, or moving pictures” (p. ix). He called this form of persuasion procedural rhetoric, and he argued that through this type of rhetoric games “support existing social and cultural positions...disrupt and change those positions..., leading to potentially significant long-term social change” (Bogost, 2007, p. ix). Gee (2009) conceived of video games as virtual social places that “induct newcomers into distinctive experiences” (p. 23) and provide players with opportunities to interpret those experiences to solve problems (Gee, 2009). Thus, the design components of a video game could surpass the virtual space and help players acquire practical knowledge and behaviors. For example, video games serve as a platform that embodies real life sustainability, cultural, social, or political practices, and the virtual space offers a stage where users can critique these practices and learn from these practices. Gee (2009), Bogost (2007), and Blair’s comments suggested that players learn behaviors and perspectives while playing games and these can transfer to the real world.

Springer and Goggin (2013) focused on examining “virtual representations of natural systems and places” (p. 112) in environmental video games. They concluded that video

games focused on sustainability must improve on three principles before they have a greater impact. First, video games must become more challenging and entertaining (Springer and Goggin, 2013). Second, the environment needs to be represented “as an interactive space and place” (p. 122). Third, they must integrate accurate information about real-world problems, and player must learn this information through active learning (Springer & Goggin, 2013). Following Springer and Goggin’s (2013) principles, I hypothesize that game developers must present the collaborations and aspects that take place in real life sustainability discourse. Video games should equip students to recognize, negotiate, and connect diverse logics, beliefs, and approaches related to actual environmental sustainability. Gathering accurate knowledge and information to inform environmental video games requires examining literature that analyzes the interchange that take place in sustainability matters. For example, scholars who examine environmental sustainability discourse have determined that representations of nature are prioritized depending on local values, assumptions, and power dynamics. Also, stakeholders that participate in sustainability discourse use the ambiguity of terms to persuade each other. Scholars have developed approaches that negotiate multiple meanings and knowledge and assure the effectiveness of environmental sustainability dialogue. The next section will review the literature that expands on these topics.

2.4 Multiple Meanings and Negotiating Meaning in Environmental Dialogue

In real situations deciphering sustainability challenges entails the partnerships of different stakeholders and negotiation of multiple perspectives. Myerson and Rydin (1996) explained that an environmental emergency, society must decide, “...how can we use all our knowledge and ideas, in the face of possible or potential environmental crisis? Which knowledge will help? And how do we begin to rethink the role of diverse fields?...” (p. v). Different individuals from a variety of disciplines such as politicians, entrepreneurs, artists, farmers, business, community leaders, and minority groups, to mention a few, collaborate to make decisions that pertain to environmental sustainability. However, scholars

in rhetoric studies have noted that collaborative efforts to create new knowledge, in any situation, require negotiating opposing ideas (Flower, 1994). Specifically, different meanings and language encounter and collide in environmental dialogue (Myerson & Rydin, 1996). That is, stakeholders bring their expertise along with their logics, backgrounds, and beliefs to sustainability discourses and these individual perspectives could conflict and crash. Myerson and Rydin (1996) explained “The facts exist in relation to those personae, and we cannot choose between the facts without being involved in the personalities, and their language” (p. 4). Subsequently, as people collaborate, they would have to embrace and negotiate multiple understandings to connect different knowledge systems and reach an understanding around sustainability issues.

2.4.1 Multiple meanings and the effect on environmental dialogue

The urgency to ameliorate environmental and sustainability issues has increased the participation of multiple disciplines and communities. Consequently, Harrison and Burgess (1994) explained, “authors from a number of different disciplines and theoretical perspectives, including, Marxism and feminism, have begun to explore transformations in the meaning of ‘nature’ in different discourses and representational practices” (p. 291). Greider and Garkovich (1994) believed that the “environment” has multiple meanings and these meanings are representative of how people define themselves.

For example, “Aborigine people and park rangers in Australia have distinct meanings of fire and very different management practice based on these meanings. These meanings reflect self–definitions of the two groups of people” (Greider & Garkovich, 1994, p. 10). The meaning of fire for aboriginal people came from holistic and traditional knowledge, while the park rangers’ meaning of fire derived from science (Greider & Garkovich, 1994). Scholars have observed these divergences of meaning in situations that required discourse communities to work together to achieve one objective. Michael (1991) used the theories of public understanding of science to inquire about the conflicting constructions of nature among staff of the Nature Conservancy Council. Whatmore and Boucher (1993) inves-

tigated the various narratives of nature that developers and planning officers employed in negotiating environmental planning. Differences in meaning could result in different explanations of environmental issues and single-mindedness.

In business, Touche (2010) found that managers across different industries had distinctive understandings of sustainability. Managers' particular definitions did not consider social-cultural, ethical, moral dimensions of sustainability when they thought about sustainability (Touche, 2010). Thus, the managers approached sustainability dialogues with restrictions. The examples of the aborigine people, park rangers, planning officers, and managers demonstrate that local cultural notions and individual perspectives determine values and viewpoints of nature, the environment, and sustainability.

Myerson and Rydin (1996) posed an example to show that individuals understand sustainability and environmental issues differently, and distinctive meanings encounter and collide in environmental dialogue. At Columbia University an environmental debate took place between Norman Myer, a campaigning intellectual and Julian Simon, an academic economist (Myerson & Rydin, 1996). In their dialogue, Simon defended growth, industrial production, and the market system by stating, "the picture also is now clear that population growth does not hinder economics development" (Myerson & Rydin, 1996, p. 3). Whilst, Myers viewed danger, a world at risk in contemporary treads (Myerson & Rydin, 1996). Namely, Myers suggested a crisis by explaining that the Earth's population has increased by 93 million people and he suggested that this number is "equivalent to more than a 'new Mexico' and this at a time when our Earth is straining under the burden of its present population of 5.5 billion people" (Myerson & Rydin, 1996, p. 3).

In Myerson and Rydin (1996)'s example, Myers and Simon seemed to consider the effects of population growth differently. Myerson and Rydin (1996) explained that the phrase "does not hinder" had room for interpretation and resulted in ambiguity. The authors examined the conversation between Norman Myer and Julian Simon, and they concluded

Simon's self-presentation is reassuring and energetic; Myers's self-presentation

is urgent and alarmed, yet also objective and definitive. The contrast involves whole human personalities. The facts exist in relation to those personae, and we cannot choose between the facts without being involved in the personalities, and their language. (p. 4)

Myerson and Rydin (1996)'s illustration showed that divergence of meaning could lead to misunderstanding and conflict. Schutten (2011) suggested that a person's social background has an impact on their partaking with sustainability issues. Thus, individuals' social backgrounds could inform their perspectives on sustainability and these views could clash. Schwarz and Thomson (1990) believed that "intersections among socially constructed categories such as race and class both operate" (p. 338) and result in different explanations of sustainability issues and the collisions of ideas, which prevent us from reaching a common understanding.

2.4.2 Ambiguity of terms as rhetorical devices

Stakeholders in sustainability dialogue could use the ambiguity of terms to persuade each other. Rydin (1999) argued that sustainability and sustainability development appear to be ambiguous, and stakeholders who participate in conversations take advantage of their vagueness to delineate their own specific versions of these terms. Participants in sustainability and sustainability development dialogue define these terms to achieve their own objectives and according to their priorities, interest, and values. Rydin's (1999) idea suggested that participants do not attempt to consider alternative definitions of sustainability and sustainability development, but simply use the definition that can best help them persuade others. Consequently, some stakeholders in Rydin's (1999) study considered sustainability and sustainability development terms as words that can be defined without considering alternative views. Thus, these terms should be comprehended as a product of multiple aspects.

Social and political aspects shape representations, concepts, definitions, and knowledge of sustainability. For this reason, Harrison and Burgess (1993) believed that it is vital to

understand particular representations of nature that are used to “legitimate specific institutional policies and practices” (p. 291). For example, some representations of nature could favor the standpoint and practice of specific groups, individuals, and legislations. Sauer (2003) found that in some cases “the convention of public discourse privilege the rational (male) objective and silence human suffering” (p. 63). Thus, understanding this connection between local knowledge, unsaid motives, values, and assumptions could help discern which representations and perceptions prevail and how power dynamics impact the process of reaching agreement over sustainability challenges.

2.4.3 Rhetoricians’ efforts to negotiate meaning

Rhetoricians have dedicated efforts to understand, “What would it take to configure an alternative public discourse where everyday people and their local knowledge have a place at the table?” (Goggin, 2009, p. 15). Some areas of study seek to understand and negotiate multiple perspectives of sustainability to develop an overall agreement. For example, Nambiar and Chitty (2014) believed that in matters of sustainability issues it is important to “reconcile meanings and develop effective cross-national and local approaches by the business sector in increasingly globalized world” (p. 493). Although reconciling multiple meanings could help tackle sustainability issues, some scholars have recognized that the process to reach reconciliation could marginalize minority perspectives.

According to Long (2009) “In environmental rhetoric, for example, it’s often assumed that the public worker’s role is to help facilitate consensus among disparate parties” (p.21). For this reason, participants in dialogue could feel obligated to abandon their perspective to help facilitate consensus. Higgins and Bush (2006) and Flower and Deems (2002) believed that professional knowledge and the most boisterous in attendance often “overshadow those whose expertise may be grounded in a different set of experience an less authorized style of discourse such as storytelling” (Long, 2009, p.22). Consequently, In *Ecospeak: Rhetoric and Environmental Politics in America*, Killingsworth and Palmer (2012) encouraged communicative rationality that considers and respects the knowledge of all people. Similarly,

Dobrin and Weisser (2002)'s *Natural Discourses* encourage focus on multiple rather single perspectives. Overall, a rhetorical approach to negotiation should attempt to create space and dialogue “in which marginalized voices bring significant expertise to solving a shared problem” (Higgins, Long, & Flower, 2006, p. 31). A more detailed examination into the dynamics of this dialogue can help advance equal participation.

For example, Flower (2003) developed the social–cognitive–theory, which helps study the process that occurs behind community dialogue to resolve a common problem. Flower studied “The story–behind–the–story...by asking the participants of a Think Tank to narrate the ‘movies of the mind’ they call upon to interpret a complex solution” (Long, 2009, p. 23). This resulted in an understanding of participants’ internal logics, which are often drive individuals’ perceptions. The consideration of these concealed logics can advance equal opportunity in community dialogue by making all participants aware of each other’s insights based on their background. Namely, “hidden logic permits other stakeholders to grasp the interpretative power of cultural knowledge other than their own” (Long, 2009, p. 23). It is important to note that this method does not assure or document consensus but attempts to “provide a cultural appropriate way to talk to diverse readers about the issues at hand while inviting readers to negotiate and integrate rival perspectives for the text for themselves” (Long, 2009, p. 24).

2.5 Conclusion

The literature I have reviewed here shows that commercial and educational video games that address sustainability issues establish idealistic expectations, simplify complex issues, and misrepresent nature and stakeholders. Additionally, the disagreement between the protagonist’s story and player’s story, ludonarrative dissonance, prevents video games from offering a more engaging experience. Some video games do not consider the local and unique settings where these issues take place. For instance, virtual spaces do not tend to depict the cultural and race diversity of the local stakeholders. In an effort to increase the usefulness of video games for education and social change, scholars in rhetoric and other

fields have explored the design and deficiencies of video games. Video game developers have suggested that video games could become more effective if they are constructed to provide an experience that reflects the complexity of real life situations. The problems with video games should be addressed in the early stages of production. For example, QA demonstrated that eliciting local expertise and knowledge during its development improved it. Nevertheless, scholars have not explored and documented extensively how video games could negotiate real life knowledge and expertise to inform the design of educational video games focused on water sustainability.

I hypothesize that we must negotiate local stakeholders' meanings and knowledge of sustainability to develop coherent video games, which represent sustainability dialogue, stakeholders, and natural processes accurately. The literature on environmental sustainability dialogue showed that it is not enough to attempt to understand multiple meanings and perceptions of sustainability. As rhetoricians have noted, when people engage in dialogue many aspects can be overlooked that prevent all participants from contributing equally. Such overlooked perspectives are vital to conduct cultural appropriate and diverse collaborations. In the same way, a realistic video game should not simplify collaborations, ignore certain perspectives, and attempt to reach a consensus based on simplifications. Rather, a video game focused on sustainability should present the multiple perspectives of all stakeholders and provide an experience in which players learn to consider, negotiate, and integrate the rival perspectives of all stakeholders.

In the next chapter, I provide details about the *Sol y Agua* case study, which aims to examine and negotiate multiple perspectives and meanings that could inform the design of the project's video game.

Chapter 3

Design of the *Sol y Agua* Case Study

3.1 Background: The *Sol y Agua* Project

The nation's shortage of scientists and engineers requires the participation of diverse students, especially Latino students, in science, technology, engineering, and mathematics (STEM) fields. The number of students in STEM has decreased (Hassan, 2008). Even more, minorities remain underrepresented in the science and engineering workforce. Although in the past decades the percentage of minorities who earned a degree in STEM increased from 7% to 10% (National Science Board, 2014), the difference in educational attainment between minorities and whites continues to broaden (National Science Board, 2014). The claim is that students' experiences with traditional curriculum prevent them from pursuing advanced STEM courses in high school, which limits their knowledge and curiosity in STEM subjects and careers (Rowan- Kenyon, Swan & Crenager, 2012). Littledyke (2008) contended that students disregard science subjects because the science curriculum lacks relevance to students' experiences and lives. For example, technical language and seemingly impractical concepts that leads to confusion and indifference (Filho & Pace, 2006). Students can learn more when a curriculum integrates the local context and their personal experiences with science methods to understand the world (Littledyke, 1996; Liberman & Hoody, 1998). To address this need, the *Sol y Agua* project at The University of Texas at El Paso aims to develop the a virtual role-playing adventure game focused on water sustainability and watershed problems in the El Paso-Rio Grande area. The video game, which extends from the Smithsonian Latino Center (SLC)'s virtual role playing adventure game *Mi Tierra-Mi Mundo*, has the potential to increase students' attitudes, awareness, interest, confidence, and process skills in STEM subjects related to environmental themes. The *Sol*

y Agua project hypothesized that a storyline that integrates the specific, targeted environmental and cultural information about the El Paso-Rio Grande area could help increase local students' interest and dispositions toward environmental themes. The name of the project *Sol y Agua* is the Spanish name for sun and water. The name intends to highlight local context and the focus on water. El Paso, Texas is known as the sun city because it enjoys sunny days for more than 300 days of the year. Since the game is focused on water sustainability issues, the team decided to include water in the title. The title in Spanish also reflects the Mexican heritage that prevails in the area. The majority of the population speaks Spanish, English, or both. The *Sol y Agua* team defines water sustainability as the activities and knowledge that would help local students manage water resources effectively while protecting and ensuring their wellbeing. Guided by this definition, the principal investigator aimed to incorporate STEM knowledge for effective resource management that could at the same time help students develop a sense of stewardship. Particularly, the team was keen in incorporating the knowledge of local scientists and Native American's perceptions of stewardship. The idea was to create a video game that links watershed science and traditional ecological knowledge to help students construct meaning, make predictions, and infer about meaningful local information.

The team consisted of three undergraduates in computer science and five faculty advisors: one PhD in rhetoric and writing studies; one PhD in computer science; one MS in computer science; and two PhDs in science education. More than half the team had no prior experience with game design and development. Two of the computer science majors had some experience creating computer applications and extensive knowledge about commercial gaming. One of the faculty advisors had knowledge about educational video game design. I participated as a graduate research assistant with expertise in rhetorical methods. As a graduate research assistant for the project, my task was to gather preliminary cultural information to develop the content of the game. I focused on conducting semi-structured interviews with community members to elicit cultural and environmental information that could be incorporated in to the video game's storyline. Over the period

of nine months, the undergraduate students and I engaged in weekly design sessions, in which we discussed the design of the game and storyline. The faculty advisors attended these meetings intermittently.

3.2 The *Sol y Agua* Case Study

By constructing a case study around the *Sol y Agua* project, I intend to examine how 1) Community members' underlying individual values, beliefs, meaning, and knowledge result in hidden logics that collide, intersect, and aggregate to construct new meaning and knowledge of local water sustainability; and 2) The new constructed meaning and knowledge can inform the design of the *Sol y Agua* project's video game. The inquiry could help increase the effectiveness of the *Sol y Agua* project's video game by providing a deep understanding of community members' underlying meanings and knowledge. Furthermore, examining how individual meanings and knowledge come together to create new meaning and knowledge of local water sustainability could help create more coherent characters and accurate stories that represent the local setting.

3.2.1 Case study design

Kohn (1997) and Yin (1994) stated that a case study explores new areas, issues where little theory is available or measurement is unclear, and present a unique or extreme case. Furthermore, Stenhouse (1998 as cited in Bassey, 1999) explained that the objective of a case study is to report experiences and relationships as these develop within a case, without dealing with generalization (Suryani, 2013). I selected a case study for this research because this analysis highlights one unique and single aspect of game design, a production process that has not been documented in depth. Since the *Sol y Agua* project seeks to create a video game that targets the local community of El Paso and the nearby Rio Grande community. It is a unique endeavor that does not seek to create the generalizations about water sustainability in other areas of the United States. My case study only focuses on

gathering local knowledge and the process that the *Sol y Agua* project used to acquire local knowledge to develop the content of the video game. The process that we used to gather specific information for the project was also a tailored and bounded endeavor. A case study method does not have to present direct and detailed observations, but mainly uses interviews (Suryani, 2013). The process of gathering local information did not deal with generalization about water sustainability; thus I considered that a case study could help me report relationships between the community members that contributed local knowledge to develop the video game. This intensive approach concentrates “on only one specific instance of the phenomenon to be studied, or only a handful of instances in order to study the phenomenon in depth” (Swanborn, 2010, p. 2). The results of this study can provide a deep understanding of how different water sustainability perspectives develop in a specific context. Yin (1994) clarified “Whether its results can be generalized in other contexts remains an open question, to be answered by complementary case studies” (p. 3).

3.2.2 Participants

The *Sol y Agua* project was keen in incorporating the knowledge of local scientists and local Native American’s perceptions of stewardship as the team sought to communicate activities and knowledge that would help local students manage water resources effectively using STEM knowledge while protecting and ensuring their wellbeing. Thus, to achieve this goal, the principal investigator identified five local scientists that could contribute knowledge about water sustainability to inform the video game. I was tasked with searching for local Native American community members and other local community members who were long-term residents of the area and who were willing to contribute their perspectives on stewardship and water sustainability. In total, six scientist, two of whom also identified as Native Americans, one social scientist, and one engineer were willing to contribute their extensive knowledge of the area and local water sustainability. For the *Sol y Agua* case study, I selected six community members from the eight community were willing to contribute their knowledge. I identified community members through purposive sampling.

The process of purposive sampling focuses on selecting participants with characteristics who will be able to contribute specific information relevant to the research (Leedy & Ormrod, 2005). The six community members that I selected for my case study provided specific local information about water issues and concepts of stewardship that seemed to reflect the main local issues. The community members talked about unique aspects of the local community and their unique experience with the local community. Additionally, purposive sampling helps understand “..why particular people (or groups) feel particular ways, the processes by which these attitudes are constructed, and the role they play in dynamic processes within the organization or group” (Palys, 2008, p. 697). The six community members’ responses seemed to hint why they felt a particular way about water sustainability and stewardship and the processes by which their attitudes were constructed. The six community members that I selected for the *Sol y Agua* case study seemed appropriate because they talked about unique aspects of the local community and their unique individual experience with water sustainability and stewardship.

The six community members had specializations in the fields of agriculture, urban systems, ground water systems, desert ecology, and traditional ecological knowledge. Five participants were directly involved in research related to environmental issues in El Paso–Rio Grande area. One community member did not have specific knowledge about water sustainability topics, but a physicist with Native American background who does research on comparing scientific and Native American world views on the environment. Another community member is currently part of one of three Native American tribes in Texas and the most well known in El Paso area. These two participants contributed indigenous knowledge regarding sustainability of local resources. I postulated that selecting community members in the same branch of science, but with different cultural backgrounds could help me examine how the individual underlying values, beliefs, meanings, and knowledge of particular scientists collide, intersect, and aggregate to construct new meaning and knowledge of water sustainability.

I identified the final six community members in various ways. In addition to the four

community members identified by the principal investigator, I found one community member through online research, and I identified one community member at a UTEP campus event honoring one of the local Native American tribe. All community members were adults 18 years of age and older, in good health, of varying sexes, abilities, and ethnic backgrounds. All participants were given pseudonyms; thus, I have not identified quotations by their real name. I believed that keeping this information confidential could allow me to be more open in bringing forward information about the participants' ideologies and perceptions. I abbreviated community member as CM and identify each with a different number rather than using their real names. At one point in the writing process I introduced pseudonyms but abandoned the idea for simplicity.

- CM1

The first participant has a PhD and bachelor's degree in anthropology. CM1's research includes topics on border sustainability such as water, climate, social change, and health disparity. CM1 currently resides in El Paso, Texas, and CM1 is a professor at UTEP.

- CM2

The second participant obtained a master's and bachelor's degree in geology and mineralogy as well as a PhD in geosciences. CM2's research topics include environmental modeling, scenarios of climate change, socio-environmental systems, climate and land change impacts on wildfire/drought/biodiversity/water; earth, ecologic, and environmental. CM2 currently resides in El Paso, Texas, and CM2 is a research assistant professor at UTEP.

- CM3

The third participant obtained a PhD in biology. CM3's research focuses on water quality, watershed planning and management, soil and water conservation, sustainability, air quality in the border region. CM3 currently resides in El Paso, Texas, and

CM3 is a research assistant professor at UTEP.

- CM4

The fourth participant obtained a bachelor's degree in agriculture, a master's degree in water resources environmental management, and a PhD in environmental resource policy. CM4's research interests include water resources and ecosystems sustainability, environmental life cycle analysis, and geospatial applications. CM4 currently resides in El Paso, Texas, and CM4 is a research assistant professor at UTEP.

- CM5

The fifth participant earned a bachelor's degree and master's degree in physics. CM5 is a descendent of a local tribe (not enrolled). CM5 is an independent author, lecturer, and consultant. CM5 is part of the board of directors of a Native non-profit organization, assisting in the establishment of an eco-retreat center and learning model whose purpose is to revive indigenous life-ways and sustainability land stewardship. CM5 currently resides in Rio Rancho, New Mexico.

- CM6

The sixth participant is currently a master's student in environmental science at UTEP. CM6 is a member of a local tribe. CM6 currently resides in El Paso, Texas.

3.2.3 Case study limitations

The *Sol y Agua* case study made different assumptions. First, I assumed that Native American are the main local groups that can provide knowledge about stewardship. Thus, I sought specific knowledge of stewardship within the Native American community. Similarly, the *Sol y Agua* team assumed that only local scientists and engineers could provide knowledge about water sustainability in STEM. Additionally, the interview questions did not ask the community members to identify their race or cultural background. Thus, four community members were selected exclusively based on their STEM knowledge while the Native

American community members were selected because they are part of a specific cultural group and race and explicitly bridge two knowledge communities markedly and seemingly at odds with regard to environmental sustainability. Thus, this case study unintentionally creates a sense of othering. Thus, the case study assigns and evaluates meaning to the responses of the Native American community members based on their race and cultural background. This is not to say that race or culture were absent in other participants—just not emphasized based on the team’s assumptions about location of stewardship knowledge.

The small sample of this study could not provide enough insight into the perspective of a broader discourse community. This could hinder the applicability of this research to the *Sol y Agua*’s video game. Barab et al. (2005) suggested that the story of video games must balance the need for local customization and maintaining the game’s integrity. Thus, the new knowledge provided by this research could not be related to a wider audience as the results only consider the perspective of a small group of individuals. However, Warnke (1987) and Flower (1994) suggested that individual understanding originates from comprehension (Habermas, 1985) of the outlooks of the collective. Thus, understanding individual values, logics, and background could still provide some insight into multiple viewpoints on water sustainability in El Paso–Rio Grande area that can be used to design an educational video game.

Conducting individual interviews with community members represents a limitation as well. The community members were not able to discuss their beliefs, knowledge, and perspective with each other. I acted as a mediator and used the transcripts of their interviews to understand and create new knowledge from their responses. This limits the level of the analysis because I was not able to bring together the community members and confirm my conclusions.

3.2.4 Research process

In Fall 2014, I conducted six semi–structured interviews. All interviews lasted between 40 minutes and two hours and included 21 IRB–approved questions. All 21 questions can

be found in Appendix A. However, for the data analysis of this case study, I focused on five questions from the broader set of 21 semi-structured interviews questions because they elicited participant insights that were directly related to the community members' underlying values, logics, and beliefs related to local water sustainability. The questions that I selected asked about the challenges and efforts to improve water resource sustainability; information do educators need to share in order to help students become more engaged in water sustainability issues in this region; and barriers and challenges that educators face in communicating issues of water resource sustainability in the El Paso area. When I reviewed the interview transcripts, these questions prompted the community members to talk extensively about their values, beliefs, and perspectives on water sustainability issues in the area and practices that could help local students maintain the wellbeing of the local water resources. The other questions did not provide information that gave insight into the community members values, beliefs, and perspective because these questions asked about sharing data or visualization that could be used in the video game and about additional resources that could inform the video game, to mention a few. The responses to these questions did not hint at any hidden logics. The five interview questions that I concentrated on for this study are the following:

1. We have been learning about the challenges that the El Paso community faces in pursuing and maintaining water resource sustainability. The following is a list of some of the challenges we have identified so far:
 - (a) Global environmental issues with local effects
 - i. Climate change
 - ii. Drought conditions
 - (b) Competition between reduced supplies and increasing demands
 - i. Urban vs. agricultural needs
 - ii. Competing value systems affecting allocation decisions (e.g., family farms, industry, open spaces, land development, increasing population)

- iii. Regional demands of the El Paso/Juarez metroplex, with bi-national water management issues
 - iv. Economic impacts of allocation decisions
 - v. Impact of water allocation decisions on overall water balance (e.g., reduced surface water available for irrigation, resulting in increased overall water usage due to ground water salinity problems)
- (c) Need for alternative and remediation technologies
- i. Water reclamation and treatment
 - ii. Capture of impact/run-off water
 - iii. Desalination of brackish water
 - iv. Evaluation of effectiveness vs. cost of various technologies
- (d) Conservation and pollution-reduction education/enforcement
- i. Behavioral changes for reduction in water usage
 - ii. Education for proper contaminant disposal
 - iii. Evaluating chemical, equipment, and process-related impacts on water quality and quantity

Are there more challenges that should be included, and if so, what are they?

2. In your opinion, which is the most important challenge, and why?
3. Please share some examples of efforts to improve water resource sustainability in the Rio Grande watershed.
4. What key information do educators need to share in order to help students become more engaged in water sustainability issues in this region?
5. What barriers and challenges do educators face in communicating issues of water resource sustainability in the El Paso area? From your perspective, what is the best way to overcome them?

The first and second questions identified the challenges that the El Paso community faces in pursuing and maintaining water sustainability. Also, the questions were intended to give insights into the way that the community members prioritized and discerned environmental challenges in El Paso-Rio Grande area based on their underlying values, beliefs, and logics. The second question, which requested some examples of efforts to improve water resource sustainability in the Rio Grande watershed, aimed to understand the community members' professional and personal values, beliefs, and logics that informed their efforts to improve water sustainability. The fourth and fifth questions asked the participants to outline key information that educators need to share in order to help students become more engaged in water sustainability issues and inquired about the challenges that educators face in communicating issues of water resource sustainability in the El Paso area. These questions aimed to identify any additional information that the game must communicate and understand the challenges that could prevent game developers from communicating this information. Similar to the other questions, questions 4 and 5 intended to gather insight into the community members' underlying values, beliefs, and logics about local concerns. I theorized that the community members' unique backgrounds, expertise, knowledge, and understating become internal negotiations and guide their inquiry about the challenges that educators face in communicating issues of water sustainability in the El Paso area. Then, I assessed six community members' individual answers to examine how their internal negotiations construct new meaning and knowledge. In order to explore these questions empirically, I framed my research by drawing on theories on construction of meaning, cognitive rhetoric, and negotiation analysis and hidden logics.

3.3 Theoretical Framework

The theoretical framework I am using to inform my interpretation of the case study data combines insights from construction of meaning, cognitive rhetoric, hidden logics, and negotiation analysis. In the book, *The Construction of Negotiated Meaning: A Social Cognitive Theory of Writing*, Linda Flower brought together these theories to reconsider

writing “as an active constructive process, as a social and rhetorical act, as negotiated meaning, and as literate practice” (Zimmerman, 1998, p. 1). Flower (1994) reconsidered the way writers construct meaning by outlining conflicts with the reproduction theory and the conversation theory, which explains the construction of meaning. Flower (1994) drew from social and cognitive research to rationalize writers’ construction of meaning as an act in the minds of individual writers within social experiences. Namely, writers carry a network of meaning in their minds and these networks interact with external forces, such as “social imperatives, prior knowledge, ability, motivation, discourse conventions...” (Flower, 1994, p.43) to construct meaning. The external forces become inner voices that engage with the internal networks of meaning and the interplay results in hidden logics (Flower, 1994). Flower (1994) proposed using negotiation analysis to understand the hidden logics that result from negotiation of inner voices and internal networks of meaning within the act of writing. In this section, I explain how the theories of construction of meaning, cognitive rhetoric, hidden logics, and negotiation analysis could be used to explain the creation of meaning in other acts, such as the act of baking a cake. In the last part of this section, I explain how these theories can be used to translate the responses of the local community members and construct new meaning from their hidden logics.

3.3.1 Construction of meaning

Flower (1994) examined the discrepancies with reproduction theory and conversation theory, and she proposed a new notion that explains the construction of meaning. Reproduction theory sees construction of meaning as “a process of unconsciously recreating the prior text of our culture” (Flower, 1994, p.58). In other words, individuals generate meaning by duplicating existing or accessible meaning (Flower, 1994, p. 56). For example, readers create meaning by “selecting, organizing, and connecting information from text, a process that is strongly influenced by culturally based expectations and prior knowledge” (Flower, 1994, p. 56). Critics of these ideas have asked, “Are traditional notions of reproducing reality possible? Are texts (school text and television messages alike) actu-

ally exerting an uncontested reproductive influence of people's minds? And do the texts and intertexts we study given an adequate picture of the meaning(s) readers and writers actually construct?" (Flower, 1994, p.59). Thus, reproduction theory cannot explain the construction of meaning by itself.

Construction of meaning as conversation can be seen in three different ways. First, Clark (1990) considered "The meaning-making function of every text is situated in the free and collaborative social context described by conversation [i.e. as an undirected interaction]" (p. xvii). Where conversation is considered "an experience of cooperative interactions through which people enact the essence of compromise" (p. xvi). This view of meaning making considers that in an oral conversation each participant is trying to bring his or her individual interpretations into agreement with the interpretation of the other (Clark, 1990). The meaning that is constructed in the conversation does not account for the meaning created through logical, personal, or manipulative aspects (Flower, 1994). Second, Flower (1994) considered that people in a conversation attempt "to infer the needs, intentions, and interpretations of one another" (p. 60). People negotiate meaning in the conversation by constantly cooperating to share an understanding (Flower, 1994). For example, participants constantly check if both partakers are agreeing and allowing the other person to propose the next the exchange (Flower, 1994). In this scenario the meaning is shared and is the product of cooperation and negotiation. Third, Sloane (1989) considered that in conversation participants "argue it pro and con, and then find the stasis-that is as Antonious says, 'the issue in doubt,' the precise point on which the dispute seems to turn" (p. 466). The speakers contemplate the situation first and try to find a middle ground. Flower (1994) suggested that all these perspectives explain construction of meaning or meaning making as developed in "conversation's unfolding interchanges, not in representation any individual participant might construct" (p. 61). Additionally, these conversational models do not consider that meaning making happens "*not only* in face-to-face conversation, but *also* in the mind of conversational partners—and in the socially situated but often solitary acts of writers" (Flower, 1994, p.63). For this reason, Flower (1994) rationalized construction

of meaning as an act in the minds of individual agents in conjunction with the external forces that influence the construction of meaning (Flower, 1994).

Particularly, Flower (1994) considered meaning as a network of multidimensional meaning that includes "...elementary attitudes, ideas, or perceptions that are intricately linked to one another in a network that permits us to entertain multiple ways of knowing" (p. 39). In this network, a concept or a word "does not exist as a coherent symbolic unit, defined by a list of attribute" (Flower, 1994, p. 39). Rather, the meaning of a word or concept is "a web of activated ideas, images, experiences in the mind of the meaning maker..." (Flower, 1994, p. 39). For instance, the act of baking a cake evokes a network of multiple meanings on one individual. Then, in a group of individuals, each person would construct their own network of multiple meanings of baking a cake, which would include "active ideas, images, experiences in the mind of the meaning maker, a web that is in turn part of the individual's large, social shaped network of knowledge" (Flower, 1994, p.39). For example, a network of the meaning of baking a cake could comprise links to visuals imagines, sounds, and memories that are emotionally significant. My network of the meaning of baking a cake comprises experience of baking cakes with my grandmother, the memories of her kitchen, the smell of her kitchen, feelings of comfort, images of her baking cakes, to name a few.

The concept of network of multidimensional meaning suggests that an act or event such as baking a cake is more than a list of attributes. Flower (1994) examined the cognitive process that takes place in individual minds within a social act. She asked the question, how do individuals situated "within an array of social, cultural, political, and economical force, go about the social cognitive process of creating...acts?" (Flower, 1994, p. 40). In the case of baking a cake, how do individuals situated within an array of social, cultural, political, and economical force, go about the social cognitive process of baking a cake? According to Flower (1994) the answer to this questions develops from cognitive rhetoric. Cognitive rhetoric answers the question by focusing our attention to how the individual minds operate within social experiences.

3.3.2 Cognitive rhetoric

Flower (1994) stated that cognitive rhetoric concentrates “on thinking processes and hence on individual minds” (p. 42). However, referent to rhetoric, it also involves “the study of social cognitive process, based on the premise that individuals only exist as a rhetors by virtues of standing both within a circle of listeners/readers and within the circle of socially structures, purposely, discourses” (Flower, 1994, p.42). Thus, cognitive rhetoric suggests a “constant interaction of cognition and social context” (Flower, 1994, p.43). Using cognitive rhetoric, we could ask how cognition and social context interact in the process of baking a cake. We know that an individual has developed an internal network of the meaning of baking a cake. The individual’s network of meaning would interact with external forces, such as “social imperatives, prior knowledge, ability, motivation, discourse conventions...” (Flower, 1994, p.43). Thus, the meaning created by the individual could be constructed by outside forces and an internal network of meaning. Flower (1994) considered that the external forces become inner voices that interact with the internal network of the meaning (Flower, 1994, p. 54). However, how do individuals negotiate the inner voices and internal network of meaning? Flower (1994) proposed using negotiation analysis to understand how an individual negotiate inner voices and internal network of meaning within an act.

3.3.3 Negotiation analysis and hidden logics

Negotiation analysis emerged from cognitive rhetoric, and the method helps examine how an individual creates meaning within an act. Flower (2003) explained that negotiation analysis follows two principles:

1. Acts (and deliberation) give us access to a “constructive process.” In the act or delivery there is active conflict between multiple “voices” or “kinds of knowledge that would shape the representation of meaning” (Flower, 2003, p. 243). “We know that when individual meaning makers are engaged in crafting a text or a conversation, these voices – these shaping forces – take

many forms. They include not only the live voices of... conversational partners, but the internal voices of personal intention, knowledge and emotion, and the internalized dictates of convention, language, and ideology.” (Flower, 2003, p. 243)

2. When individuals become aware of the conflicts they enter into the construction of a negotiated meaning, the attempt to interpret and manage conflicting voices results in provisional resolutions and – at times – in restructured understanding. Tracking this negotiation and its conflicts can reveal which voices within a broad social and cultural activity have risen to the status of ‘live’ options and come under negotiation. And it can often reveal the hidden logic that may be...producing new knowledge. (Flower, 2003, p. 243)

In the context of informing the production of the video game, I used negotiation analysis to help me understand the hidden logics of the six community members, which shaped their representation of meaning related to water sustainability issues. Furthermore, Flower (2003) stated that negotiation analysis allows researchers to understand how individuals and groups handle disagreements that interest them both at an intra- and an interpersonal level. Most importantly, Flower (2003) affirmed that negotiation analysis helps understand “knowledge-making activity by asking: How do diverse participants in an activity actually represent these conflicts to themselves and to others” (p. 244). Compared to other views of meaning making, cognitive rhetoric and negotiation analysis emphasize the individual knowledge and meaning that each individual constructs internally based on the individual’s backgrounds and external social forces.

I followed this process because deciphering how the community members negotiate their networks of meaning and external forces related to water sustainability could produce new knowledge, which could inform the design of the video game. A conceptual framework for this research is shown in Figure 3.1. I considered the interviews with the different community members as a social and cognitive act, in which the community members used their networks of meaning gathered from their discourse communities, experience, “inter-

nal voices of personal intention, knowledge and emotion, and the internalized dictates of convention, language, and ideology” (Flower, 2003, p. 243) to provide information. I hypothesized that as the community members responded to my questions, they negotiated their networks of meaning with external forces. They had to interpret and manage conflicting voices, which resulted in “provisional resolutions and – at times –in restructured understanding” (Flower, 2003, p. 243). As Flower (2003) suggested, tracing their negotiations in the interview transcripts could uncover hidden logics about water sustainability in El Paso–Rio Grande area. Then, the mediation of all of the individual hidden logics could produce new knowledge. This theoretical framework has limitations because as a researcher I make assumptions about the community members’ hidden logics. One way that this could be overcome is by creating a think tank that allows all community member to be present, and I could listen to them talk to each other. A think tank would have allowed me to understand how the community members hidden logics interact directly and confirm my conclusion by asking them directly about them.

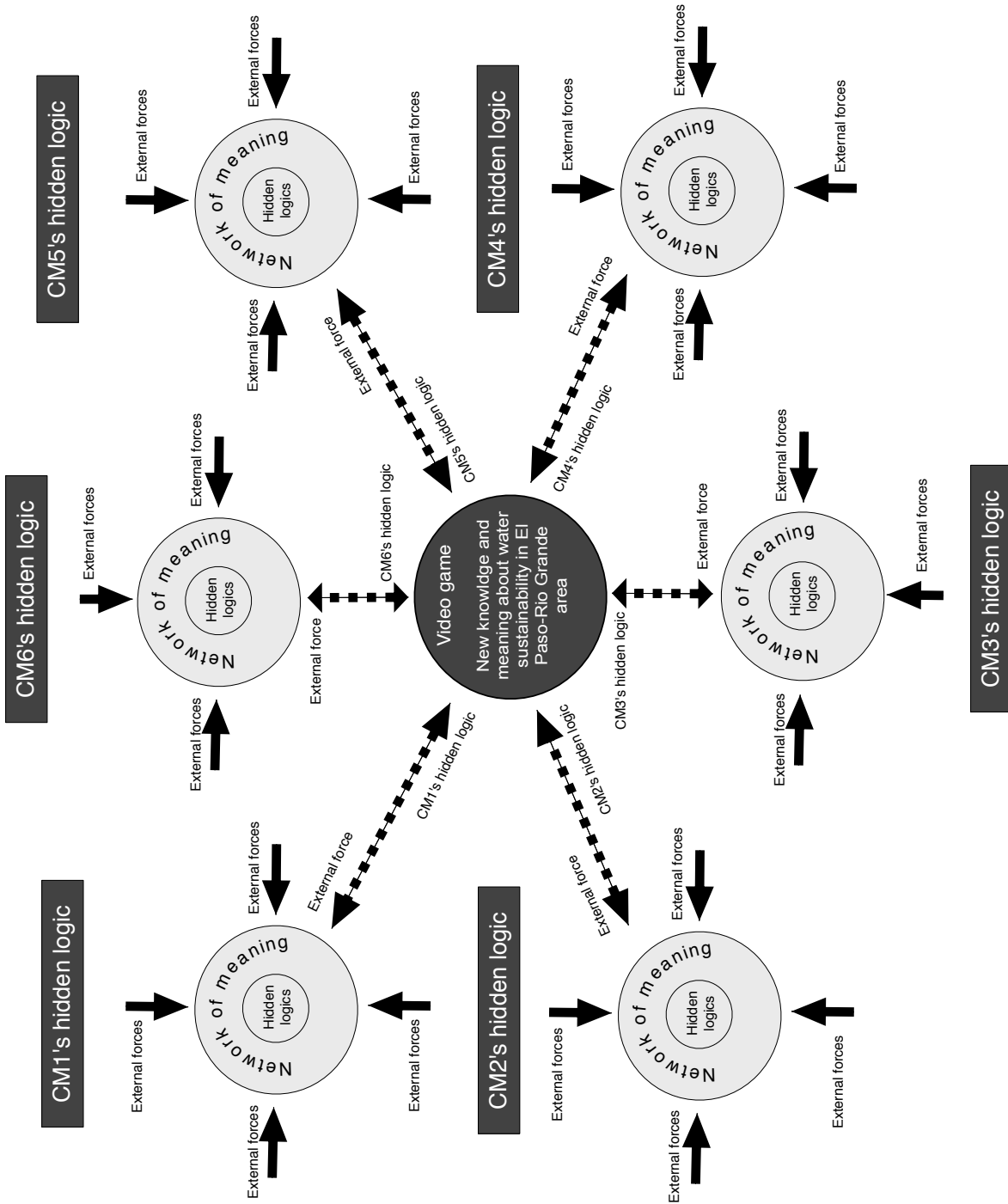


Figure 3.1: Community members negotiated their networks of meaning with external forces, and their negotiations resulted in individual hidden logics. Then, the mediation of all of the individual hidden logics produced new knowledge with the potential to inform the video game

Chapter 4

Community Members' Responses

In this chapter, I provide an overview of the community members' responses. During the interviews the community members did not answer these questions separately. The interviews were a constant dialogue in which one question led to the next question. The community members would connect their answers to a previous answer or expand their answers as I asked the next question. Consequently, in this chapter the five questions are grouped thematically to capture the connections that the community members made.

4.1 What Are the Challenges that El Paso Community Faces in Pursuing and Maintaining Water Sustainability? Which is the Most Important Challenge, and Why?

The first question I asked had two parts. The first part asked participants to name community challenges relative to pursuing and maintaining water sustainability. When asking this question, I listed examples: Global environmental issues with local effects, competition between reduced supplies and increasing demands, need for alternative and remediation technologies, and conservation and pollution-reduction education/enforcement. The second part of the question asked them to identify what they considered the most important challenge. I told them that their responses to these questions could help the *Sol y Agua* team determine the water sustainability issue that might become the focal point of the video game. These questions were designed to identify the most important issues related to water sustainability in El-Paso Rio Grande area that could become the focal point of the video game. Collectively, the community members' responses showed that it is difficult to identify one single challenge because all of the challenges overlap and contradict

one another.

CM1 did not add new items to the list of challenges that I provided. I asked CM1 to comment on the most challenging aspects of water sustainability, and CM1 commented extensively on the use of ground and surface water. CM1 answered that reduced supplies and increasing demands is a great challenge. CM1 approached the question by explaining that El Paso's water supply depends on the groundwater from the Hueco Mesilla Bolsons and surface water from the Rio Grande. The El Paso–Rio Grande area experiences drought regularly in recurring cycles. For this reason, water in this area is a valuable resource and a subject of competition. According to CM1 the municipal, industrial, and agricultural sectors struggle to divide the scarce amount of water effectively, and the city uses more water each year. Furthermore, CM1 explained that the local water company, El Paso Water Utilities, alternates from these two water resources depending on the water availability of each source. If the Rio Grande's water decreases, then the company pumps water from the Hueco Bolson aquifer. CM1 remarked that conveying the interchanging process could represent a challenge for the game developers. CM1 also highlighted his belief that these procedures do not guarantee the preservation of Hueco Bolson aquifer and Rio Grande River.

This is the real challenge in figuring out how to design this game, but this is also what the really, the basic issue you want to communicate. The short term answer, the short term answer, ok that make you happy this year, that makes you happy next year, ok, is to use this ground water to make up for the river water that is in decline. You have a bad year it is bouncing around, you know, you go to the ground, ok, it is bouncing, but it is also in decline over time, you go to the ground, ok, that answers your need this year, answers your need next year. But, the ground water is not infinite. Ok, and this is the communication challenge for you guys to think about. Ok, ground water is going down, ground water is not infinite, we are using up and it is mostly not getting replace. A lot of it is what we call fossil water, it has been there for a long of time, and

has just been sitting there, and now we are using it, and it is coming down and nothing is coming in or little is coming in. So, it is going down in the long term as we use it. So it makes us happy this year, makes us happy next year because we still have plenty of water, ok. But, it means that if we are talking about 20 years or 50 years or something. Your players of your game have to be able to do something that plays for a while, ok, somehow they are going to find out that they are actually using this up, it is going away, it is not coming back.

El Paso Water Utilities is using up the ground water and the community would exhaust this resource in the long run according to CM1. CM1 concluded that this is a short-term solution.

CM2 did not add new items to the list of challenges. CM2 considered that the biggest challenge is in the agriculture sector and the innovation of new agriculture techniques.

I think that agriculture is really the most important challenge and that is because most of our water is used by agriculture and so if we are really going to change things in the future we have to change something there. Uhm, so we need innovative ways for them to either change the crops that they doing, change the way that they water them, uhm but at the same time they are a livelihood, so we can't assume to make changes that are going to disrupt them financially. So I think that, that is going to be the real challenge figuring out how to innovate in the agriculture sector.

CM2 also suggested that the agriculture sector could take excess water and impact the lives of El Paso's residents. In her view the relationship between the residents and the agriculture sectors could be a challenging concept to depict in a video game.

Clearly the number of people who are farmers is a very low percentage, so you have a small percentage of the population using most of the water. Uhm the way that impacts the rest of us is that, uhm that is less water that we don't

have. So, I think that there is a big communication challenge there; it should not be the choice of a few to determine the future for everybody. Now how that happens in play, that is challenging, uhm, I mean, but I do think that it has to be a societal sort of transformation and that depends on people getting involved and actively working towards some sort of transformation. Certainly if nobody ever puts any pressure on them to change, they won't change.

CM3 felt that the list of challenges was comprehensive and did not add new items to the list. CM3 believed that environmental users that are gaining political power could represent a challenge.

Environmental users because now for the first time, for example last year, the Audubon society they bought water rights in the Rio Grande mainly just to maintain habitat for birds. So the environmental users are growing demand as well, still very small, compared to agriculture or urban, but they have a growing political contingency. The public wants these environmental amenities, like birds and wildlife, and wetlands, and things like that. [Pause] So I think that belongs under b [CM3 was referring to point (b) of question 1]. So, under b you have those computing value systems, so I think that environmental amenities are an important competing value system.

CM3 also believed that despite all the important challenges that El Paso community faces in pursuing water sustainability, competing demands and supply is the most important.

Number two [CM3 was referring to question 2] is which is the most important, wow, (laughter) all of these are really important. Yeah, I don't really know how to say which one is the more important. Uhm, I think that, maybe one that, that kind of encompasses a lot is (b) [CM3 was referring to point (b) of question 1] because you have competition between reduce supplies and increasing demands, uhm, but behind those reduced supplies is climate change and

some of these other things, and behind some of those increasing demands are these competing values systems... So one kind of statement that encompasses a lot, I think b does that, competition between reduce supply and increasing demands. Then you have to explore why do we have reduce supplies. Well it is because of climate change and all of this other things and why we have all of these increasing demands is because the things I am saying because you have the urban users, the agriculture, people who want environmental services and so forth.

CM3 did not comment on the challenges of representing reduced supply and increasing demands in the video game.

CM4 noted that each person classifies water sustainability issues in different ways, but outlined several items that CM4 felt need to be added to the list of challenge that we provided.

People will always classify these challenges in different ways but I think you have captured the majority of them for this region. For (bi) [He was referring to point (bi) of question 1] I would split urban demands into Municipal and Self-supplied Industries (those not connected to municipal water supplies), and also add Environmental water demands. That means the four major needs are Agricultural vs Municipal vs Self-supplied Industries vs Environmental.

I would add water pricing somewhere, probably under (bii) [CM4 was referring to point (bii) of question 1]. For (biii) [CM4 was referring to point (biii) of question 1] I think the major challenge is “inadequate water quantities to meet regional demands...” Under (b) [CM4 was referring to point (b) of question 1] also add:

- Increased reliance on groundwater that is leading to the dropping of water tables.
- Mining of non-renewable fossil water from some of the region’s aquifers.

- Inadequate understanding of the connections between surface and ground-water resources.

Under (c) [CM4 was referring to point (c) of question 1] add:

- Natural water treatment through wetlands
- Direct potable reuse.

Under (d) [CM4 was referring to point (d) of question 1] add:

- Inflexible/rigid water institutions (making it hard to alter water policies and regulations).
- Inadequate stakeholder involvement in water management decision making
- Jurisdictional differences in managing shared water resources (NM vs TX; USA vs Mexico).

CM4 responded to question one in a way similar to CM3. CM3 believed that it is difficult to prioritize water sustainability challenges in a way that encompass all aspects of related to water issues.

Water is a shared resource that happens to be scarce in this region and therefore requires integrative, holistic, and interdisciplinary approaches in its management. That makes it difficult to prioritize these challenges and single out the most important one.

CM6 considered that water rights and water accessibility represents a challenge for CM6's community.

The thing with us is that we used to be able to access the river completely at any time, but now we have to order water to perform our ceremonies. So we have to order water from the Lower Valley Commission and have that water start to flow through and then a new cycle starts because the river is dry most of the year because of irrigation and stuff like that.

4.2 Please Share Some Examples of Efforts to Improve Water Resource Sustainability in the Rio Grande Watershed. What Key Information do Educators Need to Share in Order to Help Students Become More Engaged in Water Sustainability Issues in this Region?

The third and fourth questions asked community members about efforts to improve water resource sustainability in the Rio Grande watershed and what key information do educators need to share in order to help students become more engaged in water sustainability issues. Both questions garnered information about sustainable practices and activities as well as educational information that could potentially be incorporated into the video game such as game rules, patterns, challenges, and plot to mention a few. However, community members' responses hinted information about the beliefs, logics, and experiences underlining their perspectives. Community members provided a range of answers. For example, some community members approached the question from an academic perspective and others from a personal perspective. Academically, the participants agreed that students must experience hands on educational activities to develop a sense of sustainable practices. Also, one participant suggested that students could enter careers that support sustainability. Personally, the community members mentioned sustainable practices that students could carry out at home.

CM3 suggested that students could develop sustainable practices through hands on opportunities and outdoor experiences. Students could develop sustainable customs by experiencing real life situations that show them the complexity of sustainability problems and challenge their established practices.

We want to provide students more experimental opportunities or hands on opportunities to get them engaged in kind of hands on, uhm, research and education...get out of the classroom, get out there in the river, you know that kind of thing. I mean it is a simple statement, but that is the idea, to provide students more hands on experiences and out of the classroom and into actual

situations, you know. So they learn first by experience and hands on learning.

Likewise, CM1 implied that alienation from nature could be one of the reasons that prevents students from developing pro–environmental and sustainable practices. Namely, students do not have opportunities to experience nature directly. Thus, they do not have a sense of what nature is and how it works.

Our relationship to nature, we are not removed from nature, we are still completely dependent on nature and connected to nature, but it is in a very distant...the social jargon that I would use is alienated, very distanced way. Ok, we don't use the river, we open up the tap, and we take a shower. Ok, we don't directly experience the river....People used to wash in the river....I used to teach a class in another place, but I think that the same thing will happen here, where, you know, I was showing a film of indigenous people who were hunting and...they were cutting it [the animal] up and slaughtering it [the animal], and all the students in class went ewwwww, you know they were so disgusted...and I said to them what do you think that this stuff appears wrapped and contained in the supermarket, do you not eat hamburgers. You know, maybe if you are vegetarian, but probably most of them are happy to eat the meat, they were just shocked that it came from a real, living, bleeding animal....That is part of the problem, we are absolutely connected, you can never be outside of nature. You are always connected, but we are connected in a very long distance away. I eat a banana, that banana is not dependent on the nature of El Paso...it is dependent on the nature of Ecuador. Ok, so the relationship that I have with nature is very global and very distant.

Also, CM1 and CM3 recommended providing a space for discussion. CM3 acknowledged discussion as an important aspect of understanding and providing solutions to water issues in the area. Similarly, CM1 encouraged the game developers to create a platform where sustainability issues can be discussed and examined.

...also kind of taking the problem solving approach, to like, just in discussing these problems that we are discussing, and engaging students in helping to analyze those problems and maybe even come up with potential solutions. So, I think the more in this game that you can pose the problems and to get the students to analyze the situation and think more deeply about the problem, I think that would be a good improvement.

CM4 proposed to increase the number of students that participate in careers related to sustainability to address the pressing sustainability issues.

One of the main observations to share with students is that water sustainability issues are becoming increasingly important as we go into the 21st century. Appropriately trained water professionals will be required to meet these challenges, and this is an area where they can make a lifelong and fulfilling career.

When I asked CM2 about efforts to improve water sustainability in the Rio Grande area, CM2 expressed, “In this one [question], I was not sure if you meant me personally or me as a researcher.” Some actions that CM2 practices at home could be followed by students at home. For example, CM2 mentioned the importance of planting local vegetation in homes, washing cars less often, and collecting and reusing run off water from roofs.

...we are converting our landscape to something more natural, uhm that will be a little more water friendly, we do try to capture run off from our roof and things like that and reuse it. So, simple choices, you know I don't wash my car every week, yeah those have little impact, but at least it makes me feel like I am doing something. As a researcher, I spend a lot of time working on understanding the broader landscape and how water gets used across the broader landscape, specially in desert environment, I have done some research on drought impacts. You know when you go into a drought, from a climate

standpoint everywhere is a drought, but it plays out different on the landscape, depending on what is on the landscape. So, I work on understanding patterns on the landscape...

CM1 acknowledged that part of the population in El Paso, Texas exercises some pro—environmental and sustainable practices. CM1 also suggested that separation from nature could prevent students from developing pro—environmental and sustainable practices. Particularly, people in the area eat local chiles during certain seasons. The consumptions of local native plant species helps conserve water. For example, native plants have an innate adaptability to the desert’s dry weather, and harvesting these plant species requires less water.

One thing that people do in this region still that is a very good example of the connections to nature and the connection to the way people used to lived in the past is when we starting, it is going to start happening now, is the chile roasting season, ok, because chiles are an original crop, now they are grown in an industrial way they are not grown in a traditional way, but they use less water, they are grown, you know regionally, ok, they are brought to market, and people very clearly go to chile roasters outside, uhm, you know, grocery stores...This is a good example of being close to nature because they are only eating these things, I mean you can buy chiles any time of year, they are grown in Mexico or China or whatever, but these regional things that you can get from the roasters can only happen during the chiles harvest session at the end of the summer and the fall.

Furthermore, CM1, CM5, and CM6 affirmed that people in this area do not value green yards as much as other populations in the nation. For this reason, El Paso’s communities use much less water per person by U.S. standards. CM1 commented

On average, people in El Paso use much less water per person, people are careful of water here by US standards. Ok, so while in the one hand we really

even need to be better. On the other hand, uhm,...this is by US standards a very culturally and very ecological place, and people in Mexico use even less water per person...Well, you know, the big factor here, I think is that most people don't really have big heavily watered yards...people have an idea that desert plants are attractive, and they have desert plants in their yards....I would say that...we are still in a situation that is still a problem, ok,...but, there is a local ecological ethic, uhm, of using less water, here than in other parts of the country.

CM6 and CM5 considered pro—environmental and sustainable practices that are fostered throughout life and become a part of a person's identity. Particularly, CM5 believed that Earth provides us with resources to survive. For this reason, “we have to demonstrate our appreciation for the nourishing goods that Earth supplies by living according to the cycles of the Earth and not harming the Earth.” CM5 explained, “Native American youth learn to follow certain behaviors that demonstrate gratitude and protect the Earth through observing their family members and their community.” CM5 mentioned his experience working as a physics professor at a Tribal college. CM5 began his physics classes by going outside and conducting a prayer to honor mother Earth. Thus, students were constantly reminded at home and at school of their connection with the Earth. Similarly, CM6 talked about the connection between nature and students' identities. Students are expected to respect nature because it is intertwined with their culture and provides them with resources to survive.

...you try to show them what their identity is, and our identity completely revolves around nature and the environment and everything that we do, our ceremonial cycle, everything is completely engaged with nature. So, uhm, if you show them why we dance, why we do ceremonies, why we believe in certain things and this is because this is who you are, and this is what we were taught for centuries, by our ancestors....It is just about teaching them who they are, and

if you teach them who they are, then everything else relates, because you know land and place, place! Place is so important to us, places, and what those places mean and how everything relates, you know it's like in a spiral, everything is related, you know it's a circle, it's a cycle of life. So for us we related everything that we were taught in to culture, and my biggest thing that I used to say is that if you don't protect the environment, then you are not protecting your culture, and that is what I would tell them because everything that we need to continue our way of life is from nature, so you think that the environment is not important, well then you think that your culture is not important because both are intertwined and interrelated, they are together, you can't unravel them...

CM5 and CM6 considered that youth should develop cooperative relationships with their community, and tribal members. These connections provide a sense of belonging and welfare. CM6 expounded

I think that the important thing is to let them figure out what their role is in all of this because in our community everyone has a role, everybody has a job, everybody's job is as important as everybody else. If somebody does not do their job, then something else lags, you know, and people that have the skills and education, they get their group of people and they teach, uhm. You know somebody knows how to make bread, somebody knows how to make pottery, then they pass it on, and everybody has to have their role and their place. I think that as an educator you have to relate, uhm, how the environment relates to them and what is their role in that. Maybe they're not going to be a geophysicist, but maybe they're going to be an El Paso code enforcement officer...they are going to work at the desalination plant, they can find their role in their community and learn how to help. I think that when you make people feel important and you make them feel like they matter, then you do a real service to the community, completely, because, you know just having a

place, uhm, is very important for people...So, I think educators need to figure out how they can help students find their role in the environment.

Additionally, CM5 and CM6 suggested that awareness and presence can help students understand water sustainability issues and participate in pro-environmental behaviors. In other words, water sustainability issues should be more than concepts learned in educational settings. Students should develop a cultural and spiritual relationship with water sustainability issues. CM6 suggested that despite her science background, CM6 often frames observations of the environment by using CM6's cultural and spiritual background.

Culture is always first, it's first before science to tell you the truth. But, I see the relationships that you see in science, especially like being in geology, uhm, our creation stories of emergence coming from the ground, uhm, you can see and relate that to different tectonic type activities. You know mountains coming up from the ground, pushing up. You know, if you really think about it, and you think about your relationship then maybe your spiritual nature, and your relationship, you can see the way it relates in certain theories and things. You can relate it to your culture... I do, personally, I will think about something, I will think about wow, that kind of makes sense, you know things that I have been taught, maybe it was not a scientific way of knowing that, but it makes sense, now that I am hearing the science part of it, it completely makes sense. But, you don't always have that science background to have that relationship; it is about being there and being aware...

Similarly, CM5 has written articles explaining how Native people have sustained the environment using their accumulative and local knowledge of the environment. Thus according to MC5 Native people have developed their "own science" even though it maybe call something else.

4.3 What Barriers and Challenges Do Educators Face in Communicating Issues of Water Resources Sustainability in El Paso Area? From your Perspective What is the Best Way to Overcome Them?

The fifth question asked about communication challenges. I asked this question to obtain a perspective of the most difficult concepts to communicate and gather ideas to overcome communication challenges. First, community members believe that the Earth's climate changes are unexpected and difficult to predict. Particularly, water issues develop over extended periods of time, and their origins can be inconclusive for many years. For this reason, the representation and visualization of environmental issues can be difficult. CM3 stated, "One challenge is the complexity of the situation, you know, it is hard in a simple way and in a few words to explain the complexity. Uhm, so that's a challenge." CM1 commented that the video game must follow changes in El Paso–Rio Grande area for many decades in order to understand the complexity of different environmental alterations.

...another problem is that, is the timeline thing, you know, because if you just have something where, you know, it is a game, and they play an episode and, you know, one round of the game is one year, it might take 50 years to have an effect. Somehow this game has to be designed so that there are different timelines operating and somehow they can see that even though they survive this year, this drought year, the last two years have been very severe drought years, they survive this drought year, that they are actually depleting in the long run...I actually think that this is a great, great, challenge and topic that you are doing because how to communicate this timelines is, really important, you know, but it is also really challenging. You know, it is the difference in timelines; it is the short run versus the long run. So that is your fundamental learning question, how to communicate and learn the difference between the short run and the long run....

Particularly, the area can experience numerous changes over many years. The game developers face the challenge of communicating how the natural conditions of El Paso–Rio Grande area transform continuously over decades, and these changes have an impact on the community. CM2 commented on the changes that have taken place in the landscape of El Paso–Rio Grande and how the community could perceives these changes.

A hundred years ago, it was all grass, it was not desert, uhm, that is within potentially your lifetime, or, uhm, your children's lifetime, uhm.... And I think that it is important to convey that because I think we oftentime, people think about, when they say what is nature, you know they want things to be natural, what they think of as natural is what they think it would look like 30 years ago. You know, they want it to stay in some certain way, but natural is a changing thing. What is natural for a particular places changes through time.... And you need to be able to work with the changes rather than fight against it.

The nostalgia that people feel could determine how they receive information about water issues through time. CM1 discussed another factor that could influence the communication of these concepts.

...I mean people are very sensitive to what is going on right now, they are not very good at looking into the future or even very far into the past, and so, until the last few days, it was, we have been experiencing drought and its been very hot and people were very concerned about it, and probably that was a moment when you could talk about it, you know, talk about climate change and problems of drought. But, now it has been raining every day and so people forget and they move on. They are not worried about it now, maybe they are worried about flooding or something else, you know, so they have a short, I guess expressing it as a barrier or challenge, is that people have a, if you want to called it, a short attention span. What is going on right now it is the most

important for the most part. They don't think too much into the future, and they don't remember very much from the past.

CM1 pointed to an aspect that might contribute to students' lack of memorable experience about the Rio Grande.

The system has been stable pretty much from 1960 to the present, because, uhm, that's when the Elephant Butte dam was built, and so the river is very much controlled...So, you could sort of act as the past does not matter. Now, before Elephant Butte...it was very much of a wild river, the river came and went depending on the seasons of the year, in the spring there were always floods, the river moved around, it wiped out places. Uhm, Socorro for example there is the old mission in Socorro, but that Mission was built in the 1820's, uhm, and the reason we don't have the earlier missions in Socorro is that the river obliterated them, they were made of adobe and the river washed them away...There we irrigations...the Native American irrigated, and the Mexicans during the Spanish period irrigated, but the river would come and obliterate the irrigation channels...A young person that is growing up here today will have almost no experience with the river. You know, they have experience with opening up a tap and having water come out of it. They have experience with Wet-N-Wild Water World, ok, they don't have experience with the real living river. They have experience with something that is controlled by a gigantic dam, ok, controlled by a bunch of engineers, and controlled by a concrete channel to keep it from flooding all over the place...You can get to the actual living river like out by Canutillo,...but, very few people do that. But, really most people don't know what an actual river is like. So, the river is just like this conceptual thing. In the 1900's, the river was a real thing that destroyed people's houses, it gave them life,...it gave them water for their crops...but, which was also a crazy, huge thing that smashed stuff off and flooded all over the place.

CM1's comments indicates that students' inexperience with the "living" Rio Grande restricts their view of the river and hinders their ability to see it as a meaningful part of their lives. Thus, the game could provide information about the living Rio Grande to familiarize students with the dynamic river.

CM4 stated that "One of the main challenges for educators in this region is related to the need to comprehend the region's unique cultural and linguistic setting." CM1, CM2, and CM3 proposed that using role-playing in the video game could help students understand how the river impacts different stakeholders in a local context. Assuming the role of stakeholders from the El Paso-Rio Grande community could promote an understanding of short and long-term water issues. CM2's comment highlighted the usefulness of role-playing in conveying multifaceted water issues.

I think that it is going to be challenging to figure out the right level of information to convey; I do think that, some of that complexity, being able to see it from different perspectives. I mean maybe that is what the game should do, tell the story from different perspectives...if you are doing role-playing, uhm, then you do have all these different perspectives, and they can learn a lot through the role playing...without really going into all the great details, which are going to be awful (laughter) for them to try to understand. If you are playing the role of a farmer, then you certainly, I think that a middle school kid can think through that he needs to be worried about his harvest over the next few years and then weather and climate is pretty uncertain after that, and uhm, and I think that is a role they can understand why farmers might be making, you know, short term decisions. So yeah if you are in water utilities, then in your business you are looking decades out...

CM1 concurred with role-playing as means to communicate the convolution of situations. CM1 expanded on the example of a local farmer to illustrate the intricate relationships that connect farmers, farm workers, homeowners, and irrigation districts.

Role-playing, so you can have a farmer, you know. For example, you have a farmer who has, uhm, 50 year old pecan trees, and if they don't keep those pecan trees, if they don't give them certain amount of water every session. You know, they had these trees for 50 years, so it is a huge investment. It takes 8 or 10 years for a new tree to get a tree established, uhm, and if they don't have water for it, then it goes away. So you got people in the city who want to have a green yard, people in the city who want to take a shower and wash their car and so forth. You have farmers who have different crops and the farmers are going to go out of business, who have farm workers who depend on the farmers to have business. Uhm, you have organizations of different people who supply the water, the irrigation district supplies the water to the farmers, you have the utilities that buy some of the water from the irrigation districts and also drill wells to the ground water. I mean its is possible to, uhm, develop something that would have role-playing, where different kinds of people have to deal with each other in order to get enough water to achieve some basic level of their needs....Uhm, you know to really do a good, like even a game type of model of that, it is really complicated...I mean to be realistic, you need to know what ways they get the water, governors, access, and so forth. You have to look at power, how wealthy are they...There is a very famous line...you know which way water flows?...Water flows towards money.

The community members also stated that the location of El Paso, Texas provides a good opportunity for students to learn about water negotiations and agreements between states, nations, and major decision makers, CM1 "...and that goes back to having kids, potentially doing role-playing. To have them do role-playing representing the Mexican side as well as the US side..." CM3 identified the other main stakeholders.

Well if you are talking mainly within the city, it will be El Paso Water Utilities, you know is the main, uhm, decision maker, and also the one who

offers or who promotes conservation and other things. So probably the most important decision maker in El Paso is El Paso Water Utilities, and then, umh, beyond the city. Then, I would say, the irrigation management district, or it is called El Paso County Water Improvement District, which manages all of the agricultural uses of water.

Furthermore, CM3 considered the idea of trade offs to be a difficult concept to convey. When I asked a participant about the measurement of the water footprint, our conversation led to trade offs that we make related to water. It can be difficult for the developers of the game to communicate the complexity of these trade offs as CM3 explained:

The thing that there there are trade offs in all of these personal decisions that we make and there is, there is a lot of hidden things behind all of those. I mean, we take a simple example, so, for example at your home, whether to use a swamp cooler or to have refrigerated air...Ok on the surface, of course, if you go to switch to refrigerated air it looks like you use less water, but actually it takes a lot of water to generate electricity, and the refrigerated air uses a lot more electricity, but really behind that decision still a lot of water use. So, you see what I mean, it is not so evident. So these decisions are hard, and you know there are many other personal ones. Like a, well, umh, using washable dishes versus paper plates. Then again, if you use paper plates you don't use as much water to wash dishes, but you generate more trash...So, you know all of these things, there are always trade offs like that. I don't know, I think it's good to cause people to think about those decisions. But, it's really difficult to analyze them, I don't know if you will be able to do that within the context of this game. It is kind of difficult.

CM5 and CM6 believed that pro-environmental behaviors and sustainability activities could be difficult to transmit through a video game because these should be part of everyday life and should be taught from an early age. Also, CM6 explained that educators need to

earn students' respect to have an impact on their learning.

You don't earn respect instantly; you have to gain that respect. So, when an educator comes in and they do, uhm, you know one session for Earth week or something like that, you know. Are they really gaining the respect of the students? Or is a person that comes in and they begin to establish a relationship with and became some kind of mentor towards them, then they really see the role..

Furthermore CM5 suggested that sharing Native Americans' environmental knowledge and culture could be difficult because many students are not familiar with certain aspects of their culture and background. CM5 and CM6 agreed that it is difficult for Native Americans to share their ideas about sustainability and their way of life with others. People perceive Native Americans as spiritual, but they do not understand the meaning behind their traditions. CM5 commented, "people cannot understand our dances and they make fun of them." Similarly, CM6 considered, "Native Americans are ready to share their knowledge, but people do not want to listen."

The community members' responses have the potential to contribute to the development of the *Sol y Agua* project's video game. Incorporating this information into the video game involves understanding how the community members' individual networks of meaning result in hidden logics. In the next chapter, I explore hidden logics and negotiations used to derive meaning or construct new knowledge and how these might inform the design of the *Sol y Agua* project's video game.

Chapter 5

Constructing Negotiated Meaning from the Community Members' Hidden Logics

I interviewed community members in the fields of agriculture, urban systems, ground water systems, desert ecology, and traditional ecological knowledge to elicit information that could be used to design the *Sol y Agua* project's video game. Two community members also provided perspective from their Native American cultural backgrounds. Five questions I asked provided helpful information about water sustainability issues, water concerns, communication challenges, and pro-environmental sustainable activities in El Paso-Rio Grande area. In this chapter, I examine community members' responses to uncover hidden logics. Also, I attempt to construct new knowledge from the community members' hidden logics to inform the construction of the *Sol y Agua* project's video game.

The analysis of community members' responses revealed different hidden logics. Six hidden logics surfaced: perceptions of the largest water users, perceptions of prudent water use, pro-environmental practices and collaboration, pro-environmental practices and experiences with nature, and communication challenges. In this section, I explain how community members' responses demonstrated that their hidden logics collided and intersected to create new local knowledge and transformed prior knowledge.

5.1 Hidden logic 1: Ineffective Water Management

CM4 suggested that water management in the area is not effective. The community member remarked "Inflexible/rigid water institutions (making it hard to alter water policies and regulations), Inadequate stakeholder involvement in water management decision making, Jurisdictional differences in managing shared water resources (New Mexico vs Texas;

United States vs Mexico).” Similarly, CM1 suggested that the local water company, El Paso Water Utilities, alternates from two water resources, the Hueco Bolson aquifer and the Rio Grande River, depending on the water availability of each source. CM1 stated that these procedures do not guarantee the preservation of these two water resources. CM1’s and CM4’s hidden logics about ground and surface water management could be highlighting a power relationship in water management: only certain stakeholders make decisions concerning water management and sustainability. However, as CM2 suggested “it should not be the choice of a few to determine the future for everybody...” CM2’s comments implied that only some stakeholders make decisions concerning water management and sustainability. CM1’s, CM4’s, and CM2’s hidden logics advocate for active participation of all members of El Paso–Rio Grande community in ground and surface water management and decisions to avoid ineffective water administration.

5.2 Hidden Logic 2: Perceptions of the Largest Water Users

The examination of community members’ responses uncovered hidden logics that implied that balancing water resource is a complex ongoing competition that requires identifying the largest water consumers. Community members had different logics of who the largest consumers might be. CM2 believed that the agriculture sector consumes the largest amount of water. CM2’ s hidden logic suggests that farmers control most of the water, and they could limit the amount of water allocated to other sectors. In response, CM2 proposed to improve the agriculture sector’s water efficiency. However, CM3 implied that, in the future, other sectors would increase their “political contingency” and consume more water, which could constrain the amount of water given to other sectors as well. For example, the “Audubon society they bought water rights in the Rio Grande manly just to maintain habitat for birds.” Community members’ hidden logics suggest that there is a philosophy regarding the increasing and ongoing competition for water use between humans and ecosystems. Also, the conception of the largest water user that represents the main challenge in local water management exemplifies the intersection of two hidden logics. One

community member considered farmers to be the largest water users and the stakeholders that could complicate local water management. However, another community member considered that cultural and environmental protection agencies could increase their water consumption and represent an equal or greater challenge. Consequently, the perception of the largest water users should be communicated as a changing concept that would continue adjusting as local circumstances fluctuate.

5.3 Hidden Logic 3: Perceptions of Prudent Water Use

The community members' hidden logics implied that El Paso–Rio Grande community has to examine and establish what are prudent ways to use water. CM3 explained, “The public wants these environmental amenities, like birds and wildlife, and wetlands, and things like that.” CM3's hidden logics raise the question, what are considered environmental amenities? CM3's comment inferred that the Audubon society could be considered an environmental amenity for some people. However, others could consider this organization an important advocate for conservation and restoration of natural ecosystems. Within the social system, cultural groups are competing for water. CM6 explained that water accessibility represents a challenge for CM6's community because they have to order water to perform their ceremonies. The most well known local tribe's water ceremonies could seem as unnecessary commodities for some, but CM6's hidden logic suggests that for cultural groups these traditions are crucial for the continuous survival of local history and knowledge. CM3's and CM6's hidden logics implied that the allocation of water in the area depends on different values placed on activities that required use of water resources. Some groups could place higher value on conservation and restoration of natural ecosystems as well as cultural preservation, while others could consider these unnecessary amenities. This discrepancy points to a related issues: perceptions on the meaning of quality of life. When balancing resources and quality of life in decision-making assumptions about definitions surface and must be negotiated.

5.4 Hidden Logic 4: Pro-environmental Practices and Collaboration

Community members' responses emphasized that students must develop pro-environmental and sustainable practices. Their approaches to encourage environmental and sustainable practices corresponded, but their hidden logics differed. First, the community members concurred that collaboration is essential to resolve water sustainability issues and to develop pro-environmental practices. However, the community members' perceptions of these methods diverged. CM1, CM2, and CM3 viewed collaboration as a structured activity in which students take on roles, play out discussions, use their critical thinking skills, and understand nature's impacts on different stakeholders. CM1, CM2, and CM3 proposed that assuming the role of different community members could promote an understanding of short and long-term water issues. CM2 explained, "If you are playing the role of a farmer, then you certainly, I think that a middle school kid can think through that he needs to be worried about his harvest over the next few years and then weather and climate is pretty uncertain after that..." Then, CM3 proposed that using role-playing in the video game could help students understand how the river impacts different stakeholders in a local context. CM1 also said, "I mean its is possible to, uhm, develop something that would have role-playing, where different kinds of people have to deal with each other in order to get enough water to achieve some basic level of their needs..." Furthermore, CM3 highlighted that the location of El Paso, Texas provides a good opportunity for students to learn about water negotiations and agreements between states, nations, and irrigation management district due to its location. Aggregated, the community members' comments suggested that through-role playing students could interact and collaborate to learn how professionals negotiate their needs with other community members and the environment. The hidden logics of CM5 and CM6 diverge from this view of collaboration. CM5 and CM6's hidden logics implied that individuals collaborate with others in everyday situations to work towards the survival of their community, to teach each other and to learn from each other, to share experiences, and to pass down their traditions and a way of life. Thus,

students are expected to find a role in this collaboration and work towards the prosperity of their community. CM6 expanded,

I think that the important thing is to let them figure out what their role is in all of this because in our community everyone has a role, everybody has a job, everybody's job is as important as everybody else. If somebody does not do their job, then something else lags, you know, and people that have the skills and education, they get their group of people and they teach...

CM6's hidden logic implied that they see collaboration as an integral part of their lives because their collaborations have helped them to adapt to their surroundings for many years. Namely, CM6 explained, "...we believe in certain things and this is because this is who you are, and this is what we were taught for centuries, by our ancestors..." The collective knowledge that they have gained while surviving Earth's changing environmental conditions has become part of their culture and identity. Thus, their collaboration has resulted in a lifelong engagement with their community and the Earth. CM6's and CM5's hidden logic of collaboration added a personal dimension to CM1's, CM2's, and CM3's professional hidden logic of collaboration.

5.5 Hidden Logic 5: Pro-environmental Practices and Experiences with Nature

CM1's, CM3's, and CM4's hidden logics suggested that outdoor experiences could help students develop pro-environmental behavior. CM4 expressed, "they need to be encouraged to participate in different water conservation initiatives where possible." Similarly, CM3 suggested, "We want to provide students more experimental opportunities or hands on opportunities so to get them engage in kind of hands on, uhm, research and education...Get out of the classroom, get out there in the river, you know that kind of thing." Then, CM1 believed that students should participate in outdoor opportunities to develop a sense of connections and awareness of our dependence to nature, which could result in

pro–environmental and sustainable practices. CM1 added “Our relationship to nature, we are not removed from nature, we are still completely dependent on nature and connected to nature, but it is in a very distant...the social jargon that I would use is alienated, very distant way. Ok, we don’t use the river, we open up the tap, and we take a shower. Ok, we don’t directly experience the river...” Thus, outdoor opportunities can foster profound understanding of their local natural environment and its dynamic processes.” Conversely, CM5 and CM6 believed that students learn about their local natural environment and processes through developing their identity and practicing their cultural activities. CM6 explained,

...you try to show them what their identity is, and our identity completely revolves around nature and the environment and everything that we do, our ceremonial cycle, everything is completely engaged with nature. So, uhm, if you show them why we dance, why we do ceremonies, why we believe in certain things and this is because this is who you are, and this is what we were taught for centuries, by our ancestors....

CM6’s comments suggest that Native students’ understanding of the natural environment is tied to their identity. Similarly, pro–environmental behaviors are intertwined with their culture. CM6 explained this connection

So for us we related everything that we taught in to culture, and my biggest thing that I used to say is that if you don’t protect the environment, then you are not protecting your culture, and that is what I would tell them because everything that we need to continue our way of life is from nature, so you think that the environment is not important, well then you think that your culture is not important because both are intertwined and interrelated, they are together, you can’t unravel them....

CM5 and CM6 implied that developing pro–environmental behavior and activities is a life long process and must be part of student’s culture and identity. While, CM1’s, CM2’s,

CM3's, and CM4's hidden logics suggested that field trips to the Rio Grande rivers could foster pro-environmental behavior and activities. The hidden logics of the community members conflicted. The majority of the community members believe that students could develop a deeper connection with the Rio Grande River by participating in outdoor opportunities that foster more insightful understanding of local natural environment and its dynamic processes. However, the Native American community members suggested that deep connections with nature are foster through everyday activities as part of a person's own culture and background. Additionally, the comments of the Native American community members indicated happiness comes with the wealth being of their community and families rather than personal gain and happiness.

5.6 Hidden Logic 6: Communication Challenges

CM1, CM3 and CM2 believed that communicating the timeline of environmental problems and changes in El Paso-Rio Grande represents a challenge because problems related to water develop over extended periods of time. Thus, their comments suggest that game developers have to communicate the changing conditions of El Paso-Rio Grande continuously over decades. Their explanation did not show any hidden logics. Namely, the community members articulated their reasoning directly providing examples. The community members identified other factors that could represent communication challenges. CM3 explained that trade offs that we make related to water could be difficult to portray.

Community members' hidden logics implied that local cultural perceptions, practices, and behaviors could represent challenges in communicating water issues. CM1 reasoned that previous experiences or lack of experiences with the Rio Grande could determine how students receive these concepts and this represents a communication challenge. CM1's hidden logic implies that many students could feel alienated from the living Rio Grande and they might not perceive the river in a meaningful manner. CM1 concluded that the game could provide information about the living Rio Grande to familiarize students with the dynamic river. However, CM4 commented, "One of the main challenges for educators in

this region is related to the need to comprehend the region's unique cultural and linguistic setting." CM4's hidden logic suggested that the task of providing information about the living Rio Grande and local environment could be difficult. CM1's and CM4's hidden logics implied that incorporating information about the region's existing culture would require extensive comprehension of existing perceptions. For example, educators must understand the communities' cultural history in order to represent the complexity of the local setting and avoid misrepresentations, stereotypes, and derision of cultural groups.

CM6's and CM5's hidden logics exemplified the difficulty of incorporating information about the region's existing culture. CM6 stated that people outside Native communities do not comprehend the meaning behind their traditions. CM6 commented, "people cannot understand our dances and they make fun of them." CM6's hidden logic suggest that Native American could be discourage to share their knowledge in a video game. Even more, CM1's hidden logic appears to support this idea. CM1's comments suggested that non-native students' alienation from the Native American culture and previous perceptions about Native Americans could prevent them from understanding and internalizing natives' perspectives and dismiss Native American's knowledge.

5.7 Construction of New Knowledge and Implications

Flower (2003) stated, "The challenge for creating new knowledge is whether new knowledge has been constructed or whether prior knowledge has been transformed..." (p. 254). My analysis of the community members' responses demonstrated that their hidden logics collided, intersected, and aggregate to create knew local knowledge and transform prior knowledge. Community members' underlying values, beliefs, meanings, and knowledge did not conclude in sets of opposite views or a single agreement, but rather into "partially contradictory, partially overlapping, sometimes coexisting networks of knowledge" (Flower, 2003, p. 268). The mediation of community members' hidden logics yielded new knowledge with regard to issues of water management, pro environmental and sustainable practices, and communication challenges.

5.7.1 Water management issues

One of the principal water problems in El Paso–Rio Grande area is water scarcity. The effective allocation and regulation of the limited amount of water represents a challenge. First, the community members' responses confirmed that Rio Grande River's water and Hueco Mesilla Bolson's supply has diverse functions in the community and plays multiple roles in the conservation of ecosystems, farming, and social systems. Namely, the Rio Grande River helps support local habitats. In the social systems, the river supports food production and amenities. Thus, the students need to understand the Rio Grande's and Hueco Mesilla Bolson's multiple roles and the struggle to distribute the scarce amount of water effectively. Moreover, students must understand the different value systems that community members place in their water usage. As community members implied, students would have to examine water management systems in the area, consider the needs and value systems of all community members, define environmental amenities and priorities, and decide as a community the best way to divide the limited amount of water provided by the Rio Grande River and the Hueco Mesilla Bolson.

5.7.2 Pro–environmental practices

In addition to effective water management, community members emphasized that students must develop pro-environmental practices. CM1, CM2, and CM3's hidden logics suggested that collaboration could help students develop practices pro–environmental practices. CM1's, CM2's, and CM3's perceived that collaboration as a structured and professional activity, in which students take on roles, play out discussions, use their critical thinking skills, and understand nature's impacts on different stakeholders to negotiate their needs with the needs of others. However, CM5's and CM6's hidden logics add to others' notion of collaboration by suggesting that students must learn to collaborate with others not only in a professional context but also on a personal level and as a part of a community working towards the same goals. For CM5 and CM6 students should not simply aim to

negotiate their needs with the needs of others, but rather students must learn to go beyond discussions and compromises. For example as CM5's hidden logic inferred a farmer should develop a lifelong commitment to share and teach other farmers effective sustainable farming techniques, educate the local community about sustainable farming, and practice activities that guarantee the wellbeing of local ecosystems and the community as a whole. CM1's, CM3's, and CM4's hidden logics suggested that field trips to the Rio Grande rivers could foster pro-environmental activities. Conversely, CM5 and CM6 believed that students learn about their local natural environment and processes through developing their identity and practicing their cultural activities. CM5 and CM6 implied that developing pro-environmental activities is a life long process and must be part of students' culture and identity.

5.7.3 Communication challenges

The main challenges for educators in this region is to comprehend the region's unique cultural setting. As the hidden logics of the community members suggested, this task could be difficult. Incorporating information about the region's existing culture would require extensive comprehension of existing perceptions. For example, educators must understand the community's cultural histories in order to represent the complexity of the local setting and avoid misrepresentations, stereotypes, and derision of cultural groups. Also, educators must consider students' previous experiences about the Rio Grande, the Hueco Mesilla Bolson, and Native Americans, to name a few in order to understand how previous perceptions can prevent them from understanding and internalizing knowledge about these topics.

5.7.4 Implications for the *Sol y Agua* video game

Community members' hidden logics did not resolve into discrete opposing claims or consensus. Rather, community members' hidden logics partially contradicted, partially overlapped, and co-existed. These logics should be echoed in the virtual space of a video

game. Video games need to represent concepts, decisions, and dialogue about water sustainability as contradictory, overlapping and co-existing. Environmental educational video games presume that energy sources and reduction techniques could be implemented in any city despite the distinctive environment and resources of each city (Springer & Goggin, 2013). For example, the storyline of a video game could suggest that nuclear plants are the best option to provide renewable energy in a city without describing the repercussions of their implementation. In this study, community members' hidden logics suggested that the current management of the Rio Grande River and Mesilla Hueco Bolson could become inefficient in the future. Some of the community members explained, the agriculture sector consumes most of the water resources. However, cultural groups, environmental organizations, and domestic users are growing and they are increasing their consumption of water. At the same time drought conditions and scarce water resources could limit the water supply in the future. Thus, the hidden logics suggest that the video game should not depict desalination plants as the only and best option to provide water. Similarly, current plans to manage the Rio Grande and Mesilla Hueco Bolson should not be assumed to be the best alternative. Players need to develop a comprehensive understanding of the benefits and disadvantages of implementing specific management plans. Players must learn to examine the partially contradicted, partially overlapped, and co-existing demands of all groups and decide how to divide the water effectively as local environmental, social, and political conditions change. Additionally, the video game should help students understand and evaluate the deficiencies of current management methods, prepare them to improve current systems, and find alternative procedures that are more inclusive. Students, also must learn to participate in decisions that guarantee the preservation of the Hueco Bolson aquifer and the Rio Grande River, to demand from water authorities more effective management programs, and to inform others about local water sustainability issues and pro-environmental behaviors.

Springer and Goggin (2013) stated that video games require players to connect with different stakeholders, but the players' interactions are simplified versions of real-world po-

litical decisions, and they overlook political complications. The simplification of conflicting involvement and the absence of different stakeholders does not permit players to consider the power relationships that take place in dialogues about sustainability issues and the negotiations that must take place to resolve these concerns. Community members' hidden logics overlapped and considered that students should collaborate to resolve water sustainability challenges and to develop pro-environmental and sustainable practices. However, the hidden logics also partially contradicted. CM1, CM2, and CM3 believed that through role-playing students could interact and cooperate to learn how professionals negotiate their needs with other community members and the environment. For example, a student could play the role of a farmer. As a farmer, the player would have to consider the success of his or her harvest over the next few years and the uncertainty of the local weather and the world's climate. Additionally, the player would have to consider sharing the local water supply with other farmers and community groups. The farmer would have to collaborate and deal with others in order to get enough water to achieve a successful harvest. The hidden logics assumed that professional collaborations can help students understand the complexity of sustainability issues, the impact of water scarcity on individual stakeholders, and help them develop skill to carry on professional collaborations. These hidden logics suggested that only certain professionals collaborate to make decisions about water management and issues. CM5's and CM6's hidden logics partially contradicted this professional view of collaboration. Namely, their hidden logics suggested that players should learn to collaborate with others in everyday situations to work towards the survival of their community, to teach each other and to learn from each other, to share experiences, and to pass down their traditions and a way of life. Furthermore, players need to find a role in this collaboration and use their ability to work towards the prosperity of their community. CM6 argued that not all students will have interest in STEM fields, but the game should help them figure out how they can help achieve water sustainability despite their career choice. Thus, the hidden logics of the community members contradicted, but also complemented each other. The video game should encourage players to collaborate in both a professional

and a personal level.

According to Springer and Goggin (2013), “nature is depicted in most multiplayer on-line games as an inexhaustible dispense of resources” (p. 122). The hidden logics of the community members contradicted. Some community members’ hidden logic suggested that students view the Rio Grande River and the Hueco Mesilla Bolson as a distant concept detached from their daily lives. Therefore, students must visit the Rio Grande River and the Hueco Mesilla Bolson to develop a connection with these water resources. However, CM6 believed that students view that river as part of their community and family, and they should acquire this view through everyday life. CM4 expressed the need to encourage participation in different water conservation initiatives when possible. Then, CM3 suggested taking students to the Rio Grande River to encourage a sense of connection and reality and CM1 argued

...we are not removed from nature, we are still completely depended on nature and connected to nature, but it is in a very distant,...the social jargon that I would use is alienated, very distant way. Ok, we don’t use the river, we open up the tap, and we take a shower. Ok, we don’t directly experience the river....

Linking outdoor opportunities to the virtual space of the video game could foster more insightful understanding of local natural environment and its dynamic processes. Although these efforts could instill an appreciation for nature and the Rio Grande River, CM5 and CM6 believed that developing pro–environmental behavior is a life long process and must be part of student’s culture and identity.

CM6 expressed that students learn about their culture and at the same time they learn pro–environmental behaviors and sustainable practices. Native Americans community members considered that youth should develop cooperative relationships with extended family, community, and tribal members. These connections provide a sense of belonging and prosperity. As CM6 commented

I would tell them because everything that we need to continue our way of life is from nature, so you think that the environment is not important, well then you think that your culture is not important.

This comment implied that natural resources such as the Rio Grande River are living members of their community. For this reason, students are expected to develop a healthy relationship with the river in the same way that they cultivate wholesome relationships with their families, community, and elders. CM5's, and CM6's hidden logics suggested that Earth provides us with resources to survive. For this reason, we have to demonstrate our appreciation for the nourishing goods that Earth supplies by living sustainable lives. Additionally, collaboration appears to be an essential aspect of their community since collaboration helped them survive many hardships throughout their history. The concepts that the CM5 and CM6 contributed could be difficult to transmit through the game because these should be part of everyday life and should be taught from an early age.

CM6's hidden logic contradict CM3's and CM4's hidden logics. Namely, CM6 implied that the main aspect that would help students. Students need to build a relationship with nature based on values found in their own cultures. For instance, students, educators, and game developers could identify already exhibited successful behaviors or strategies through observation, for example through a positive deviance inquiry (see <http://www.positivedeviance.org>) that support pro-environmental behaviors and water sustainability activities. Then, players could implement and practice these behaviors or strategies in gameplay. This approach assumes that behaviors and strategies to protect the Rio Grande River and the Hueco Mesilla Bolson already exist in the students' cultures. Thus, students do not have to derive pro-environmental behaviors from other cultural groups. Also, students could be more willing to practice pro-environmental behaviors that already exist in their daily lives and that it is part of their identities. CM1 provided an example of people in the area eating local chiles during certain seasons. The consumption of local native plant species helps conserve water. This activity is part of the local culture already. Therefore, students should be encouraged to practice this activity

and to make it part of their identity. The video game could incorporate similar activities. The virtual space could help player examine why these are effective pro–environmental activities, and how these relate to their culture and identity.

Dill, Gentile, Richter, and Dill (2005) and Glaubke, Miller, Parker, and Espejo (2001) analyzed of 70 console games and they concluded that minority characters rarely appear in video games, but when minority characters emerge in games they are stereotyped. For example, Latina women and Native American men were never present in these games. Different ethnic groups inhabit the El Paso–Rio Grande area. Thus, the video game should represent the various ethnic and cultural groups. For example, the story line could incorporate aspects of the local tribe’s culture and a character that represents this community. The presence of the local tribe in the video game could familiarize students with various traditions, knowledge, and views. However, game developers should avoid presenting minority characters and knowledge superficially and out of context. For example, including Native peoples’ dances, beliefs, and knowledge without explaining the history and background of their culture could cause students to develop meaningless and stereotypical perceptions of this group. As CM5 and CM6 suggested many students are not familiar with certain aspect of Natives culture and background. Thus, they could perceive Native Americans as spiritual because they do not know and understand the long history and meaning behind their traditions. The community members’ hidden logic partially contradicted, but they also can co-exist. The video game could help players see the Rio Grande River and the Hueco Mesilla Bolson as more than nexhaustible dispense of resources by both encouraging direct experience with the rive and helping players discover cultural connections with the river. Players could realize that the Rio Grande River and the Hueco Mesilla Bolson are already part of their identity and daily lives.

Chapter 6

Concluding Remarks

6.1 Significance of the Results

Scholars and game developers affirm that educational and commercial video games have great potential for both communicating complex issues that severely affect our lives and for preparing students of all ages to resolve these problems. Video games could be considered communities in which students can judge and negotiate multiple, competing information and issues that are impossible in real life for reasons of safety, cost, and time. Thus, video games could enter classrooms as interactive learning spaces where students could participate in intense emotional and sensory experiences that help them prepare for the future. Video games that encourage deep learning and lasting behavioral changes remain a hope more than a reality.

Currently, most video games do not represent the complexity of real situations. Hocking (2007)'s ludonarrative dissonance explained some the inconsistencies in video games. In some virtual spaces, characters are given specific characteristics that defined their personality traits, but in game play the players are allowed to act in ways that inconsistent with real world environments. For example, in video games some doors do not open or lead nowhere and characters can walk through walls. Similarly, video games that address sustainability issues make simplifications and establish idealistic expectations that do not resemble real life sustainability challenges. Furthermore, video games do not consider the local and unique settings where these issues take place including the cultural and race diversity of the local stakeholders. Springer and Goggin (2013) implied that video games could become more engaging by presenting more realistic and complex settings. May (2013) suggested redefining the way we approach video game building to offer players a complex

and authentic experience. Springer and Goggin (2013)'s and May (2013)'s comments are an appeal for additional and detailed steps that can help bring real life complexity in to virtual spaces.

This research attempted to collect and examine information from actual settings and real life situations to contributing to developing the storyline of the *Sol y Agua* project's video game. Particularly, I aimed to understand how do the community members' individual underlying values, beliefs, meaning, and knowledge result in hidden logics that collide, intersect, and aggregate to construct new meaning and knowledge of local water sustainability. Then, I aimed to construct new meaning and knowledge of local water sustainability that could inform the construction of the *Sol y Agua* project's video games.

6.1.1 Hidden logics that collide, intersect, and aggregate to construct new meaning and knowledge

Assemblage of community member's responses demonstrated that their networks of meaning and hidden logics collided, intersected, aggregate, and balanced to create knew local knowledge and transformed prior knowledge. For example, Native Americans' concepts of collaboration added a personal dimension to the community members' professional logic of collaboration. Furthermore, the conception of the largest water user that represents the main challenge in local water management exemplifies the intersection of two logics. One community member considered farmers to be the largest water users and the stakeholders that could complicate local water management. However, another community member considered that cultural and environmental protection agencies could increase their water consumption and represent an equal or greater challenge. Consequently, the perception of the largest water users should be communicated as a changing concept that would continue adjusting as local circumstances fluctuate. The logics of the community members also conflicted. Most of the community members interviewed believe that students could develop a deeper connection with the Rio Grande River by participating in outdoor opportunities that foster more insightful understanding of local natural environment and its dynamic

processes. However, the Native American community members suggested that deep connections with nature are fostered through everyday activities as part of a person's own culture and background. Additionally, the comments of the Native American community members indicated happiness comes with the wealth being of their community and families rather than personal gain and happiness.

Barab et al. (2005) believed that video games' story lines must balance local customization and the video games' integrity. Some of the insights of community members were grounded in concepts that have been discussed in risk communication scholarship. CM1, CM3 and CM2 believed that communicating the timeline of environmental problems and changes in El Paso–Rio Grande area and other places represents a challenge because problems related to water develop over extended periods of time. The community members response echoed environmental risk communicators, which have identified the problem of communicating long term and complex environmental problems. Thus, their perspective could apply to any game focused on environmental sustainability issues as well as bring a balance between local customization and the video game's integrity.

6.1.2 New knowledge of local water sustainability that could inform the construction of the *Sol y Agua* project video game

Currently, the design of video games focused on environmental sustainability might include the ideas of local stakeholders, but that does not guarantee that students will participate in effective intercultural inquiry, collaborative problem solving, and negotiation of meaning. A video game should present the complexity of real life water sustainability issues, assure that students have a space where they can dramatize the complicated negotiations between competing logics, and help them carry out this knowledge into the real life dialogue and circumstances. Additionally, through environmental video games, students can learn to survive alongside local water sources without damaging them. For instance, as responsible citizens, students need to negotiate and develop lifestyle and financial practices that provide a quality of life while renewing and protecting the local environment

and water resources. The case study’s insights could help improve the video game design process by incorporating situated, contextual knowledge and diverse characters that accurately represent the setting of El Paso–Rio Grande area. The information constructed using the hidden logics of the community members could help the *Sol y Agua* team develop a video game that intertwines situated and accurate context with STEM content pertaining to local water issues. Game developers could bring together characters, narratives, and settings relatable to players and STEM themes related to local water sustainability. For example, the concept of the largest water user can provide an opportunity for players to understand simple and advance measurement techniques used by STEM professionals to estimate water use and models that project future water use. Players could examine graphs that visualize agricultural water use, household water use, and recreational water use, and water management. Graphs could represent the water use of the local Native American tribe, local chile farmers, and the Audubon society of El Paso, Texas. Also, the video game could include graphs that visualize water withdrawal from the Rio Grande and the Hueco Mesilla Bolson. Players could determine the largest water user using actual models and estimates. Then, the game could ask players to negotiate the water needs of stakeholders while preserving the Rio Grande and the Hueco Mesilla Bolson. Players’ negotiation would also involve understanding the value systems underlying the necessities of the local Native American tribe, local chile farmers, environmental protection agencies, and Rio Grande and the Hueco Mesilla Bolson. In turn, examining different value systems would require understanding different perspectives based on culture, history, and settings. Incorporating local history and community members’ individual perspective could help students make informed and equitable decisions.

Flower (2003) explained, “dialogue needs a point of stasis, a way of opening a shared question so that people can deliberate together (and not jut rehearse their standard stories)” (p. 248). The *Sol y Agua* project’s video game could serve as a point of stasis where the ideas of local stakeholders and students could be deliberated together in an inclusive manner. Negotiating the community members’ hidden logics demonstrated that dialogue

and collaboration have the potential to include the voices and differences of all stakeholders, such as those of cultural groups and marginalized community members. A comprehensive discourse that allows for different input and assures the best interest of all community members could help insure water sustainability in the El Paso–Rio Grande area. However, the community members’ responses implied that dialogue and collaboration about water sustainability in El Paso–Rio Grande must be enhanced. In reality the community members do not have spaces or opportunities to come together and resolve local water sustainability issues. Even more, dialogue tends to marginalize certain voices. Incorporating ideas from different stakeholders does not guarantee intercultural inquiry or collaborative problem solving. As Flower (2003) explained, in real life dialogue, “hearing the voices and opposition of others can leave one’s image of a problem unscathed, one’s plan of action unchanged” (p. 254). Thus, future generations must learn to negotiate and incorporate all voices in order to attain effective water sustainability.

6.2 Future Work

Chapter 2 showed that there are a growing number of studies focused on examining the discrepancies of established environmental video games to improve the experience of players and encourage social change. However, very little has been written about pre production steps that could help improve environmental video games. QA project used social–responsive design to engage students in the design process of their game and documented their process. However, limited studies have documented the contribution of experts in the design process of an environmental video game. As a member of the *Sol y Agua* team, I learned that an effective and believable video game must be designed in close collaboration between game designers, content experts, and end users. Game designers can provide expertise in visualizations, video game rules, and overall design. End users can provide insight about the effectiveness of the video game and their preferences. However, game designers and end users do not understand the realm of environmental sustainability issues and the complex negotiations that take place in environmental sustainability discourse.

As the hidden logics of community members showed there are many values, knowledge, and beliefs that must be negotiated to achieve genuine compromise between stakeholders and comprehensive solutions to sustainability issues. Participation of local community experts can help identify potential clashes that marginalize the voices and insight of particular individuals or groups. Also, expert insights can shed light on disparities between value systems, knowledge, and beliefs and provide methods to achieve effective cooperation in virtual spaces.

The analysis presented provides opportunities for further study. Although the game is focused on STEM topics related to water sustainability, the video game should be framed using local cultural elements and knowledge. This study suggests that the *Sol y Agua* team must conduct more detailed research to identify pro–environmental behaviors that already exist in El Paso–Rio Grande area. This could require observing the behaviors within the broader community, identifying individuals that are practicing effective pro–environmental behaviors now, and examining the cultural background of local pro–environmental behavior of different local groups. This information could be acquired through asset-based, participatory methods, e.g., positive deviance. As the QA project demonstrated, incorporating the audience of the game in the design process could help make the video game more effective. For example, interactions with local students could provide more insight into pro–environmental attitudes and logics that are interwoven in their identities and culture. Additionally, future investigations should avoid othering community members. For example, all community members that are willing to contribute knowledge to develop the video games should be asked about their race and culture and manifest these aspects in reports and the video games to avoid identifying and separating groups by their race and culture. Additionally, the process of gathering knowledge should incorporate opportunities for group discussions. For example, community members could participate in think tanks in which they can talk to each other and their hidden logics can interact directly. The direct integration of community members could produce more accurate understating of their perspectives, ideas, beliefs, networks of meaning, and hidden logics.

The Rio Grande River and Hueco Mesilla Bolson aquifer are the main water resources in the area. Thus, the video game's storyline and activities should be framed around these main water resources. The community members agreed that students are disconnected from the living river. The Rio Grande River and the Hueco Mesilla Bolson aquifer tend to be remote concepts for students. Incorporating visits to the Rio Grande River that are connected to activities within the video game could help students develop a relationship with the living river. As the members of the local tribe commented, the river should become part of students' identities and culture. Thus, students should find a deeper and personal connection with the river and aquifer. For example, some students could have grandparents who experienced life in El Paso, Texas before the construction of the dams, which currently control its flow. Other students may have family members who helped build these dams. Furthermore, students concerned with animals might want to explore why animals that inhabited the Rio Grande River in the past are not longer found in the area. As the local tribe members suggested, the video games should not only present the current situation of water sustainability issues in the area but also the historical background that caused the current conditions. The video game should help students examine where they belong within this history. In future research, all these aspects should be investigated and utilized.

6.2.1 Future of environmental video games

May (2013) suggested the cooperation of game designers, local experts, and end users could help create a better experience for the player. As the virtual environment of video games continue to improve and transform, the collaboration between different discourse communities to create environmental video games would become more valuable. For example, video games that use immersive virtual environments (IVE) "allow users experience vivid sensorimotor stimuli by digitally simulating sensorimotor information. As a result, users are able to embody experiences by seeing, hearing, and feeling realistic perceptual cues linked to those experiences" (Ahn, 2011, p. iv). Project that use IVE exemplified the importance of gathering and managing information from the real world to provide a

credible experience for the users.

Nonny de la Peña, a senior research fellow at the University of Southern California, creates virtual reality of actual news events using IVE. De la Peña's *Project Syria* "draws wrenching attention to the plight of some one million children victimized by the ongoing civil war" (Bajak, 2015, para. 5) by recreating the environments where children suffer and placing participants as witnesses of these events. According to De la Peña, *Project Syria* allows participants "to go beyond passive viewership and become participants in the mediated context, seeing, hearing, and feeling the experience as if were their own" (Ahn, 2011 p. 2). Projects that use IVE could have an enormous impact on participants' sensory and cognitive experiences and these could have a greater impact on participants' attitudes toward complex and difficult contexts, such as environmental sustainability issues. In order to make participants more compelled to contribute to problem-solving or to change their attitudes, game designers using IVE would have "to offer embodied experiences—a vivid, realistic mediated experiences bolstered by simulated sensory information" (Ahn, 2011, p. 1). Thus, game designers would have to collaborate with experts, actual witnesses, and other groups to bring reality and accuracy to IVE video games. In the future, IVE could be used to create video games focused on environmental sustainability. IVE could allow players to witness environmental changes that take place over many years, experience the decline of the environment and species, and participate virtually in dialogues that address environmental issues. The design process of well-informed, immersive, and accurate environmental video games would require the participation of experts in environmental issues and stakeholders that can provide knowledge about the specific setting where the environmental video game take place. In this space, rhetoricians' analysis could help translate the knowledge of multiple stakeholders. Rhetoricians can assist developers in constructing new knowledge and meaning to create virtual spaces that are both effective at conveying the complexity of real life problems and capable of providing spaces where players can rehearse behaviors and activities that lead to well informed solutions.

Appendix A

Interview Questions

A.1 Environmental questions

1. We have been learning about the challenges that the El Paso community faces in pursuing and maintaining water resource sustainability. The following is a list of some of the challenges we have identified so far:
 - (a) Global environmental issues with local effects
 - i. Climate change
 - ii. Drought conditions
 - (b) Competition between reduced supplies and increasing demands
 - i. Urban vs. agricultural needs
 - ii. Competing value systems affecting allocation decisions (e.g., family farms, industry, open spaces, land development, increasing population)
 - iii. Regional demands of the El Paso/Juarez metroplex, with bi-national water management issues
 - iv. Economic impacts of allocation decisions
 - v. Impact of water allocation decisions on overall water balance (e.g., reduced surface water available for irrigation, resulting in increased overall water usage due to ground water salinity problems)
 - (c) Need for alternative and remediation technologies
 - i. Water reclamation and treatment
 - ii. Capture of impact/run-off water

- iii. Desalination of brackish water
- iv. Evaluation of effectiveness vs. cost of various technologies
- (d) Conservation and pollution-reduction education/enforcement
 - i. Behavioral changes for reduction in water usage
 - ii. Education for proper contaminant disposal
 - iii. Evaluating chemical, equipment, and process-related impacts on water quality and quantity

Are there more challenges that should be included, and if so, what are they?

2. Are there more challenges that should be included, and if so, what are they?
3. In your opinion, which is the most important challenge, and why?
4. How are decisions made related to efficiency, conservation, and water reuse in the El Paso area?
5. Please describe the tools or methods for measuring and evaluating our water footprint.
6. Please share some examples of efforts to improve water resource sustainability in the Rio Grande watershed.
7. What key information do educators need to share in order to help students become more engaged in water sustainability issues in this region?
8. What data, information, or images can you share that could be incorporated into the game or lessons? [share what you have collected to date]
9. What barriers and challenges do educators face in communicating issues of water resource sustainability in the El Paso area? From your perspective, what is the best way to overcome them?

10. What types of educational, research, and career opportunities are available to students in environmental sciences?
11. What other key groups or leaders might have helpful information on these topics?
12. Do you know what should be taken into consideration when building a water park?
13. How do you develop a feasibility study?
14. Do you know where we can learn about the factors that intervene in the construction costs of a water park?
15. Do you know where we can learn about the regulations regarding waterpark facilities?
16. Where can we obtain financing for a waterpark project?
17. Do you know an expert company or architect that we can consult to build a water park?
18. What other key groups or leaders might have helpful information on these topics?

A.2 Optional environmental questions

1. Please identify specific issues related to Rio Grande watershed groundwater and surface water conditions and management.
2. What are some technologies that would help address water challenges in the El Paso area?
3. If there are any collaborative initiatives already in existence that address issues of water resource sustainability in the Rio Grande watershed (for example, programs involving collaboration between agencies or the U.S. and Mexico), how could this project be integrated with these other on-going initiatives? In your opinion, which is the most important challenge, and why?

4. Please share some examples of efforts to improve water resource sustainability in the Rio Grande watershed.
5. What key information do educators need to share in order to help students become more engaged in water sustainability issues in this region?
6. What barriers and challenges do educators face in communicating issues of water resource sustainability in the El Paso area? From your perspective, what is the best way to overcome them?

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Curriculum Vitae

Claudia Chihiro Santiago graduated from Parkland High School, El Paso, Texas. As a senior in high school she was vice-president of the National Honor society, president of the Parkland Pride and Japanese animation club, rank number one in the Parkland High School Tennis team, graduated in the top ten of her class, and was named a Gates Millennium Scholar by the Bill and Melinda Gates Foundation for her academic achievements. In addition, she was a recipient of the Ysleta Education Foundation Outstanding Achievement Scholarship, the Ronald McDonald House Charities HACER scholarship, and two-time recipient of the League of United Latin American Citizens (LULAC) scholarship.

At New Mexico State University (NMSU) she earned a bachelor's degree in physics with a minor in mathematics. Moreover, she was a hunt seat rider for the NMSU Women's Varsity Equestrian Team and a member of NMSU's intramural swim team. The summer after her sophomore year she participated in the New Mexico Alliance for Minority Participation Program (New Mexico AMP), which is designed for undergraduate students to conduct professional research. The objective of her research was to assemble a list of candidate stars in the nearby star cluster, The Pleiades, to be searched for planets that seem to present conditions favorable for life. The next summer she continued her participation with New Mexico AMP conducting research with the NMSU NanoSat group. Moreover, as a participant of the Ronald E. McNair Program at NMSU she conducted research under the guidance of Dr. Christopher Churchill. Her investigation focused on studying organic molecules in the external galaxy MKN 231 by identifying the diffuse interstellar bands (DIBs) in QSO absorption line systems. Furthermore, under the supervision of Dr. Kim Griest at the Summer Training Academy for Research in the Sciences (STARS) at the University of California San Diego, she calculated the magnification of the Type Ia supernova SN 1997ff. She predicted how much magnification occurred using the theory of gravitational lensing. During the summer of 2007, before starting a master's degree,

she participated in the 2007 RIPS summer program at the University of California, Los Angeles (UCLA) Institute of Pure and Applied Mathematics. In this research, she was part of a team that investigated the geometric structure of manifolds that are propagated from periodic orbits surrounding the fixed points of the Planar Circular Restricted Three Body Problem.

In the fall 2007, she was awarded a Graduate Gates Millennium Fellowship, and she entered graduate school at The University of Texas at El Paso (UTEP) Department of Physics. While pursuing a master's degree in geophysics she worked as a teaching assistant at the Department of Physics and research assistant at the Department of Geological Sciences. As a research assistant, under the guidance of Dr. Diane Doser, she used geophysics mapping software and resistivity-modeling software to study suspected fracture zones that affect the ground water flow of a high-discharge artesian spring, named Rattlesnake Springs, situated in the southwestern New Mexico. Claudia's results were published in the *Journal of Environmental Engineering Geophysics*. Also, as a master's student, Claudia was named a Minorities Striving and Pursuing Higher Degrees of Success in Earth System Science (MS PHD'S) Scholar. Her participation in this program provided her with professional development opportunities, science exposure, and mentoring relationships. After obtaining a master's degree in Geophysics in 2009, she began a PhD in Geological Science at UTEP. As a PhD student, she obtained a UTEP NSF GK-12 fellowship. As a fellow working at Mission Early College High School (MECHS), she led activities that stressed the important role of physics in the conservation of Earth resources, organized a scientific field trip, and invited guest speakers. In 2011, she was selected to participate in the Lunar Exploration Summer Internship at the Lunar and Planetary Institute (LPI). As part of a team of American and international students, she searched for landing sites on the Moon where ancient lunar soil samples can be collected. Her contributions were published in "A Global Lunar Landing Site Study to Provide the Scientific Context for Exploration of the Moon."

In 2012, Claudia decided to attain an MA in Rhetoric and Writing Studies (RWS) at UTEP's English Department. While pursuing a master's degree in RWS, she worked as a

tutor at UTEP's Miner Athlete Academic Center (MAAC) and UTEP's Writing Center. As a teaching assistant, she taught RWS 1301 and 1302. Through her graduate studies in RWS, she conducted research at UTEP's Cyber-ShARE Center of Excellence. Under the guidance of Dr. Lucía Durá, she was responsible for conducting interview to elicit information about watershed problems from local Native Americans and experts in the fields of agriculture, urban systems, ground water systems, and desert ecology. Additionally, she participated in The Roshan Lal Chandna Just Citizen Scholars Program. As a member of this program, she had the opportunity to meet distinguished social activists in the border community of El Paso, TX and to participate in activities related to social justice. Currently she is a research assistant at UTEP's Department of English. Working with Dr. Jennifer Clifton, Claudia investigates how new knowledge is created when different groups collaborate. Additionally, she teaches ENGL 0312 in the Developmental English Department at UTEP. After completing an MA in RWS, she plans to complete a PhD.

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