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Investigation of Sense of Place Effects in an Online Learning Environment

Jeanne Lambert Sumrall

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By

Jeanne Lambert Sumrall

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By

Jeanne Lambert Sumrall

Approved:

Renee M. Clary
(Major Professor)

Charles L. Wax
(Committee Member)

Brenda L. Kirkland
(Committee Member)

Darrel W. Schmitz
(Committee Member)

Michael E. Brown
(Graduate Coordinator)

R. Gregory Dunaway
Professor and Dean
College of Arts & Sciences

Name: Jeanne Lambert Sumrall

Date of Degree: May 9, 2015

Institution: Mississippi State University

Major Field: Earth and Atmospheric Sciences

Major Professor: Dr. Renee M. Clary

Title of Study: Investigation of sense of place effects in an online learning environment

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Candidate for Degree of Doctor of Philosophy

In relation to the constructivist learning theory, understanding what a student may already know in order to use this knowledge as a scaffold for further education is imperative. The online classroom offers a unique and challenging environment for the evaluation of a student's previous knowledge, especially in the field of geosciences where knowledge may be associated with geographic affiliation. An individual's geological and meteorological sense of place may play an important role in evaluating a student's previous knowledge in this field of study. To test this hypothesis, students in an online master's program were given pre-knowledge surveys to evaluate their previous knowledge in Meteorology and Geology, as well as Geological and Meteorological sense of place surveys (Clary, R.M., and Wandersee, J.H., 2006; Clary, R.M., Wandersee, J.H., and Sumrall, J.L., 2013). Students were then categorized by geographic regions within the United States. Students were also given interest surveys at the end of their first year in the Masters program, and selected students were interviewed during their capstone field experience at the end of the second year of the program. Results suggest that there were subtle differences between regional groups of students throughout the study. More pronounced differences were noticed in the Meteorological pre-surveys than the Geological pre-surveys. Both sense of place surveys also indicated differences across regions, but the Meteorological sense of place survey showed greater regional differences when individual questions were analyzed. Interestingly, the participants who were interviewed at the end of the Masters program showed more geologically specific attachments as opposed to meteorologically specific attachments to areas that they considered to be "home." The importance of moving and traveling throughout one's life also became evident during the analysis of the interviews. Overall, this study of an online Master's program concludes that geographic differences and moving/travel experiences among students matters to education in an online setting. The study emphasizes the importance for online instructors to evaluate teaching techniques based on geological and meteorological sense of place. By taking this into account in an online classroom, geographic disparities could be minimized and content interest levels could be increased.

Key words: sense of place, distance learning, geoscience education

DEDICATION

This dissertation is dedicated to my family. It is dedicated to my husband, Dr. Jonathan Sumrall, who convinced me to continue my education and earn my PhD. This dissertation is dedicated to my parents, Joan and Lewis Lambert; my brother, Robert Lambert; and my grandparents, Mary and Dr. Jean W. Lambert, who always knew that I could do it. Finally, to my baby boy, Landon Lewis Sumrall, who gave me a deadline and the final motivational push to finish before his birth.

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INTRODUCTION

Project Introduction

In an online (or distance) learning environment, an instructor's audience can be separated by great geographic expanses. There is a gap in the current research involving each student's geographic location and background locations, and how previous place attachment may affect individual learning experiences and successes. To better evaluate each student's geographic background, each student's sense of place has been analyzed to determined if there are correlations to students' learning success.

An individual's sense of place can be described as a personal attachment to a specific geographic location (Taun, 1976; Buttimer, 1976). Place attachment studies have been taking place in humanistic geography since the 1970's, but more recent studies focus on using place attachments in educational settings to encourage diverse learning (Semken, 2005), and resource management studies determining an individual's sense of place on his or her awareness and environmental interest in the area (Farnum et. al., 2005). Therefore, a sense of place can involve both content knowledge and the affective domain. An individual can establish more than one sense of place throughout his or her life, but it has been suggested that an emotional hierarchy is created. An individual's primary sense of place is known as his/her idiotopy (Pascual-de-Sans, 2004).

This study focused on determining whether an individual's pre-existing idiotopy affects his/her academic success in an online geoscience master's level program. The results of this dissertation could be utilized for online instructors to better understand and create broad-based learning environments that utilize their students' place based attachments.

Research Questions

1. Does an individual's sense of place play a significant role in her/his success in geoscience classes when the subject material that is studied relates to his/her dominant sense of place or "home" region?
2. Does an individual's sense of place play a significant role in his/her cognition of geologic/meteorological events within his/her dominant sense of place or "home" region prior to instruction?
3. Is an individual more interested in geoscience topics that relate to his/her primary sense of place?

CHAPTER II

LITERATURE REVIEW

Sense of Place

Emergence of Sense of Place Research

The idea of an individual's "sense of place" can appear to be a vague concept, and depending on the field in which the concept is referred to, it may even go by different verbiage such as, "place attachment." Many fields, including resource management, architecture, landscape and design, sociology, educational psychology, environmental psychology and philosophy, and geography (see a review by Furman et al. 2005) have all utilized and added to the current interpretation of what it means for an individual to feel a sense of place for a specific geographic location. Though this term has evolved, some of the basic tenants that underlie this concept are just as important today as when they were first discussed in humanistic geography literature in the mid-1970's.

Based on the works of geographers Taun (1975 and1976) and Buttimer (1976), an individual's sense of place can be described as a personal attachment to a specific geographic location (Taun, 1976; Buttimer, 1976). Tuan (1976) stated, "Humanistic Geography achieves an understanding of the human world by studying people's relations with nature, their geographical behavior as well as their feelings and ideas in regard to space and place" (p.266). In order to develop a sense of place, an individual must have personal experiences within a specific space that evokes the use of his or her senses

(Taun, 1976). Relph (1976) further defined the aspects of a sense of place by distinguishing between place attachment and place meaning. He defined place attachment as a link between people and specific geographic places. Place meanings are associated with symbolic and cultural ways of knowing. Place meaning can be described as the essence of a place, or the cultural meanings associated with geographic locations (Relph, 1976).

The idea of an individual's sense of place was not derived arbitrarily. Landscapes, space, and place have a long history in cultural geography. Don Mitchell (2000), in a review of studies on landscape, suggested that "just as landscape is a work – a product of the work of people – so too does landscape do work: it works on the people that make it" (p. 102). Through-out his book, Mitchell referred to landscapes as "stages" in which man (or woman) acts on a location and creates a relationship between people and place. These basic tenants of "landscape" can be traced back to a cultural geography revolution in the U.S. in the 1920's brought on by Carl Sauer's 1925 essay, "The Morphology of Landscape." Mitchell traced vast fields of geography back to Sauer. Mitchell (2000) stated that Sauer's work dominated and helped to create themes in geography such as, "a concern with the material landscape; an interest in cultural ecology and the often deleterious effects of humans on the environment; a desire to trace the origins and diffusion of revolutionary cultural practices such as plant and animal domestication and the use of fire" (p. 21). The connection that Sauer found between humans and the ecological landscapes that they inhabit is a theme that has pervaded throughout geography studies in the twentieth century and into the twenty-first century. It was these ideas of landscapes, spaces, and places long written about in human geography literature that Taun expanded upon in his 1974 and1976 papers. As Stedman (2003) stated, "Space is defined in opposition to space. Space is not culturally constructed; it is described by using geometric principles of distance and direction……If space is general, place is particular: it is where general values are made concrete" (p.823).

Sauer's basic concepts are also evident today in sense of place educational studies. Nature and culture work together on an individual's "knowing" and understanding and are therefore an important aspect of learning. Sauer advanced the study of space, but Taun put the person into the place.

Sense of place literature and the philosophies underlying this concept have come a long way since the 1970's, but there are still aspects of this phenomenon that are heatedly debated. One post-modern area of debate questions whether or not a critical pedagogy and place-based education can be happily married. Gruenewald argued, "that 'critical pedagogy' and 'place-based education' are mutually supportive educational traditions" (p.3). His 2003 paper, "*The Best of Both Worlds: A Critical Pedagogy of Place*" discussed the emphasis that critical pedagogy places on "spatial aspects of social experience" (p.3).

Conversely, Bowers (2008) believed that many environmental educators take a "critical pedagogy of place" for granted without understanding the underlying epistemologies that make these two theories incompatible. His main argument hinged on the lack of imbedded cultural knowledge utilized in critical pedagogy. To truly understand a place, and an individual's sense of place, a cultural aspect must be taken into account, and a western cultural mindset is not necessarily the only way to see things.

He suggested that the two theories share general compatible assumptions. For instance Bower stated, “The critical pedagogy theorist’s emphasis on social justice issues and the place-based educator’s stress on student’s becoming active participants in the interplay of their local communities and bioregions can easily be interpreted by science/environmental educators as natural allies in creating a more sustainable future” (p. 325). Even with some compatibility he still saw a major flaw in the marriage of these theories. He stated,

> To reiterate, the key reason that a critical pedagogy of place is an oxymoron is that the linguistic tradition of relying upon abstractions, including abstract theories that encode many of the same taken-for-granted assumptions that underlie both the universal decolonization and the market liberals’ efforts to universalize the West’s consumer dependent lifestyle, fail to take account of the intergenerational traditions of habitation that still exist in communities. Places have a long and culturally varied history, while the language of a critical pedagogy of place has a specific history that carries forward the traditions of ignoring the diverse ways in which more ecological centered cultures and community practices have contributed to long-term habitation of place (p. 333).

Though an intriguing philosophical debate involving sense of place and educational epistemologies, this argument is not a main focus of this research and will not be discussed any further. We will instead focus on the development of an individual’s sense of place, and how this sense of place may affect interest, emotions, and cognition of a geographic location throughout an individual’s life-long learning.

Place as a behavior, cognition, emotional, and interest modifier

The term sense of place has now been expanded to place knowledge, place identity, and satisfaction (Kaltenborn, 1998). Sense of place has both a cognitive and affective domain. It is thought that this place attachment includes an emotional sense that is often thought to be positive (Stokowski, 2002), but could also be a negative emotion (Kudryavtsev, Krasny, &Stedman, 2012). These attachments and satisfaction levels involved with sense of place can have an impact on behaviors. According to Stedman, attachment and satisfaction do independently influence behavior in opposing ways. Based on this research Stedman stated, "Attachment and satisfaction is with symbols attributed to the landscape. One cannot understand sense of place without knowing its cognitive content; meaning put the "sense" into sense of place" (p.577). It has also been postulated, that a specific Sense of Place attachment to an outdoor location may develop over time into value for general wilderness spaces (Brooks, 2006). Though this definition has been expanded to include other aspects of place attachments and evolved over the years, the term "sense of place" is still the most inclusive term to use when referring to both cognitive and affective attachments to a geographic location (Jorgensen and Stedman, 2001).

These aspects of sense of place have vast implications for the secondary effects of place attachments on an individual. An individual's sense of place has been linked in the literature to a variety of attributes including behavioral changes, pro-environmental thoughts and intentions, cognition, emotional, and interest modifiers (Jorgensen B, and Stedman, R. 2001). When selecting educational strategies, knowing how to influence all of the above listed areas of an individual's thought process is a crucial component to effective teaching. When a student is able to apply new information to relevant past experiences involving specific places, previous place knowledge may allow for a higher level of comprehension (when associated with Bloom's revised taxonomy (Bloom, 2004)) as opposed to simply remembering or recalling information.

How does one acquire a sense of place?

Throughout our lives there are specific places that may stand-out in our memories. They may be notable because of specific enjoyable or memorable experiences, or because of experiences that we would rather forget. As one forms an attachment to specific spatial locations, these places may leave lasting marks on an individual's memory. Much like animals, humans have "territories" where they feel comfortable and a part of the "insider" crowd (Taun, 1976). Taun (1976) emphasized that in order to develop a sense of place, an individual must have personal experiences within a specific space that evokes the use of his or her senses. These attachments can vary over developmental life stages and time (Hay, 1998). Relph (1976) expanded upon this definition by emphasizing that geographic location alone is not sufficient enough to create a sense of place, there must be personal involvement. Therefore, based on the literature, and for our research purposes, we accept that "Sense of place is a combination of both physical (environmental) and personal/social interaction in the place" (Shamai and Ilatov, 2005: p. 468).

There are a variety of reasons for a sense of attachment to a place. Place attachment is accentuated in those that are raised in a certain location, and even more so in multi-generational locational bonds (Hay, 1998). This occurs when multiple generations of a family are raised in the same geographical location, and older generations pass down physical geographic meanings, as well as social interactions, within the place of meaning (Hay, 1998). Semken (2005), who, like Hay (1998), also studied Native cultures, agreed that sense of place is socially constructed, and that it influences the way people observe and interpret the world around them. He argued that Native cultures have the natural features and phenomena of their homeland embedded within their cultures. They are inseparable components. These attachments and cultural ways of understanding can be utilized to enhance learning experiences for these cultures(Semken, 2005).

Outside of Native cultures, the creation of place attachment has also been found to be more significant when associated with social interactions of family and friends (Eisenhauer et al., 2000; Kyle, 2007). There is often a need to not only identify the physical geographic location within a sense of place study, but also the social context with which individuals experience that particular place. In this way, social interactions and community formations are important to the establishment of a sense of place.

Community place identity can be established through such activities as competitive sporting events, though this is not an all inclusive activity (Tonts and Atherley, 2010), as well as family and cultural interactions (Hay, 1998; Semken, 2005). A sense of place may also involve a power struggle. It is not always inclusive. Like many aspects of culture, structures of power can play a role in the formation of a group and/or an individual's sense of place. Because a sense of place often involves social interaction, it can also act to exclude others (Shamai and Ilatov, 2005). In this way, place can be exclusionary, and negative as well as inclusive and positive. Within communities, "Local symbols reflect and enhance sense of place" (Peterson and Saarinen, 1986: p.

164). Those that understand and accept these culturally created symbols are included in the community. According to Lidskog (1996),an individual's feeling of belonging can be equally affected by a specific geographic place or 'sociospatial consciousness' and the community's social structure.

Yet, community social structure is not the only other component in creating place attachments. Hammit et al. (2006) found in their study of trout anglers that, "place bonding is a multi-dimensional construct that may consist of more than the traditional dimensions of place identity and dependence" p.38. They established a five dimensional model including familiarity, belongingness, identity, dependence, and rootedness to predict place attachment. Using models such as these, it has also been shown that field scientists develop strong place attachments associated with their research sites (Rossbacher, 2002), but little has been done to determine if strong pre-existing place attachments (childhood) brought the scientists to these types of sites.

Throughout a human's life-cycle, individuals may create many place attachments, but these attachments will be positioned in a hierarchical system of importance. The sense of place an individual generates at a certain point in their life cycle may stand out as a point of reference (Pascual-de-Sans, 2004). Pascual-de-Sans (2004) described these lasting feelings of geographical identification as *idiotopy*. Under a constructivist view, we build upon our previous "place." A person may leave a place behind, but some places, our idiotopy, greatly affect our way of understanding our geographic settings in the future (Pascual-de-Sans, 2004). We will delve into the construction of our participants' childhood geological and meteorological place attachments in order to determine the importance of these attachments on educational endeavors within the geosciences.

Ways to study and measure and sense of place

There are two basic methodologies utilized in place-based research, positivistic and phenomenological; the second approach being the more prevalent in sense of place research. Positivistic research typically involves quantifiable data and objective and measurable methods. Whereas the phenomenological approach hopes to understand a phenomenon, often socially constructed, that may be interpreted differently by different people. The phenomenological research approach typically involves qualitative methods. Both approaches may contain methodologies that can contradict the underlying constructs or give indefinite answers. Stedman (2002) stated, "We are thus left with a paradox: On one hand are interesting statements that avoids positivistic hypothesis testing; on the other hand are quantitative treatments of place that have often failed to engage these important theoretical tenets" (p. 562).

Depending on the philosophical background applied, the measuring of an individual's sense of place can be a daunting task. Some scientists believe that a sense of place, as a phenomenological concept, can only truly be derived through qualitative studies. For instance, relationships of sense of place are often individually unique, and therefore, are studied best in a qualitative interview narrative (Sarbin, 1983). Sarbin believed, and made a case for a more holistic humanistic approach to studying sense of place. These non-positivistic views, or humanistic views, attempt to deal with the difficulties of measuring an individual's sense of place through interviews and other qualitative assessments, and they emphasize the difficulties in doing so when using quantitative approaches. Anne Buttimer (1976) suggested that, "Scientific procedures which separate "subjects" and "objects," thought and action, people and environment are inadequate to investigate this lifeworld. The phenomenological approach ideally should allow lifeworld to reveal itself in its own terms" (p.1).

Paasi (2003) suggested that, "instead of assigning automatically an explanatory role to this very popular category, regional identity itself has to be "explained" (p.481). One cannot take the person out of the place attachment, and therefore, it is important to understand the phenomenon as holistic and through a qualitative lens.

On the other hand, there are those that believe an individual's sense of place may adequately be studied utilizing a positivistic approach. Shamai and Ilatov, (2005) have attempted to bridge this gap by suggesting a ranking procedure to determine positive and negative aspects of place attachment. This is not Shamai's first attempt at utilizing a positivistic approach to study sense of place. The author also conducted positivistic surveys (with Kellerman as a coauthor) in 1985 developing a four-level approach, and again individually in 1991, developing a seven-level ordinal scale. Similar unidemensional scales have been utilized by Kaltenborn (1998) to determine place attachment, while Cuba and Hummon (1993) determined place identity, and McAndrew (1998) identified place rootedness. There are four attributes within Shamai and Ilatov's positivistic scale including polarity, number of dimensions, number of components, and directness of the questions. These attributes should be considered when creating surveys. Shamai and Ilatov's positivistic scale was legitimized by analyzing the place attachment of residents from a Lebanese border town in Israel. The authors conducted face-to-face interviews and phone interviews using a bipolar, three survey question, Likert scale ranging from -5 to +5. This allowed the researchers to analyze both positive and negative feelings about the respondent's place of residence. They were able to determine different significant levels of attachment to both the local city and the state of Israel between the native (Sabra) people and immigrants of the town. They also noticed an increase in attachment for the Sabra based on length of residency, and both populations saw an increase in attachment when compared to the respondent's age (positive correlation). Social group also made a difference in the level of attachment. The study tested multiple groups in pilot studies to determine the validity of the survey. The study proved that it is possible to measure, empirically using a straight forward technique, an individual or group of people's sense of place on a dipolar scale. The authors did not attempt to understand what creates this place attachment, and they did not assert that this is the only way to test sense of place. In these studies, the authors suggested that the type of study, and the desired measure should, "be tailored to each case, and the variety of methodology tools are only an advantage which widens the scope of sense of place" (Shamai and Ilatov, 2005: p. 475).

Richard Stedman (2003) also advocated for more positivistic studies in sense of place research. He contended, "that sense of place is relatively rich in theory and relatively poor in quantitative applications. Simply put, sense of place theorists have been better at raising important questions than they have been at testing them as propositions" (p.822). Stedman essentially called for more quantitative research that incorporates a theoretical basis. The author suggested using existing social psychological frameworks such as beliefs, attitudes, and behaviors as predictive measures for sense of place research. Stedman stated,

> I will grant that some elements of complexity are lost in these translations. But this is not the point: I am not advocating an elimination of the phenomenological

> perspective in place research. The approach used should reflect the nature of the question one wishes to answer (p.828).

Stedman viewed a sense of place as a multidimensional phenomenon, but he felt "the components can be measured by using relatively conventional social psychological research (e.g., quantitative survey instruments that explore attitudes, beliefs, and behaviors)" (p. 827). An example of this multidimentional approach can be seen in Hammit et al. (2006). Hammit et al. (2006) found in their study of trout anglers that, "place bonding is a multi-dimensional construct that may consist of more than the traditional dimensions of place identity and dependence." They put forth a five dimensional model to explain recreational place bonding. Stedman, though advocating for more easily quantifiable methods to utilize in management planning, was careful to point-out that the methodology used in each study must reflect the questions that are asked.

Both the qualitative and quantitative approaches to studying sense of place are currently being utilized in the field and are generally accepted depending on the hypothesis in question. As can be seen in the literature, hypotheses involving discrete locations are more conducive to positivistic approaches than hypotheses that try to determine an individual's primary sense of place. The author has chosen, based on the questions being proposed, to take a phenomenological approach utilizing a qualitative mixed methodology technique derived from the survey techniques found in Clary and Wandersee (2006). This survey is conducive to determining an individual's childhood sense of place even when these individuals' idiotopies vary widely over great geographic distances.

A place for sense of place in education – connection between sense of place and constructivism

Within educational theory, place-based education (the use of a specific place and cultural knowledge of that place that learners may already have as an educational tool), and sense of place educational knowledge (utilizing an individual's sense of place as a starting point) fall under the newer constructivist teaching theory (derived from the constructivist learning theory) that made its way on the scene with the important works of David Ausubel, Joseph Novak, Ernst von Glasersfeld and others. David Ausubel (1968) succinctly defined the importance of this learning theory when he stated, "The most important factor influencing learning is what the learner already knows; ascertain this and teach him accordingly" (Ausubel, 1968: p. iv). Though meant to represent a constructivist mindset, this statement has been taken to justify a multitude of different learning theories. For instance, this statement could be interpreted to justify the importance of Piaget's stages of development theory, but for our purposes we will discuss this idea in relation to the constructivist movement in which the learner is an active participant in the learning process and is continually building on previously attained knowledge.

Some have linked the bases of the constructivist theory all the way back to Greek philosophers (McComas and Lafferty, 1996). More recently, the works of Dewey, Piaget, Ausuble, and Vygotsky have been associated with some of the ground work that was later coined constructivist learning theory (McComas and Lafferty, 1996). Though some of these authors may not be the visionaries for the present concept of constructivism, their works were instrumental in contributing to the constructivist framework.

Constructivism builds upon what the learner already knows, and what is familiar to them based on past experiences. Learning is “a persisting change in human performance or performance potential …[which] must come about as a result of the learner’s experience and interaction with the world (Driscoll, 2000 p.11)”According to Volk and SO (2002) this is a “dynamic and social process (p.1)”Essentially, the learning is actively creating meaning through their own lens of experiences fostered by their own desire to learn. Often learning takes place in a social context. A primary component to understanding the constructivist learning theory and constructivist teaching methods is the understanding that students do not enter the classroom a blank slate as once thought. A teacher is not a vendor of knowledge to passive participants, but a guide to active learners. The basic tenants of the constructivist learning theory based classroom compared to a traditional classroom are summarized in figure I.

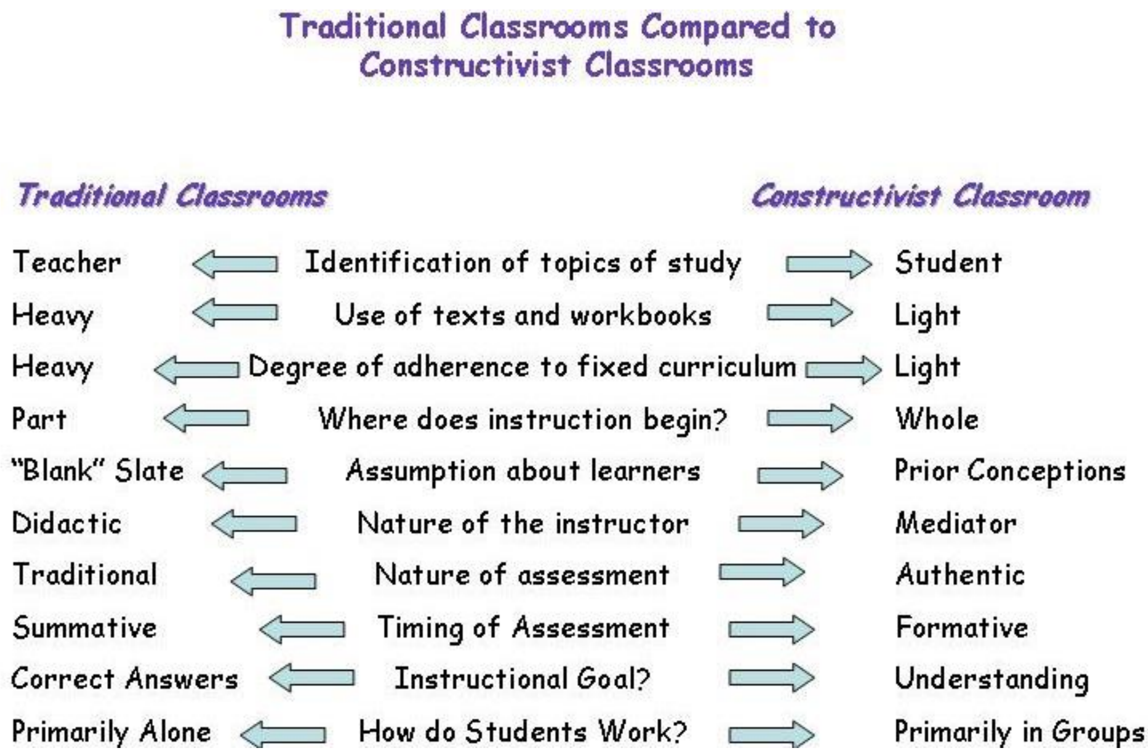

Figure 2.1 Traditional Classrooms Compared to Constructivist Classrooms

A Comparison of Traditional Classroom learning to Constructivist Classroom learning modified from McComas (1996).

As Tobin (1993) stated, "constructivism has become increasingly popular…..it represents a paradigm change in science education." (p. ix) Teaching strategies associated with constructivist learning theory include those that encourage questioning and generative learning such as inquiry based models. Mintzes et al. (1998)expanded on these strategies to include concept mapping. Concept mapping developed as a way of better understanding how children learn in a science classroom. Ausubel's (1968) work helped define the constructivist learning theory as a pathway of learning in which students assimilate new knowledge and concepts into a pre-existing knowledge framework or an individual's "cognitive structure." Novak and Cañas (2008) described concept mapping as being derived, "Out of the necessity to find a better way to represent children's conceptual understanding emerged the idea of representing children's knowledge in the form of a concept map. Thus was born a new tool not only for use in research, but also for many other uses.

Constructivism learning theory, as a learner centered theory, is also an essential concept for online educators. As von, Glaserfelds (1982) asserted, a central point to constructivism is the concept that learning is generated in the mind of the learner, and it is not simply a transfer of knowledge. Active learning is an important aspect when developing constructivist teaching techniques and these approaches are vital to an online environment where the learner is primarily in charge of their learning experience. The importance of learner centered approaches in the online environment will be discussed in more detail within the online section of this paper.

Based on this simple definition of constructivist theory, it is easy to identify the links between place-based education, sense of place, and constructivist learning. Every individual comes into a classroom with well developed place-based experiences and ways of knowing. It seems essential to identify this place knowledge and expand on it through the learner's existing lenses. These previous place-based attachments may influence a learner positively or potentially negatively if they have developed misconceptions based on these experiences. The following section examines some of the literature that has amassed in the sense of place educational field.

Educational sense of place findings

Once the concept of an individual's sense of place became linked to the recently popular constructivist educational theory, educators in a variety of fields began to study the phenomenon. A review of these studies uncovers a vast array of different approaches to evaluate philosophical needs, studying, identifying, and utilizing an individual's sense of place within an educational context. All areas of study have furthered the awareness for the need of sense of place acknowledgement within education.

Gruenewald (2003) called for more philosophy based reviews of sense of place and place attachment educational studies, as opposed to the traditional testing, based on the philosophies of Paul Shepard and David Abrams. He stated, "The greatest challenge we face is that both dominant cultural assumptions about what it means to be educated person and dominant, institutionalized educational practices remain disconnected from the land and its lessons" (p.33). He professed that our advanced language itself along with our current technologies have taken us further from the natural world even when we attempt to teach about this world. We no longer have to use our primary senses to experience the world around us like our ancestors did.

In Schroder's 2006 article, the author sought to unite global and local educational concepts in a new way relying on an individual's sense of place. The author looked at the intersection of three different concepts, native-science, interculturality (a term used within the paper that combines the definitions of multicultural and cross-cultural), and place-conscious education. The author attested that schools have the ability to either enhance the bond that students have with their environment or to break it. There is a fundamental need to re-think educational philosophies and combine the above concepts into a well balanced educational regime. By encouraging an emphasis on these three concepts, "Place-conscious education is at once local, based as it is on local biological, cultural and political realities, and global as it is appropriate for any human community anywhere on the planet" (p. 315). Schroder challenged us to find ways to incorporate this type of educational regime that does justice to both local and global knowledge through sense of place educational techniques.

Anna Cole (2007) also called for educators to re-think the environmental education basic principles of knowledge, skills, effect, and behavior, to take a broader view of environmental education that includes race, class, gender, and culture. She encouraged her discipline to branch out to other disciplines including place-based education to help create a more dynamic environmental education curriculum that includes a cultural aspect. Cole described her own experiences as an educator and her own failures to communicate these additional aspects of the environment to her students. She stated "Instead, by emphasizing scientific knowledge and methodologies, I devalued students' cultural and community experiences and knowledge and limited our learning potential" (p.42). She suggested that,

> A stagnant discipline, unwilling to reflect, restructure, and reimagine itself will not continue to thrive and evolve in relevant, useful ways. Environmental education will be well served by continuing to expand its discourse around the role of race, class, gender, and justice (p.42).

Her basic tenant for this was a call for a more holistic approach to environmental education that includes a look at individual's pre-existing knowledge and culture. Cole pointed to educational literature suggesting the same restructuring of education and the holistic philosophies needed to teach about the entire environment we live in. Without a holistic view that includes an individual's sense of place, environmental education is limited.

In his review of place-based education practices, Sobel suggested (while discussing standardized testing and curriculum) that, “Educational diversity falls prey to the bulldozers of standardization.” There is a need for more educational programs and techniques that take an individual’s sense of place into consideration. He reviewed programs that allow students to experience the world that they know through a scientific lens.

Cole (2007), Schroeder (2007), and Sobel dove into the philosophical need for sense of place education within educational curriculum in the sciences, but they lacked statistical evidence supporting the use of place-based education as being beneficial to students. A further review of the literature provides the statistical evidence needed to back these authors’ claims.

Mary Lou Bevier, et al. (1997) discussed a program seeking to enhance the geoscience knowledge of First Nation adult students in British Columbia, Canada. The area is rich in geologic and cultural history, and a perfect setting for geoscience place-based education utilizing the local’s pre-existing cultural knowledge of the area. The area is rich in cultural history and ties to the land, but very few of the locals seek education or employment elsewhere. With an amendment of rights by the Canadian government, it is essential that the First Nation people have knowledgeable geoscientists within their community to help manage the First Nation’s resources. The program was not only well received by the locals; all of the North Coast Tribal Council Education Centre participating students went on to pass their provincial science course, making the program a huge success. The program even sparked some of the students’ interest so much that they showed a desire in pursuing post-secondary educational science experiences.

Mary Lou Bevier, et al. (1997) sought to use students' individual sense of place as a jumping off point to encourage knowledge growth. On the other hand, Kudryavtsev, A., Krasny, M., & Stedman, R. (2012) took a reverse approach and sought to determine whether environmental education programs in urban environments can enhance an individual's sense of place. The authors found a significant increase in place meaning with the experimental group that underwent an environmental education program, but no significant increase in place attachment was found in either group. The level of place attachment for the Bronx students in both the experiment and control groups was relatively low, with both positive and strong negative feelings towards the place in general.

Educators, in an age when education is constantly under fire, are always looking for ways to enhance teaching strategies and research learning theories. The above listed studies help researchers develop a solid argument for the importance of an individual's sense of place, and/or place-based education. I seek to further this research by determining the effect level of an individual's childhood idiotopy on his or her base knowledge of the geosciences, as well as his or her ability to advance this knowledge in areas related to their childhood idiotopy. Eventually, these findings may enhance the way online teachers create curriculum, and even how we teach educators to teach.

Teacher education and sense of place

There has been a push for professional development programs for educators in recent years. Currently, there are a plethora of government grant programs offered for teacher education and outreach programs that are meant to better prepare our future and current teachers, especially within the sciences. This study will predominantly involve teachers enrolled in a geoscience Master's program. It is therefore important to have an understanding of studies that have been conducted involving sense of place research and the education of teachers.

Reisberget. al. (2006) described teacher education programs as being fragmented experiences due to the demands of state education standards. One possible solution to this fragmentation problem that they suggested involves using multicultural children's books as a collaborative tool among a diverse subject area pre-teacher group. They chose to integrate critical pedagogy, place-based education, and multi-cultural children's literature. The three participants (instructors within the education department who teach six different classes) read and reflected on the chosen book. Afterwards, they shared their reflections and discussed each other's analysis of the book. The end results suggested that collaboration in this manner among different subject areas of a teaching program may help reduce the feel of fragmentation in teacher education programs. The authors, "believe this process of collaborative learning across the boundaries of our respective content areas has great potential for integrating the programmatic fragmentation endemic to many teacher education programs" (p. 130). This article attempted to conceptualize how to improve an education program through collaborative programs, but, as a case study, it does not indicate levels of significance for such a program.

In Meichtry and Smith's (2007) study the researchers attempted to quantify the effects of their K-12 teacher professional development program. The study involved researching (and actually visiting) a local river starting at the headwaters and traveling down to its mouth. During the study, the teachers conducted water testing at multiple sites along the river. The study found in a repeated measure study using 5-point Likert-type scale surveys administered as pretests, posttests, and long-term posttests that confidence levels in teachers to teach watershed and science related topics increased as all four items surveyed had p values of less than 0.05. They also found that confidence in using place-based education (all three items had p values less than 0.05) in their classrooms increased along with the comfort in technology use (six technology items out of seven items had p values less than 0.05), the comfort in conducting field investigations with students (all four items had p values less than 0.05), and using specific instructional strategies (three out of five strategies had p values less than 0.05) due to the teacher professional development program. The authors felt that this place-attachment component brought further relevancy by incorporating local settings and community based experts. An unexpected result of the program was the teachers' increased proenvironmental attitudes (using the New Ecological Paradigm Scale) after completing the professional development sessions. Adding a cultural component was also an unintentional consequence of this study. As the teachers progressed down the selected river, they interacted with the local cultures as the land uses changed, and as one teacher stated, "You not only see the evolution of a river; you see the evolution of people who live along the river" (p.26).

These studies emphasize the importance of place-based teacher education, but they focus more on the eventual usage of place-based education in an educator's repertoire. We are more concerned with how an individual's sense of place may affect his or her pre-existing knowledge and interest, as well as the ability to acquire further knowledge in the geosciences. Once an educator understands how his or her own childhood sense of place may affect his or her learning, place-based education programs may appear more relevant to educators. There is a current gap in this research area that we intend to fill.

Online Learning

The online environment

The online classroom has increasingly become a viable and desirable alternative to traditional face-to-face learning environments. As of 2011, 31% of all higher education students were enrolled in at least one online course. As defined by the Sloan Consortium, an online course delivers at least 80% of the material online, and there are generally no face-to-face interactions. In contrast, traditional courses deliver 0% of the material using online technology, and all content and materials are delivered during face-to-face meetings. The Sloan Consortium go on to define web facilitated classrooms as those that incorporate minimal use of the internet with 1-29% usage (often for the posting of a syllabus and assignments), blended or hybrid courses as those with 30-79% of material presented online and a reduced number of face-to-face meetings (Allen &Seaman, 2010). For our purposes, the Sloan consortium's definitions for both the traditional classroom and the online classroom will be utilized.

The proportion of students desiring online opportunities is on the rise. The 2010 Sloan report indicated a 21% growth in online enrollment from 2009 to 2010 (Allen & Seaman, 2010). The present growth rate reflects a trend seen over the past seven years. From 2002 to 2009 the online enrollment of students taking at least one online course increased from 1.6 million to 5.6 million (Allen & Seaman, 2010), and this number grew again to 6.1 million in 2011(Allen & Seaman, 2011). That is an average growth rate of about 19% for the 2002-2009 period, and it was expected to level out prior to 2010. During this same time period, overall higher education enrollment only grew less than two percent (Allen & Seaman, 2010). As of 2011, it appears that the growth rate has finally slowed to a rate of 10%, which is the second lowest rate for a one year period since 2002, and the overall higher education growth rate shrunk to less than one percent (Allen & Seaman, 2011).

The growth is in part due to the present state of the economy. Many individuals have used the down turn in the economy as an opportunity to go back to school, or to seek a degree for the first time. During this time, funding for 47% of the institutions polled had decreased while enrollment had increased. The prevalent increase in enrollment came from students desiring online courses from existing online programs. This growth concentrates online learning to already large institutions, such as the selected institution for this study. Significant growth did not come from start-up programs at smaller institutions (Allen & Seaman, 2010). Though the growth has begun to plateau, it is clear the online learning is a desired portal for education, and it is here to stay.

There has been some controversy in the past involving the effectiveness of online learning. In 2011, 67% of chief academic offices polled believe that online learning outcomes are as good as or superior to face-to-face instruction. Not surprisingly, academic leaders of institutions that offer online courses view the outcomes of online learning in a more favorable light than those from institutions that do not offer online learning opportunities (Allen & Seaman, 2011).

There has been a plethora of research, especially during the early years of fully online courses, seeking to prove or disprove the effectiveness of online learning in the wake of the explosive growth in the online sector of education. Learning effectiveness, as defined by the Sloan Consortium (2002) establishes a comparison of online vs. traditional classroom learning.

> Learning effectiveness means that learners who complete an online program receive educations that represent the distinctive quality of the institution. The goal is that online learning is at least equivalent to learning through the institution's other delivery modes, in particular through traditional face-to-face, classroom-based instruction.

Many researchers further established this mindset of comparing online courses' effectiveness to traditional courses' effectiveness. Research by Zhang (2004) indicated that students enrolled in online "Virtual Mentor" (VM) courses, that offer multimedia integration, which are influenced by the constructivist learning theory, performed better than students taught by the same instructors in traditional in-person settings. The VM concept encompasses many principles into the online classroom system including multimedia-integration, just-in-time knowledge acquisition, interactivity, self-directivity, flexibility, and intelligence. It is not simply a cut and paste of an in-person classroom curriculum into an online environment. In contrast, O'Malley (1999), when looking at students perceptions, found that students did not feel that they learned more in online or distance learning courses. In fact, the students surveyed preferred traditional classroom courses to online courses, yet they wanted to be given more opportunities to take online courses.

Still others argued, in relation to media based education, that the real issue has nothing to do with the portal in which education is delivered. Studies that simply look at a face-to-face classroom and compare it directly to an online classroom are missing the point, and comparing apples to oranges. Effective teaching methods are effective teaching methods, and the real issue is the quality of instruction (Clark, R. E., 1983). This may be true, but teaching methods need to vary based on the medium used to deliver the educational material. As Tallent-Runnels et al. (2006) found, online opportunities are not hard to find, but the quality of instruction varies vastly. This theme appears to get at the heart of the real problem. As Karen Swan (2004) found in her lengthy study and summary of online education research, effective online learning stems from effective teaching methods in an online environment. This environment is vastly different than the traditional classroom environment, and in some ways it is better. For instance, it can be a better portal for equal opportunity discussions (Swan, 2004). She provided a long list of requirements associated with an effective online learning environment that are still followed by many institutions today.

Due to the available technology, there are obvious differences in material transfers in online classrooms when compared to traditional classrooms, but there are also differences in the student populations of these two educational methods. Differences in online versus the traditional classroom populations are a well known fact. Distance learning retention rates are widely accepted to be much lower than traditional on-campus college students (Simpson, 2004). The demographics of the online environment can vary widely, and make it hard to decipher any distinct trends associated with a homogenous group (Holmberg, 1998). Melody Thompson (1998) stated, "A close examination of the demographics, situational, and affective characteristics of those who study at a distance reveals both similarities common to large portions of the population as well as a wide range of individual characteristics and, therefore, needs" (p.9).

Due to the nature of online learning, it is also important to note the geographic differences in the student populations and therefore, possible differences in needs. When dealing with such a geographically diverse group of students, unintended issues could arise in the online classroom that are less pronounced in the traditional classroom. For instance, it has long been recognized that standardized tests, including everything from IQ (a measure of an individual's intelligence based on a given test) (Cleary, 1968; Scarr, 1981; Temp, 1971) testing to mental health disorder testing (Robert Malgady, 1996), can bias certain cultures and regional groups. There have been many attempts to deal with these biases. Janet Helms (1992) suggested ways to correct for testing differences for Caucasians and African Americans. Nancy Cole (1981) "argues that questions of bias are fundamentally questions of validity." Some of these differences may exist in traditional classrooms, but may also be exaggerated by geographic differences common in online environments.

Geographic difference have been studied casually, such as Eileen Thompson's (1997) inclusion of geographic differences in retention rate studies, but little has been done to identify and deal with geographic cultural differences when both teaching and testing students in online classes. This study intends to bridge the gap in research between geographic differences that may relate to an individual's sense of place, and his/her performance in online geosciences classes.

Online science courses

The need for science literacy in our country is essential for an understanding of both national and international events and issues. Since World War II, there has been a worldwide focus on science education and literacy due to its influence on economics and world power (Downing and Holtz, 2008). Low and middle income countries are seeing the need to boost science, technology, innovations, and therefore education in these specialties in order to raise the quality of life for their people (Watkins, et al., 2007) Those educated in the sciences are essentially a form of capital to both developed and developing countries alike (Downing and Holtz, 2008).

> Health and illness, flood and drought, want and plenty: each of these dichotomies rests squarely within the province of science education, for science education enables one to think critically and creatively, to collaborate, to investigate, to solve real-world problems, and to apply a body of knowledge that is dynamic and that rewards the lifelong leaner with its challenge (p. 1).

General science education does not guarantee the acquisition of critical thinking skills. It is not simply knowledge of scientific discoveries that enables a member of society to be a scientifically literate individual that is able to solve scientific problems. The kindergarten through 12th grade (K-12) National Science Education Standards not only focus on the learning of scientific content knowledge, but knowledge through inquiry-based investigations that foster critical thinking skills. Critical thinking as defined in the National Science Education Standards (National Academy Press, 2003), "includes deciding what evidence should be used and accounting for anomalous data. Specifically, students should be able to review data from a simple experiment, summarize the data, and form a logical argument about the cause-and-effect relationship in the experiment (p.145)." The focus of these standards is on student-centered learning requiring critical thinking skills (especially when associated with practical experiences) that will create scientifically literate citizens (National Research Council, 2003). Ritter (2012) attested that online learning environments require a shift from teacher-centered learning to the student-centered learning that is required in the critical thinking process while completing practical work. The online environment may be an ideal platform for student-centered learning that not only fosters, but requires, the students to acquire and utilize critical thinking skills and past experiences to become scientifically literate citizens.

As the need for scientifically literate citizens increases, we may need to consider alternative avenues to make science learning more available to all learners. One way in which to bring science education to the masses is through online courses that enable both traditional students and life-long learners to continue their science education. The World Bank has emphasized this need for skilled workers and lifelong learners by stating, "Producing knowledge intensive, technologically sophisticated, higher value goods and services is not possible without a trained management cadre and labor force with the appropriate mix of technical and vocational skills (Science, Technology, and Innovation, 2007: p.1)."Though the internet is not an all encompassing technology that is available to the entire population, it is a growing force that should be utilized. As of December 2009, 74% of Americans use the internet, and almost 80% of English speaking Americans are online (Rainie, 2010). At that time 60% of American households had broadband connections, and 55% of Americans used wireless internet. By July of 2010, the number of mobile internet users (including laptops and cell phones) had increased to 60% in just six months (Smith, 2010). Technology has allowed for the advancement of not only science, but also the availability of science education for a diverse group of learners, but in order for online science learning to be effective, certain criteria need to be met.

Swan's 2004 paper focused on general concepts for broad categories of online courses. Science courses may pose additional problems when establishing the required environment to foster critical science thinking. What is clear is that "practical" work is an essential part of all types of science learning, and must be considered within both in-person and online course designs and effectiveness assessments. Downing and Holtz (2008) emphasized the importance of practical work in developing scientists and when developing online curriculum. They summarized the meaning of practical work,

> As regularly construed, practical work in science comprises the laboratory and field work exercises in a course that characterize the style of scientific inquiry itself as well as the modeled activities of that discipline's science professionals (e.g., chemical experiments, biological sample collections, astronomical observations, geological mapping etc.). However, practical work is more expansive than just laboratory work or field work (p.74).

Aspects of lectures as well as theory and procedure related homework assignments are included in "practical" work. A summary of multiple types of practical work categories within science education and examples of how to incorporate these practical work experiences into distance education courses are available in both Downing and Holtz (2008) work, and Swan, 2004. The ability to deliver appropriate and effective practical experiences is at the heart of online science learning debates.

Though the online environment may be a perfect platform to expand science learning, not everyone is on-board with online science education. Online science courses have been criticized for their ability or inability to deliver meaningful experimental or practical learning. Couture (2004) emphasized that the overall credibility of distance learning courses depends on their ability to deliver simulating hands-on instructional activities. Millar (2004) argued that multimedia representations of real world events do not disclose all of the data, and therefore cannot replace hands-on real world experiences.

There also seems to be a lack of desire to offer these online science courses for reasons other than objections to adequate learning. Out of 90 schools with geography departments that were surveyed in 2012, only 37% of them currently offer an online physical geography course. According to the heads of the departments, the primary reasoning (54%) for not offering an online physical geography course is the lack of interest by faculty members and lack of faculty resources (46%) (Ritter, 2012). Open responses indicate that the time requirements may play a factor in the lack of desire of faculty members to develop and run online courses. Unless online teaching is included in professional development and promotional standards, faculty members are less likely to participate in this time consuming teaching method (Lucas and Wright, 2009). Faculty incentives and professional development exercises may need to be incorporated in order to demonstrate online learning can benefit both the educators (enhanced skill levels) and the learners (Ritter, 2012).

On the other hand, Ritter (2012) stated that "Online education bestows the advantages of flexible leaning over time and space, ready access to rich learning materials, promotion of collaborative learning, self-assessment, and application of constructivist and connectivist pedagogies (p.1)." Barton (1998) found that online practical experiences have some benefits that may make them preferable to laboratory and other hands-on practical experiences. These online experiences can reduce information clutter, save time, better emphasize the desired material, and supplement the material with added visual information (including charts, graphs, videos). Students who desire additional access to lecture materials and the ability to re-watch and review recorder lectures may actually improve their assessment performance in online classrooms (Turner and Farmer, 2008). This benefit of repeatability may also apply to field-trip and experiment experiences.

Virtual field-trips have become effective, cost-efficient, and desirable alternative in-person group field-trips. Sites such as NOAA and USGS give access to a plethora of real-time data that can be used in practical analyses by students around the globe. Using these types of websites and other technologies enable students to perform personalized activities and field experiences. This may actually encourage students, who may otherwise simply blend in on group fieldtrips, to expand their individual knowledge to a greater extent. Shelton and Hedley (2002) found a significant comprehension improvement when they utilized a reality model to visualize the sun-earth relationship with their students. When conducting a virtual field trip to encourage desert geomorphology knowledge, Douglas and Dorn (2008) found no statistical difference in virtual vs. in-person field trips. Students were found to be given a "real-life picture" of what they were learning by utilizing Google Earth for virtual fieldtrips (Clary and Wandersee, 2010). Practical experiences such as these are at the heart of science education at all levels, and can be a positive component to an effective online science course.

It is clear that virtual field experiences and experiments, though not perfect, can be implemented to improve student understanding of science concepts in online learning environments. What is not clear in the literature is whether or not the geographic background of students may bias their understanding or ability to complete or fully comprehend the assignments and exercises within an online course. Online science courses encourage diversity across geographic boundaries which can add a level of difficulty for faculty members who teach under constructivist assumptions. Will some students fare better than others due to their previous geographic backgrounds and experiences? I hope to further the geographic understanding of geoscience online students to better comprehend their needs for both lecture material and the unique practical experiences required in online geoscience courses.

CHAPTER III

METHODS

Setting/Participant Selection

The Teachers in Geosciences (TIG) program is a Masters program that targets in-service teachers. Students beginning this online master's program in the 2012 and 2013 fall semesters at a large Carnegie Research I extensive university in the southern US were asked to participate in a longitudinal study that would follow them throughout their program. The study IRB can be found in Appendix A. The project began with the incoming fall 2012 TIG students and continued through their projected graduation in August 2014. Out of the total N=115 possible participants (61 in the fall of 2012 and 54 in the fall of 2013), n=54 (47%) student selected to fully participate in the initial offering of the study. Most of the student participants were current K-12 science teachers. Out of the N=115 participants, 65 of them were women, 46 were men, and 4 of them did not specify a gender. Incoming students were asked to complete four separate surveys at the beginning of the program: the geology pre-survey (Appendix B), the meteorology pre-survey (Appendix B), the Geology Sense of Place survey (Appendix C), and the Meteorology Sense of Place survey (Appendix C). The geology and meteorology pre-surveys were designed as benchmark data prior to the start of classes. The geology survey was developed through a custom selection of the *Geoscience Concept Inventory* (Libarkin & Anderson, 2012), and the researcher created additional questions that incorporate specific knowledge of geographic locations. All questions were then vetted by other geology instructors and researchers as part of the validation process. The meteorology pre-test was partially provided by a Professor of Meteorology and further developed by the investigator with the help of meteorology instructors within the online master's program. The general meteorology questions were gathered from pre-tests that had been given to incoming meteorology masters students in the past to determine their basic meteorology knowledge. Specific regional questions were then written by the researcher, and all questions were then vetted by other meteorology instructors and researchers as part of the validation process.

Science content pre-survey

The pre-surveys consisted of 20 questions each of basic meteorological and geological knowledge, but they also consisted of 10 questions each that were specific to certain regions. For instance, during the meteorological pre-survey students were asked questions about Lake Effect snow, the specific air mass that causes Nor'easters, and Chinook winds. Similar regional geologic questions were asked that related to glacial landforms, volcanoes, river deltas, and other regional phenomenon and landforms.

These pre-surveys were beneficial to both the researcher of this study as well as the individual students in the TIG program, and took no more than 20 minutes each. They provided benchmark data to determine pre-existing knowledge in the earth sciences, and they helped entering students identify areas of weaknesses and strengths. The pre-surveys also allowed both the students and the researchers to identify areas of progress throughout the program.

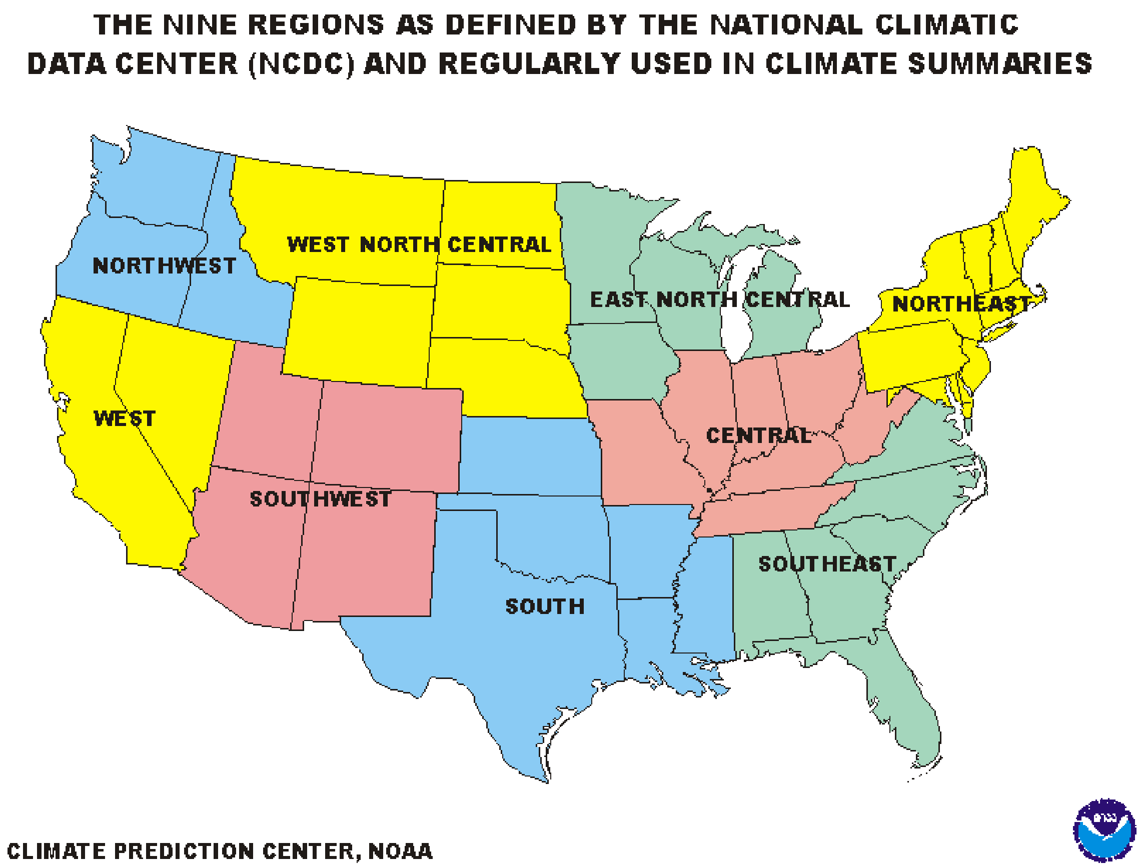

Figure 3.1 Region Map

Climatic region map created by NOAA and available on the NOAA website

Within the surveys, individual students were prompted to identify, when given a NOAA climate regional map of the United States (see Figure 3.1), what they thought of as their “home” region. Students were also asked to include their current zip code along with other demographic information.

After the surveys closed, the data were organized in spreadsheets, and analyzed using SPSS software. ANOVA statistical analyses were run in order to determine if there were any significant differences between regions on the total pre-survey scores for the geology and the meteorology pre-surveys. Chi-Square tests were run on each question for both pre-surveys to determine significance between regions for all of the questions.

Sense of place survey and end of year one survey

Additionally, participants completed sense of place writing templates in geology and meteorology (Clary and Wandersee, 2006; Clary et al., 2013). Participants were asked to complete the Geological and Meteorological Sense of Place identification online surveys to identify their childhood idiotopy and to further probe their defining geological and meteorological childhood experiences. These surveys (Appendices C) sought to identify the individuals' dominant sense of place, and utilized an existing survey (Clary and Wandersee 2006) for the geological sense of place survey, and a direct template for the meteorological sense of place survey (Clary et al., 2013). The surveys were administered to incoming students in the (TIG) Master's program during the first semester of admittance into the TIG program in the fall of 2012 and 2013.

Content analysis methods (Neuendorf, 2002) were performed to assess and code the data, and MAXQDA11 software was utilized during the line-by-line, manual coding process in order to better organize the data. The researcher read through all of the responses by the students for each of the questions prior to determining a coding system for each question. Answers for each question were selectively reduced to code for the frequency of specific concept categories most relevant to the question. Each question was coded multiple times by the researcher to ensure reliability. The same procedure was utilized when coding each survey for overall concept categories. Overall themes were geared towards geographic settings in relation to meteorological and geologic events and features.

Surveys were administered to students again at the end of their first year in the program. At this point in time the study participants should have completed Meteorology

I in the fall semester and Geology I in the spring semester. The end of year one survey was designed to probe the students' thoughts about these two courses, and to determine interest levels in specific topics. It was hoped that these surveys would enable the researcher to better understand the relationship between a student's interests in relation to their primary sense of place. The surveys were then coded using the same methods established for the Sense of Place surveys.

Assessment analysis

The students' quizzes/homeworks/tests/final (assessment) grades were collected for the specific courses in order to analyze and to determine relationships between the individual students' sense of place and their knowledge levels in subject areas relating specifically to the geographic regions they are most significantly attached, based on their initial sense of place surveys. Participating students' scores from Meteorology I (N=51) and Geology I (N=31) were collected and analyzed using SPSS software. These courses were chosen because they are the first experiences that the students have in geology and meteorology in the TIG program. Meteorology I is typically taken in the fall semester of the students' first year, and Geology I is typically taken during the Spring semester of the first year. These courses were also examined due to the number of students within these courses by the completion of the study. Many of the students involved in the study had not yet taken the upper level meteorology or geology courses, or had dropped out of the program after not doing well in one of these first two courses.

The collected grade data were analyzed utilizing Kruskal-Wallis and Repeated Measures procedures available in SPSS software to determine relationships between an individual's sense of place and his/her knowledge, and ability to attain knowledge, in relation to his or her predominant geographic attachment. First, all of the regions were compared in relation to the scores on each individual assessment grade using the Kruskal-Wallis non-parametric ranking statistical test. The analysis was run a second time for each of the assessments for only regions with at least three or more participants. The Kruskal-Wallis test is robust, but it typically requires comparisons between at least three scores per category. When overall significance was found, pairwise comparisons were analyzed to determine the source of the significance between the different regions. The robust Bonferroni correction was also utilized to further reduce the chances of type-I errors.

Repeated measures tests were also run in SPSS for both the Meteorology I grades and the Geology I grades in order to determine any significance between the assessments themselves. A Bonferroni adjustment was applied in order to minimize Type-I errors. Pairwise comparisons were further analyzed to determine the location of significance between assessments. These statistical tests were used to determine whether or not certain assessments garnered higher or lower grades in general by all of the students.

Interviews

Finally, students were selected to participate in semi-structured30 minute interviews and short (5-10 minutes) follow-up interviews. Purposeful sampling methods were used to identify potential interview subjects during their elected TIG capstone field courses. The TIG program requires students to participate in a field course during the summer of their graduating year. These courses seek to expand on the students' general knowledge in different geoscience areas, and often help expand their knowledge of the setting they choose. Students may choose close-to-home locations for these field courses, or they may choose exotic locations far from home. The students were selected based on trip selection and willingness to participate in the interview process. The Upstate, New York field course was selected by the researcher to attend due to the number of study participants and the availability to attend the course. There were six total participants that were eligible to partake in the interview process, and four of these study participants attended the Upstate New York field course. All four of the study participants that attended this trip agreed to be interviewed and observed on the trip. These four students each fell into different age ranges:1956-1960, 1961-1965, 1966-1970, and 1981-1985. They are all top students in the program and females, so the researcher is aware that this is a skewed representation of the total TIG population. Though these results are skewed by gender and capability, the researcher is confident that valuable information can still be gleaned from these interviews.

Phenomenological theory was utilized throughout the data collection and analysis processes. The interviews were audio and video recorded with permission of each interviewee, and each recording was saved on a computer under a pseudonym. The interviews were all transcribed by the researcher (Appendix G) using Dragon Dictate software. Each transcribed interview was double checked for accuracy by the researcher prior to the explication process. Field notes were also taken throughout the weeklong field course, and recorded in a field notebook during observation activities. The interviews were then coded in accordance with narrative summary analysis techniques. MAXQDA11 software was utilized to aid in the open coding process and organization of the thematic analysis.

CHAPTER IV

GEOGRAPHIC AFFILIATION AND SENSE OF PLACE INFLUENCES ON INCOMING ONLINE STUDENTS' GEOLOGICAL AND METEOROLOGICAL CONTENT KNOWLEDGE

Methods

Students beginning an online master's program in the 2012 and 2013 fall semesters at a large southern Carnegie Research I extensive university were asked to participate in a longitudinal study that would follow them throughout their program. Most of the student participants are current K-12 science teachers. Incoming students were asked to complete a geology and meteorology pre-survey for benchmark data prior to the start of classes. The geology survey was developed through a custom selection of the *Geoscience Concept Inventory* (Libarkin & Anderson, 2012), and the researcher created additional questions that incorporate specific knowledge of geographic locations. All questions were then vetted by other geology instructors and researchers as part of the validation process. The meteorology pre-test was partially provided by a Professor of Meteorology and further developed by the investigator with the help of meteorology instructors within the online master's program. The general meteorology questions were gathered from pre-tests that had been given to incoming meteorology masters students in the past to determine their basic meteorology knowledge. Specific regional questions were then written by the researcher, and all questions were then vetted by other meteorology instructors and researchers as part of the validation process. Additionally, participants completed sense of place writing templates in geology and meteorology (Author and other, 2006; Authors and other 2013) to further probe their defining geological and meteorological childhood experiences. However, we focus only upon the content surveys in this paper.

The pre-surveys consisted of 20 questions each of basic meteorological and geological knowledge, but they also consisted of 10 questions each that were specific to certain regions. For instance, during the meteorological pre-survey students were asked questions about Lake Effect snow, the specific air mass that causes Nor'easters, and Chinook winds. Similar regional geologic questions were asked that related to glacial landforms, volcanoes, river deltas, and other regional phenomenon and landforms.

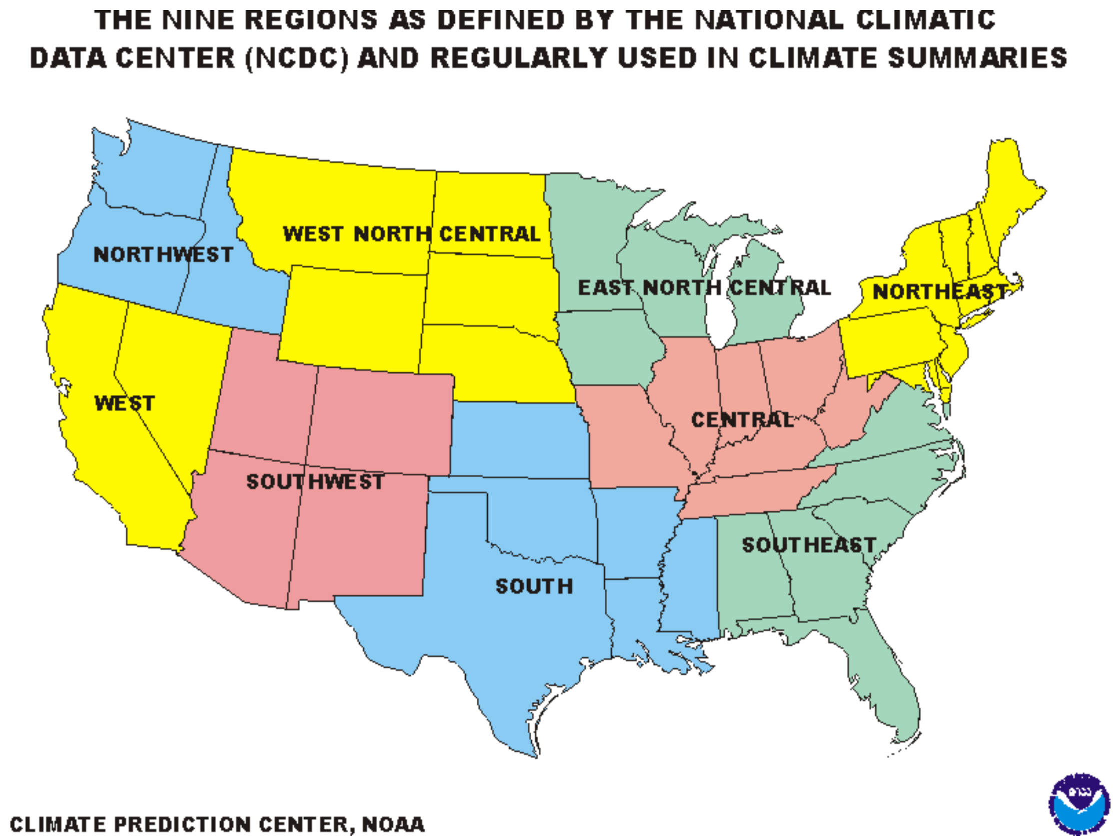

Figure 4.1 Region Map

Climatic region map created by NOAA and available on the NOAA website

Within the surveys, individual students were prompted to identify, when given a NOAA climate regional map of the United States (see Figure 4.1), what they thought of as their "home" region. Students were also asked to include their current zip code along with other demographic information.

After the surveys closed, the data were organized in spreadsheets, and analyzed using SPSS software. We ran ANOVA statistical analyses to determine if there were any significant differences between regions on the total pre-survey scores for the geology and the meteorology pre-surveys. Chi-Square tests were run on each question for both pre-surveys to determine significance between regions for all of the questions. When answering the questions regarding which region the students considered to be "home," one student identified a region that was not on the map (Great Plains). This region was not included in the analysis process.

Results

The overall pre-test scores, as shown in Table 4.1, for the different regions did not show any significance between region differences [$F\ (8, 57) = 0.85$, $p = .561$] for the meteorology pre-survey or for the geology pre-survey [$F\ (6, 61) = 0.85$, $p = .354$]. This was to be expected because most of the incoming master's students who took the pre-surveys were currently teaching earth science and other science courses at the K-12 level, and they had a basic knowledge of the material.

Table 4.1 Total Average Pre-survey Scores

Region	Average pre-survey Geology Score	Participants	Average pre-survey Meteorology Scores	Participants
West	228	5	210	3
East North Central	208	5	190	3
Central	202	14	162.5	12
West North Central	200	2	155	2
Northeast	197.5	16	200.6	17
South	192	10	178.9	9
Southwest	190	2	166.7	3
Southeast	186	15	182.3	13
Northwest	176.66	3	180	4

Total average scores (out of a possible 290 for geology and 300 for meteorology pre-surveys) for each region on both the meteorology pre-survey and the geology pre-survey. No significance was found between regions for either of the pre-surveys.

Meteorology pre-survey by question

The answers for each question of the Meteorology pre-survey were then analyzed by region using a Chi Square test run in SPSS software, using the Bonferroni adjustment, to determine whether or not the relationship between these variables was significant. Questions 5 ($X^2(8, n = 66) = 20.327$, $p = .009$) , 15 ($X^2(8, n = 66) = 20.639$, $p = .008$), and 17 ($X^2(8, n = 66) = 17.893$, $p = .022$) of the meteorology pre-survey all showed significance when comparing correct answers and incorrect answer within regions for these questions. Therefore, the answer a student gives for these particular questions does show dependence on the region that the student considers to be "home." The questions that were asked, regions, and Chi Square values can be viewed in Table 4.2 below

Table 4.2 Meteorology Chi-Square results by question

Question	Question Text	Pearson value and P value	Regions showing significance between expected and actual value	Total Correct answers over the total participants
5	Maritime Polar (mP) air masses in the North Atlantic are commonly associated with this type of storm:	Pearson = 20.327 p = 0.009	Northeast	Northeast = 17/17
			Northwest	Northwest = 1/4
			South	South = 4/9
15	Which of the following statements is true of tornadoes:	Pearson = 20.639 p = 0.008	Southwest	Southwest = 0/3
			Central	Central = 11/12
			Northeast	Northeast = 17/17
			South	South = 7/9
			Southeast	Southeast =11/16
17	Why do hurricanes initially form only in the tropics?	Pearson = 17.893 p = 0.022	West North Central and	West North Central = 0/2
			Central	Central = 12/12
			Northeast	Northeast = 16/17
			South	South = 9/9
			Southwest	Southwest = 3/3
			West	West = 3/3
			East North Central	East North Central = 3/3

Questions that were significant after Chi-Square test was run to compare the regions' answers on each question. The first column represents the question number in the pre-survey. The second column states the actual question. The fourth column indicates which regions showed significance between answers and ones that varied greatly from other regions. The fourth column shows the total number of correct answers over the total number of participants in a region.

Geology pre-survey by question

When each geology question from the pre-survey was analyzed using Chi-Square testing in SPSS, using the Bonferroni adjustment, only one question showed significance. Question 8 asked the students to identify the relationship between earthquakes, volcanoes, and tectonic plates had a Chi-Square value of ($X^2(8, n = 72) = 15.886$, $p = 0.049$), showing significance when comparing correct answers and incorrect answer within regions for this question. Question 22, which was related to the formation of sinkholes, did not show significance with Chi-Sqaure values of $X^2(8, n = 72) = 15.414$, $p < 0.052$. Do to the Chi-Square value being close to 0.052, a closer look at the answers for this question was warranted, and it will be more closely analyzed in the discussion. These questions responses per associated region, and Chi Square values are summarized in Table 4.3.

Table 4.3 Geology Chi-Square results by question

Question	Question Text	Pearson value and P value	Regions showing significance between expected and actual value	Total Correct answers over the total participants
8	Which of the following responses best summarizes the relationship between volcanoes, large earthquakes, and tectonic plates?	Pearson = 15.886 p = 0.049	Central	Central = 14/14
			East North Central	ENC = 5/5
			Northeast	Northeast = 14/15
			South	South = 6/8
			Southwest	Southwest = 2/2
			West	West = 5/5
			West North Central	West North Central = 2/2
			Northwest	Northwest = 1/3
2	Sinkholes are most often formed by:	Pearson = 15.414 p = 0.052	Central	Central = 10/14
			East North Central	ENC = 5/5
			Northeast	Northeast = 10/16
			Northwest	Northwest = 0/3
			South	South = 5/10
			Southeast	Southeast = 12/15
			Southwest	Southwest = 2/2
			West	West = 5/5

Questions that were significant after Chi-Square test was run to compare the regions' answers on each question. The first column represents the question number in the pre-survey. The second column states the actual question. The fourth column indicates which regions showed significance between answers and ones that varied greatly from other regions. The fourth column shows the total number of correct answers over the total number of participants in a region

Discussion

Our results indicate that there was no significance between regions in the students' overall scores on the content pre-survey. This was expected because the students who participated in this study are mainly K-12 science teachers. This is also a master's program, so many of the participants had some basic pre-existing knowledge of the subject matter.

Though there was no significant differences on the overall pre-survey scores between the regions, when each question was analyzed, there were questions that showed statistical significance using the Chi-Square analysis method. Shown in table 4.2, question numbers 5, 15, and 17 of the geology pre-survey all showed statistical significance. Questions 8 and 22 (table 4.3) of the meteorology pre-survey also showed significance.

Question 5 of the Meteorology pre-test stated, "Maritime Polar (mP) air masses in the North Atlantic are commonly associated with this type of storm." The possible answers for this question were Midlatitude Cyclone, Nor'Easter, Hurricane, or Atlantic Surge. The correct answer is "Nor'Easter". All 17 participants from the Northeastern U.S. answered this question correctly. On the other hand, only one out of four students from the Northwest, and only four out of nine students from the South correctly answered this question. Students who consider the Northeastern United States their home region have had personal experiences with Nor'Easters every winter. This pre-existing knowledge may be due to their meteorological sense of place and pre-existing way of understanding weather events. An old saying originally coined by Herbert Marshall McLuhan is, "I would not have seen it if I had not believed it." This quote underlines some basic notions of how an individual's pre-existing knowledge can determine how they view the world around them. Students from the Northeast were able to identify with a weather event that they already knew about. Students from the Northwest showed no consistency in their choice of answers, while students from the South, though incorrect, showed more consistency in the wrong answer that they chose. Many southern states are subjected to hurricanes during hurricane season. The two wrong answers that most southern students chose were hurricanes and Atlantic surges. More research is currently being conducted in order to better understand the causes of these differences in responses, and whether or not the individual's geographic sense of place had a role in each student's response.

Question 15 of the Meteorology pre-test stated, "Which of the following statements is true of tornadoes?" The possible answers for the question were Most common in Midwest, Great Plains, and Southeast, Usually occur along the warm front of a mid-latitude cyclone, Occur most frequently in winter, and All the statements are false. The correct answer is, "Most common in Midwest, Great Plains, and Southeast." Students from the South, Northeast, Central, and Southeast all scored well (above 68%) on this question. No student from the Southwestern U.S. correctly answered this question. As can be seen in Figure 4.2, students from the Southwest rarely experience the threat of tornadoes, whereas, students from the South, Central, Southeast, and even the Northeast may have personal experiences with tornadoes. These students' regional knowledge, and meteorological sense of place may be tied to knowledge of tornadoes, and tornado seasons.

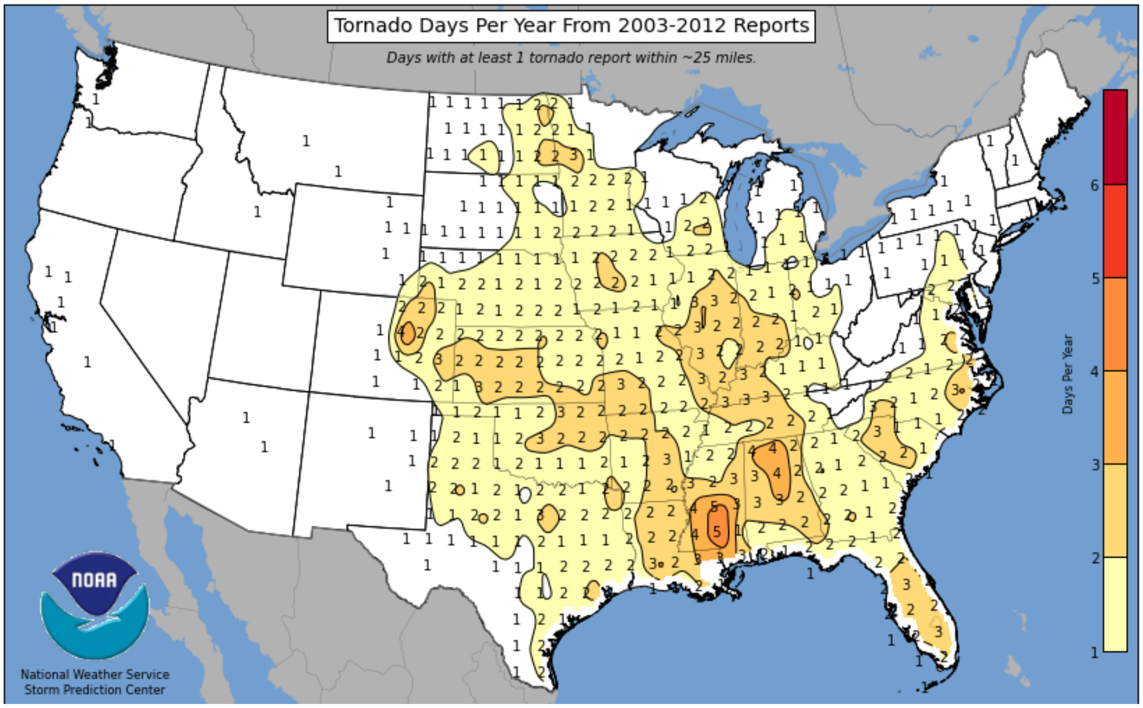

Figure 4.2 Tornado Days Per Year.

This figure was taken from the NOAA Storm Prediction Center website. The image indicates the average number of tornado days for locations throughout the continental United States. As can be seen by this figure, the majority of tornado days occur in the Central and Southern areas of the country. Very few tornado days occurred in the Southwestern United States from 2003-2012.

Question number 17 of the Meteorology pre-survey asked, "Why do hurricanes initially form only in the tropics?" The possible answers for the question were warm water temperatures are found there, stronger pressure gradients are found there, subsiding air currents are found there, Coriolis is weaker there. The correct answer is, "warm water temperatures are found there." Most regions did well with this question, except for the students from the West North Central region. Figure 4.1 illustrates that this region encompasses the Dakotas, Montana, Nebraska, and Wyoming. These states are some of the furthest from any possible effects of hurricanes. Areas of the South, Southeast, and Northeast are obviously affected by tropical storms and hurricanes most years. Even areas of the West, Southwest, and Central regions have experienced the effects of hurricanes in the past. Though students from the West North Central region had a tough time with questions about hurricanes, they did much better when asked about Chinook winds and blizzards which corresponds with their regional meteorological sense of place.

Question 8 from the geologic pre-survey stated, "Which of the following responses best summarizes the relationship between volcanoes, large earthquakes, and tectonic plates?" The possible answers to this question were volcanoes typically occur on islands, earthquakes typically occur on continents, and both occur near tectonic plates; Volcanoes and large earthquakes both typically occur along the edges of tectonic plates; Volcanoes typically occur in the center of tectonic plates and large earthquakes typically occur along the edges of tectonic plates; Volcanoes and large earthquakes both typically occur in warm climates; and Volcanoes, large earthquakes, and tectonic plates are not related, and each can occur in different places. The correct answer to this question is, "Volcanoes and large earthquakes both typically occur along the edges of tectonic plates." Oddly, the students from the Northwest did not score well on this question. The Pacific Northwest sits on an active plate boundary suggesting that tectonics should be a part of these students' geologic sense of place. These students are located in a region that experiences earthquakes, and has active volcanoes. All of the students from the Northwest suggested that earthquakes and volcanoes are related and have to do with plate boundaries; they just did not all get the locations correct. More information is needed to determine the reasons for the responses of the students from the Northwest.

Finally, question 22 of the geologic survey stated, "Sinkholes are most often formed by?" The possible answer to this question were Meteorite impacts on soft sediments, Roof collapse of a dissolutional feature, An avalanche debris pile that caves in on itself, A tsunami event that penetrates into the water table, All of the above. The correct answer to the question is, "Roof collapse of a dissolutional feature." Dissolutional collapses are common in karst regions throughout the world. Figure 4.3 illustrates the areas of the United States that have karst and pseudo karst features. The dark green and light green indicate areas were carbonate rocks such as limestone are located. These carbonate rocks are soluble. These areas are known for features like caves, sinkholes, and other karts features.

Students from many of the regions did well on this question, but it seemed to depend on where in the region the students were located. Those from the Northwest scored poorly. All of the students from the Northwest reported to be from areas without karst features such as Seattle. Many of the students from the South were also from areas without surficial karst features. The students in the South who got this question correct, based on their zip codes, appear to be from areas near or associated with karst features. This question does bring up some very interesting insight into the specifics of an individual's geologic sense of place. We hope to further investigate questions like this as we analyze the geological and meteorological sense of place surveys in more detail.

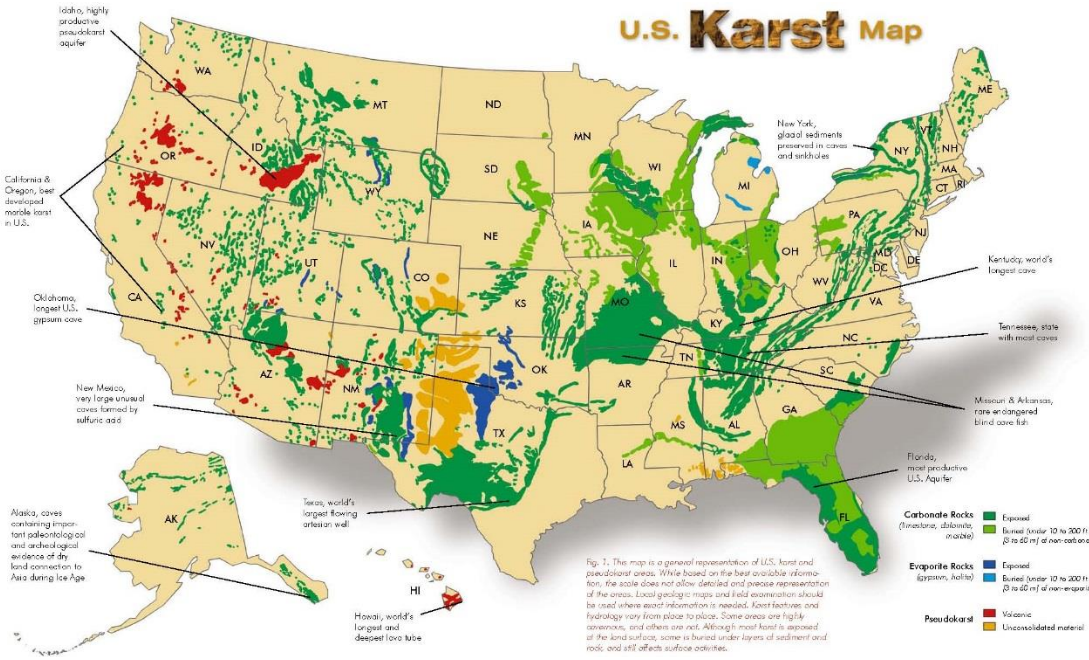

Figure 4.3 United States Karst Map

The map from the USGS indicates karst and psuedokarst areas of the United States. Carbonate rocks such as limestone, dolomite, and marble. Areas with surficial and near surface limestone are most affected by current sinkhole formation. The blue and light blue areas indicate evaporate rocks. These rocks are also highly soluble. The red and orange areas have volcanic and unconsolidated materials that are considered pseudokarst features.

Though our data do show some significant results for specific questions on the pre-survey, more work needs to be done in this area to determine the extent of the connection between a student's home region and meteorological sense of place and geological sense of place and how it affects a student's pre-existing knowledge in geology and meteorology. Continued future analysis of our sense of place qualitative studies will expand on this topic. Also, as previously stated, these students were master's students. They also are primarily K-12 teachers that teach basic geologic and meteorological concepts to their own students. Though this pre-exposure to geologic and meteorological concepts may have leveled the playing field for the total pre-survey scores, it may have also detracted from the effects of and individual's primary geologic and meteorological sense of place on their pre-existing knowledge in these areas of study. We have shown that some questions are indeed significant for groups in an online Masters geology and meteorology course, but a similar study utilizing college freshmen may show even more significant results.

The small number of participants in certain regions may have also impacted our results. When conducting these studies it becomes difficult to ensure sufficient student data for each region. The participation in this study was voluntary, and even with encouragement and incentives, we were only able to capture the interest of about 47% of the student population of this master's program. Still, 47% is a high percentage of participants for voluntary surveys. In order to further develop this research, additional studies with large quantities of students from all regions will need to be conducted.

Conclusions

As instructors of online courses, trying to deliver the educational material in a way that is personalized to individual students is a challenge; especially with the knowledge that an individual's way of knowing and understanding the world is intricately linked to his or her primary sense of place. The great geographic differences in our online student populations can exaggerate these different ways of knowing. In order to better understand our students and to follow Ausubel's insight, "the most important factor influencing learning is what the learner already knows; ascertain this and teach him accordingly" (p. iv), we first need to know how are students understand the world around them. When teaching geology and meteorology online courses, a basic understanding of what a student considers to be his or her home region may be the first step in understanding how to better accommodate an individual’s pre-existing geological and meteorological knowledge.

CHAPTER V

GEOLOGICAL SENSE OF PLACE DATA AND RESULTS

Methods

Content analysis (Neuendorf, 2002) revealed that the students within the study had varying geologic backgrounds. The survey responses can be found in Appendix D. These results are not surprising considering the geographic diversity of the student population involved in the online TIG program. Though differences in geologic experiences were evident throughout the survey, there were also some common themes that pervaded within the subject group (N=53). For example, very few students considered their "home" region to be different from the region where they grew-up (n = 5, 9%). This even applied to those who had moved away from their home region for their adult life. Only one student claiming the Central region as his or her home region grew up elsewhere; only two students claiming the Southeast as their home region did not grow up there; only one student identifying the West region as home did not grow up there; and only one student naming the Southwest as home grew up elsewhere. Another common theme was the number of times specific National and State Parks were mentioned. The Grand Canyon was most mentioned within the surveys (*n* = 22).

Data and Results

Each question was coded multiple times to ensure validity. Some students gave more than one answer for each question, while others gave no response for some questions. Therefore, the total number of responses varies for each question. Common themes were identified for each survey question. For instance (N = 68), sand (n = 14, 21%), rocks (n = 13, 19%), and dirt (n = 11,16%) were the most common geologic products associated with "playtime" in the yard. Interestingly, when asked what part of the earth interested them the most as a child (N = 60),32% (n = 19)of the students surveyed reported non-geology related categories such as the biosphere (n = 10, 17%) and weather related topics (n = 9, 15%). Of the geology related topics (N = 41), mountains (n = 5, 12%) and rocks/minerals (n = 5, 12%) scored the highest.

Only 26% (n = 14) of the respondents (N = 53) did not have a collection of earth materials as a child. Those students having collections amassed predominantly specific rock and fossil collections (n = 18, 34%). Within the group of students that listed specific rocks or fossils (n = 18), particular types of quartz (n = 6, 35%) and fossils (n= 6, 35%) were the dominant categories. Other students' collections were entirely based on the look or texture of the rocks and minerals (n = 8, 15%).

The majority n= 39, 75%) of the students surveyed (N = 53) did not have particular chores or jobs related to rocks or minerals as youth, and of those that did discuss particular jobs (*n* =13 students), rock/mineral removal jobs such as, "I had to take rocks out of the garden" scored the highest (n = 8, 62%). Only 4% (n = 2) of those that listed particular chores discussed enjoyable projects related to school or scouting. Although most of the students did not have enjoyable jobs/chores related to rocks and mineral, many of them did identify specific rocks or landforms that they used to play on as children. Of the 53 participants, 70% identified rocks or landforms (n = 37) that they played on as children. The most common items listed were mountains and hills (n = 10, 27%), rocks and boulders (n = 8, 22%), and specific travel related landforms (n = 8, 22%). For example, one student recalled, "Didn't have one in my neighborhood [*sic*]. But at my papw's[*si*c] home about 25 miles away there was a rock called Stone Face. It was about 100 feet up on a cliff about around 20 feet in length."

Interestingly, when asked to identify a favorite geologic process,53% (n = 28) of the students, out of 53 responses, discussed processes that they had no experiences with, or that were not located within their identified home region. Though many students had never experienced these phenomena themselves, of those that acknowledged geologic processes, (n = 30, 77%) identified violent processes such as volcanoes (n = 22, 56%) and earthquakes (n = 8, 21%) as major interests. Many students (n = 14, 26% of the total) actually identified non-geology related topics such as "severe weather." The Meteorology Sense of Place survey, the Geology Sense of Place surveys, and both of the pre-surveys were available at the same time, and they could be taken in any order. It is possible that the students who responded with meteorologically derived answers had either taken the Meteorology Sense of Place survey and/or pre-survey first or saw these surveys prior to beginning the Geology Sense of Place survey. This may have primed the students for meteorologically related responses.

Most of the students (n = 34, 64% of 53 total responses) incorporated some geologic products into childhood crafts. The students who utilized geologic products tended to integrate rocks in crafts the most (n = 18, 53%). When asked about specific rocks touched during youth, most of the students (n = 41, 77%) did enjoy touching a specific rock texture (n = 17, 32%) or a specific rock itself (n = 24, 45%). Within those that chose a specific texture (n = 17), the predominant was smooth (n = 15, 88%), and the prevalent rock (mineral) mentioned was mica (n = 4, 17% of 24 specific rock/minerals). Students enjoyed "peeling it apart."

Interestingly, many students who listed unusual rocks and landforms chose specific locations (n = 24, 50% of 48 total responses). Of those students that chose specific locations (n = 24), the National Parks were predominantly discussed (n = 17, 71%), and out of the 17 students that chose national parks 7 (41%) relayed experiences at the Grand Canyon. The students that chose general unusual landforms and locations (n = 17, 35% of total) described mountains (n = 5, 29%), caves and karst features (n = 3, 18%), and erosional glacial features (n = 3, 18%).

Unfortunately, the majority of students did not have specific rock or fossil collections as children (n = 28, 53% of 53 total responses). Some of these students did say that they now have collections as adults. Those that did possess collections as children (n = 25 students) either obtained rock collections (n = 14, 56%), fossil collections (n = 2, 8%), or they collected both rocks and fossils (n = 9, 36%). This is contrary to one of the previous questions that asked about the collection of earth materials. It appears that many of the students collected geologic items as students, but only 25 of the students believed that their collections actually constituted a rock or fossil collection. Some students mentioned collecting sand or other items that they did not consider rock collections.

Remarkably, most of the students (n = 47, 89% of 53 total responses) were able to list specific geologic formations or products that their childhood hometown was known for. Of those that listed formations or products (n = 47 students), 51%(n = 24) described specific locations, (n = 8) 17% discussed specific rocks or fossils, (n = 13) 28% mentioned general locations such as "the Appalachian Mountains", and only (n = 2) 4% described specific processes such as "glaciation." Students also appeared comfortable with most of the geologic features that they remember from childhood. Of the 53 respondents, 72% (n = 38) cannot remember fearing or avoiding any geologic landform or object as a child. Those students who mentioned fears or avoidance behaviors (n = 15 students) described heights and cliffs (n = 6, 40%) and water related features and landforms (n = 5, 33%) as the dominant features or objects causing fear or avoidance.

When asked to describe an exotic geologic location that made a big impression on the student as a child, the majority of students (n = 42, 79% of 53 total) described a specific location. Not surprisingly, out of the students that listed specific exotic locations (42 students)71% (n = 30) of them listed locations outside of the region that they considered "home." Though the students had no trouble describing exotic geologic locations that made big impressions on them as children, most of the survey group (n = 31, 58% of 53 respondents) could not identify a sound associated with a geologic process or event from childhood. Of those students that did remember a sound (18 students), they predominantly remembered sounds associated with water such as waves on the beach, flowing water, or waterfalls (n = 13, 72%). A much smaller number of students (n = 3, 17%) remembered the sound of an earthquake.

Unfortunately, most of the students surveyed (n = 34, 64% of 53 total) did not have a person whom they considered a geology mentor as a child. Those students who did have mentors (19 students) interestingly described relationships with family members (n = 12, 63%). Regrettably, only 26% (n = 5) of those with mentors mentioned teachers as mentors.

Though most students surveyed did not have geology mentors as children, the majority still had favorite gemstones (n = 51, 96% of 53 total). Of the 50 specific gemstones mentioned, the most cited gemstone was Amethyst (n = 10, 20%) with the next closest competitor, Garnet, only garnering 10% (n = 5) of the student specific survey answers. The students relayed intriguing reasons for choosing specific gemstones. The predominant reason was because it was the student's birthstone (n = 25, 44% of 57 total reasons), and the second most popular reason was simply because the student liked the look or color of the gemstone (n = 17, 30% of 57 total reasons). When students were asked to describe the color they most associated with the word "rock," most students chose gray (n = 29, 54% of 54 total specific responses). The next most popular color mentioned was brown (n = 10, 19%). Very few students chose other colors like red (n = 5, 9%), black (n = 2, 4%), or white (n = 3, 6%).

The stories written by the survey participants for the two essay questions were impressive. Due to the vast array of answers, and the different essay questions to choose from, the essays were coded into four separate categories: person mentioned, feature mentioned, location, and process. There were a total of 43 people mentioned in the essays, 87 features described, 106 locations discussed, and 31 processes named by the students. Overall, a father was the most identified person by surveyed students (n = 11, 26% out of 43 total). Grandparents were close behind with a grandmother talked about by 23% (n = 10) of the students and a grandfather discussed by 21% (n = 9) of the students. Other people mentioned that the students associated with specific geologic objects, landforms, or events, were brothers (n = 5, 12%), friends (n = 3, 7%), and aunts or uncles (n = 1, 2%).

After reviewing the essays it became clear that certain geologic features continued to appear in the stories. Of the 87 features discussed by students, the features most commented on in the essays involved water or canyons (n = 25, 29%). Mountains were the second most noted feature (n = 19, 22%). Other commonly mentioned features included specific rocks and boulders (n = 13, 15%), beaches (n = 11, 13%), caves and karst (n = 6, 7%), and volcanoes (n = 6, 7%). Interestingly, when a closer look at the locations of specific features and places that were mentioned in the essays, 64% (n = 50) of the 78 known locations were either near where the student grew-up, or within the home region. Only 26% (n = 28) of the specific known locations mentioned were outside the students' home regions, and 26% (n = 28) of the total (106) locations mentioned were not specific enough to designate them to a category inside or outside of the students region. It appears that personal experience in a geologic setting, especially those that were close to home and/or took a regular place in the students' life, were the most prominent memories for the study participants. This is important to note and understand when trying to determine a student's pre-existing knowledge, and to be able to build on these experiences within an online classroom. This knowledge also adds a challenge for online instructors. Unlike in-person classrooms at many regional universities, the instructor must deal with experiences from a variety of geographic settings around the country, and potentially around the world.

Geologic processes commonly discussed within the essays were also noted. In total, 31 processes were mentioned by students in the essays (106 total essays). Of those 31 processes, erosion/weathering was mentioned the most (n = 9, 29%). Sedimentation was a close second at 23% (n = 7), and a couple other common processes included glacial processes (n = 4, 13%) and flooding (n = 4, 13%).

After examining and coding each question, the surveys were further coded using overall consistent features mentioned in the surveys based on the students' identified "home" region. The most common geologic themes mentioned in the Northeast region (N = 13 participants with 131 features mentioned) were rocks/boulders (n= 38, 29%), mountains (n = 12, 9%), and non-geology themes such as meteorology concepts (n = 12, 9%). Though the Central region (N =12 participants with 151 features mentioned) still saw a high number of times that rocks/boulders were discussed (n = 40, 26%), the students surveyed differed from the Northeast region in the other typical geologic features described within the surveys. The Central region saw a higher occurrence of the reference to lakes/rivers (n = 32, 21%), and fossils (n = 16, 11%). The Southeast region (N = 10 participants with 95 features mentioned) still saw a high number of references to rocks/boulders (n = 19, 20%), but the region also recorded high rates of the number of times mountains (n = 15, 16%) and beaches (n = 15, 16%) were mentioned. The Southeast also had a fair number of students describe non-geologic events such as hurricanes (n = 11, 12%).

The South region (N = 9 participants with 99 features mentioned) once again had a large number of times that rocks/boulders were described within the survey (n= 22, 22%). The South differed from previous regions in that it had a relatively large number of times that caves/karst features (n = 10, 10%) and volcanoes (n = 10, 10%) were discussed. The only other region that (percentage wise) mentioned volcanoes as much as the South region was the Southwest region (n = 2, 11.7%). No other region had as high a percentage of karst/caves mentioned by the students. Unlike the previous regions, the East North Central region (N = 3 participants with 44 features mentioned) survey participants only discussed rocks/boulders 14% (n = 6) of the time. The top three features mentioned in the surveys for this region included lakes/rivers (n = 9, 20%), rocks/boulders (n = 6, 14%), and fossils (n = 5, 11%). Similar to the East North Central Region, the West region (N = 2 participants with 18 features mentioned) also did not mention rocks/boulders as the most dominant feature within the surveys. The top features within the survey responses included mountains (n = 7, 39%), lakes/rivers (n = 3, 17%, all of which were rivers), volcanoes (n = 3, 17%), and rocks/boulders (n = 3, 17%).

Students from the Southwest region (N = 2 participants with 17 features mentioned) again identified rocks/boulders the most within the survey (n = 8, 47%), but the next highest features mentioned were mountains (n = 2, 12%), earthquakes (n = 2, 12%), and volcanoes (n = 2, 12%). Again, the last region with more than one student, West North Central region (N = 2 participants with 25 features mentioned), discussed rocks/boulders the most in the surveys (n = 6, 24%). Of their responses, the next most popular geologic features/events/items mentioned were earthquakes (n = 3, 12%) and fossils (n = 3, 12%).

When looking across regions at the occurrence of different geologic features/items/events within the student surveys, more patterns were observed. Overall, mountains were mentioned by the West region (n = 7, 39% out of 18 features) and the Southeast region (n = 15, 16% out of 95 features) the most. This is not surprising because mountain ranges such as the Rockies and the Appalachians are prevalent features throughout much of the West and the Southeast, and many of the students who described mounts were from the mountainous areas of these regions. Though coastal and mountainous areas of the Southeast are very different, they were all included in the original regional map as a part of the Southeast region. Future studies may benefit by further disseminating areas within each region to more specifically identify home region features. Students in the West made statements such as, "The geologic process I learned the most about from practical experiences in my childhood was mountain building." A student from the Southeast when asked what geologic formation her town was famous for stated, "we are the foot of the app. mountains."

Volcanoes, on the other hand, were discussed by students from the West (n = 3, 17% of 18 features) and Southwest (n = 2, 12% of 17 features) regions the most. One student from the Southwest, when asked about her favorite geologic process, described her fascination with volcanoes, "I always thought volcanoes were neat, especially when I learned the mountains around my hometown were dormant volcanoes."

As might be expected, beaches/oceans were discussed the most by students from the Southeast (n = 15, 16% of 95 features) and the South (n = 7, 7% of 99 features) regions. Students from the South region continually brought-up beach and ocean related products such as "sand" and "seashells" throughout the survey, and one student in the essay simply stated, "Growing up in South Mississipi [*sic*] you only see mountains on TV or in books. I love the ocean and the beach." Students from the Southeast also continually mentioned "waves hitting the beach," "collecting seashells", and typically stated, "The geological process I learned the most about from practical experiences in my childhood was the weathering, erosion and deposition of the beach. After one of our hurricanes the beach disappeared and in the next year it was back." Interestingly, students from the East North Central region also had 7% (n = 30) of the total landforms/processes/features mentioned (out of 44) focused on beaches. The main difference in this region was the description of Great Lakes beaches verses ocean beaches. One student stated, "My memories revolve around walking the beaches of the Great Lakes during Summer vacations looking for the fossil..."

Lakes and rivers were also commonly described within the surveys. As might be expected due to the prevalence of lakes and rivers in these areas, students from the Central (n = 32, 21% of 151 features) and the East North Central (n = 9, 20% of 44 features) regions described experiences with lakes and rivers the most. One student from the central region described her experiences with the flooding of rivers near her home town, "The geological process I learned most about from practical experiences in my childhood were the happenings of the floodplains. We lived close to three fairly large rivers and every couple years there would be some sort of flooding. Most people in our community were farmers, so often is was a very devastating time. Living in that area, I realized that rivers don't stay in one place, they move around over hundreds of years in that flat area between the bluffs. We didn't really have big river bluffs like I've seen in some other places, but there was a definite difference in height of the land outside of where that particular river had changed course." On the other hand, students from the East North Central region, which included the great lakes region of Minnesota, Michigan, and Wisconsin that are often known for the many glacial lakes, made statements involving these features:

> "Water - Minnesota is known for The land of 10,000 lakes" and, "Growing up, I swam a lot - and mostly in lakes. The area that I lived had one lake after another; it seemed as though you couldn't skip a rock without hitting another lake. The tall tales that we read in school told about how Paul Bunyan used to work in the area, and the lakes were left-over from him walking around. As fantastic as this sounded, I knew there was more to the story of the lakes than a over-sized logger. Later in school when we were taught that our lakes were a result of melting glacier, and the bluffs were from the same, I loved to envision the landscape frozen and underwater when we drove in the countryside. Who knew what the land would look like in another 10,000 years."

Oddly, the West region also noted 17% (of 18 features) of the students' responses towards rivers/lakes. After closer review it became apparent that all comments were directed towards rivers with specific comments like,

> "It was one of the very best days of my childhood, and it involved the creek that flowed behind my house. My brother and I decided to try to find where the headwaters of the creek was. We had only been a short ways up the creek in the past, so we packed a lunch and started on what we thought was a short hike. Soon we were in unchartered territory. The channel narrowed and the walls of the creek increased. We came to the waterfall and to pass it we had to forge a new

> path along the walls towering above the torrents below. My brother decided to cross using the flying lead approach. In two bounding steps, he crossed, the dirt where he stepped crashing down below. I was more cautious. I tentatively starting crossing and started falling down. It was a huge drop and I would have been killed if I fell. I clawed at the dirt and moved across the path. My brother found a stick and attempted to have me grab it. Eventually, I made it across, completely filthy. We continued up the creek and made it a beautiful lake in a meadow. We decided it was worth the life threatening journey to get to such a unique place."

Not surprisingly, the only students that mentioned glacial processes were those originally from the Northeast (n = 4, 3% of 131 features mentioned), the Central (n = 4, 3% of 151 features mentioned), and the East North Central (n = 1, 2% of 44 features mentioned) regions. These areas were all recently (geologically speaking) glaciated. Students from these regions made comments such as, "The gelogical [*sic*] process I learned the most about from my practical experience in my childhood was glacial formations. I grew up in an area that was carved out by retreating glaciers during the last ice age" and, "The marks from a glacier were unusual."

Students from the Southwest (n = 2, 12% of 17 features) and the West North Central (n = 3, 12% of 25 features) mentioned earthquakes the most, while students from the Central and the West regions did not discuss earthquakes at all in the surveys. Students from the Southwest and West North Central regions indicated personal experiences with earthquakes such as, "I did experience feeling a small earthquake in high school. It was a long distance away but strong enough to see things sway in the house where I live," and, "I know I've experienced quite a few earthquakes, but I only remember one from about two or three years ago. It sounded like something heavy was being pushed across the floor." It is important to note that the students who grew-up in the West and the Central regions did not live near active fault zones that have experienced any recent earthquakes. Earthquakes are a common occurrence in certain areas of the West region such as the San Andreas Fault, but not all areas of the West lie on recently active faults. Though there is a major fault, the New Madrid fault, that underlies an area along the Mississippi river just north of Memphis and portions of the Central region, it has not been active during current generations. Students who had personal experiences with earthquakes appear to find these interesting enough to remember and report on the experience.

All regions mentioned rocks and boulders a great deal throughout the surveys, but the Southwest (n = 8, 47% of 17 features), Northeast (n = 38, 29% of 131 features), and the Central (n = 40, 26% of 151 features) saw the highest number of references to rocks and boulders. All of these areas contain visible rock outcrops. This is also a more difficult feature to analyze due to the prevalence of questions geared towards the descriptions of rocks or boulders.

Specific descriptions and experiences with caves and karst features were mentioned the most by the South (n = 10, 10% of 99 features), the East North Central (n = 3, 7% of 44 features), and the Northeast (n= 3, 2% of 131 features). Multiple students in the South region stated "caves" when asked about exotic geological locations that made a big impression on them, or when asked about the most unusual rock, landform, or geologic process that they experienced. One student from the South also listed caves as the geologic landform that they were afraid of as a child. Portions of the South region are known for karst related features while other areas of the south are devoid entirely of surficial karst features. The absence of these features close to home may be a reason for the students to describe them as "exotic." It is also possible that caves in general, even for those in regions with karst features, could be considered an "exotic" feature simply due to the mysterious nature of these underground landforms. Stories listed in the essays, such as the one below, suggest that the students from the South who mentioned karst features had personal childhood experiences with them,

> "It was one of the very best days of my childhood, and it involved visiting the caverns located in San Antonio area. I remember the importance of not touching the walls of the cave because the oil from our hands would ruin the cave walls. I was fascinated by the stalactites and stalagmites, but I did not understand what they really were at the time. After finishing the tour I remember thinking how the earth was so fascinating and wanting to learn as much as I could about the environment."

Students from the East North Central and the Northeast regions also described caves as a favorite exotic landform, and they relayed experiences with caves within their region such as Mammoth Cave National Park in Kentucky and Howe's Caverns, NY. One student described his experience in Howe Caverns in the essay that stated,

> "It was one of the very best days of my childhood, and it involved the landform called Howe's Caverns. This natural underground cave fascinated me as a child and I can vividly remember the look, smell and feel of the cave. I really enjoyed the portions that were so narrow you had to turn sideways to move through, since

at the time, it made me really feel like an explorer. At the end of the cavern is a river where the tour guides take you on a small boat ride, and at one point, they turn off all the lights in the cave. I have never in my been [*sic*] in such pure darkness as I had in those caves. I found it fascinating and slight [*sic*] frightening at the same time. I had the chance to return there as an adult and still found it fascinating even though my education level had vastly improved."

Though the percentages of participants discussing karst features such as caves was not as high as other features, the descriptions given by the participants was extremely detailed. As is evident by the very detailed student essay listed above, these cave experiences appeared to have a lasting impression. The essays, when compared to other landform features, were both longer and more detailed. It is possible that these students described more detailed experiences because, as the student above mentioned, the cave experience that they had elicited a feeling of both excitement and fear. Commercial caves and National Park caves also often include guided tours that allow the visitors to learn more about the geologic experience. These two factors may play a role in the detail accounts of students. This should be investigated further in future studies.

Cliffs and bluffs were a feature noted the most by the East North Central (n = 4, 9% of 44 features) and the West North Central (n = 1, 4% of 25 features) regions. Interestingly, cliffs and bluffs were either seen as scary features, or fun features. Students relayed stories such as, "it was fun to walk the trails along the river bluff," and, "There were some bluffs nearby our house that we liked to climb up and pick blueberries. We could see our lake andour [*sic*] town in the distance." Other students stated, “Edgeds [*sic*] of very high cliffs,” when asked about geologic features that they were afraid of as a child.

Throughout the surveys, students mentioned specific State and National Parks that enchanted them geologically as a child. The Grand Canyon appeared to have the largest impact on students from the Northeast (n = 10, 8% of 131 features), West North Central (n = 2, 8% of 25 features), and Southeast (n = 6, 6% of 95 features) regions. All of these students described the impact a visit to the Grand Canyon had on their overall geology experiences as a child. Students made statements such as, “One of the best days of my chilhood [*sic*]was visiting the Grand Canyon. Theres [*sic*]nothing more awe striking and impresive [*sic*]enough to make the hairs on your arm stand up! The beauty and excitement of such sight is humbling,” and, “i [*sic*]lived in the city so it was all usual stuff until I [*sic*] went to the grand canyon [*sic*].” Most of the students from these regions discussed the Grand Canyon in their essays such as,

> “It was one of the very best vacations of my childhood because it involved the southwest US. Growing up in New Jersey I had a very different life than all my cousins and family did growing up in the Midwest. My parents are originally from Colorado and Utah. Every other year we would camp our way out west for a vacation. We would see the family in both states but we would also add new sites to our trips. One year we decided to go south, through the Canyon lands and to the Grand Canyon. It was so cool to see all these cool things that nature made. We didn’t have any hand in it, nature did it and did it better than anything we could have done. Not only did we see cool things in the parks, which was expected, but the drive was amazing. All the red rocks, the mountain passes and the amazing

formations. Trying to figure out what each formation looked like was one of our favorite past times. What a fun trip that was. So very different than the world of New Jersey that I lived in. I think this is one of the reasons I still love going to see nature's works in my everyday life."

Interestingly, none of the students from the Southwest or the West regions, those closest to the Grand Canyon, mentioned the Grand Canyon in the surveys. All of the students that were most impacted by the Grand Canyon described it as an "exotic" place. Those that have been to the Grand Canyon can testify to the amazing beauty of the place, but it is not by any means the only unique and beautiful place, or even canyon, in the Southwest United states. The Southwest United States is filled with amazing geologic features. Students from other parts of the country may have never experienced such raw geology because other areas of the country are covered by vegetation and overlying sediments. Students from the Southwest did mention other National Parks within their region such as Bryce Canyon, Zion, and Craters of the Moon as having an effect on their geology experiences as a child. The students that mentioned these other National Parks lived (and currently live) closer to these parks than to the Grand Canyon. They mentioned visiting these other parks with family members.

Fossils were predominantly noted by students in the West North Central (n= 3, 12% of 25 features), East North Central (n = 5, 11% of 44 features), and the Central (n = 16, 11% of 151 features) regions. Fossils can be found in sedimentary rocks, and sedimentary rocks dominate portions of these regions. Students in these regions described personal experiences within the region involving fossils such as, "It was one of the very best days of my childhood, and it involved the landform, fossil bed. We were on a family vacation and along the drive to Chicago we were going to take a side trip to the Ashfall's fossil bed in Nebraska. Getting to see real scientists at work in my home state was never forgotten and was one of the main motivations to become a science teacher." One student stated, "I didn't collect much, but I did have a few trilobite fossils that I had found in a quarry." Intriguingly, a species of trilobite is the state fossil where he grew-up.

Though the Southeast and South regions described oceans and beaches the most, they did not specifically use the term "sand" as much as the West North Central (n = 2, 8% of 25 features), East North Central (n = 3, 7% of 44 features), and the Southwest (n = 1, 6% of 17 features) regions. Remarkably, all of the students that referenced "sand" specifically in these regions associated sand with "playtime" either in a sand box, or during arts and crafts activities. One student, when asked about a geologic product that was an important part of "playtime" commented, "Sand! I was always playing in our sandbox when I was outside." None of these students described specific experiences with in situ sand locations such as beaches.

Finally, students in the Southeast (n = 11, 12% of 95 features), South (n = 9, 9% of 99 features), and Northeast (n = 12, 9% of 131 features) regions discouragingly referred to non-geology related topics throughout the surveys. It became apparent that at least four of the students from these regions were primarily interested in the meteorology aspect of the content. For instance, when asked about their favorite geologic landforms typical responses were, "storms", "weather", and "I was never a person interested in most geological features, only when it impacted me. The only time that was during Hurricane Hugo." These statements are discouraging for geology instructors of the TIG program, but they can be encouraging for instructors involved in the meteorology portion of the TIG program.

Conclusions

When these results are compared to the data and results from in-person classes that were researched in the 2006 study by Clary and Wandersee, “A Writing Template for Probing Students’ Geological Sense of Place,” it becomes clear that the overall geologic sense of place for the student body in the online setting is vastly different from the in-person setting. The geologic backgrounds of online students were varied and unique, showing regional similarities, while the students from the in-person class identified a homogenous student group with very similar geologic backgrounds (Clary and Wandersee, 2006). These findings add to the importance of this study and the understanding of online students’ geologic backgrounds. In order to build on a students’ existing geologic knowledge, it is essential for online instructors to first be able to evaluate pre-existing knowledge in an efficient and effective manner.

CHAPTER VI

METEOROLOGICAL SENSE OF PLACE DATA AND RESULTS

Methods

It was determined through content analysis (Neuendorf, 2002) that the students within the study had varying meteorological backgrounds. The survey responses can be found in Appendix D. Considering the diverse geographic backgrounds of these students, these results are not surprising. Each question of the surveys was analyzed for overall themes, and then further analyzed for the geographic similarities and differences between students within the themes. Throughout the surveys the 54 students (N=54) that were a part of the study often gave more than one answer or description to each question. Weather, unlike climate, changes both daily and seasonally, especially in the midlatitudes. The continental United States, our area of study, is situated in the midlatitudes. Students often gave multiple responses to each question, which may reflect seasonal differences within the region that they grew up in. Therefore, each question includes a description of the coding system in order to better represent the multiple responses given by students.

Data and Results

When the students were asked about their favorite childhood weather event, many of the students could not narrow their statement to just one weather event. There were 71 events coded. The majority of the students described thunderstorms, storms, or rainstorms (n = 29, 41% of the 71 coded answers). The next most common answer given was snow or winter weather (n = 18, 25%). The vast majority of students from the Northeast listed snowstorms as a favorite event (n = 9 of the 14 Northeastern students, 64%). Out of the total 18 students that described snow events in their answers, only 5 of them grew-up in Southern states (n = 5, 28% of 18), while 61% of the students that mentioned snow as a favorite event were from a northern region. The remaining 2 students were from the Central region (n = 2, 11% of total). The students from the Southern states that did report snow events were from areas where snow is rare, but it has been known to happen occasionally.

Students were then asked why they chose a specific favorite weather event. Interestingly, all 3 of the students that said they enjoyed "cooling off" were from the South region and were talking about rain events. Snow events brought school closers (n = 10, 12%), and the students enjoyed playing in both the snow and the rain (n = 14, 16%). Students also found the events fascinating (n = 12, 14%), and they enjoyed watching the weather events (n = 12, 14%).

Some students also gave more than one answer when asked to describe a weather event that they feared as a child. There were 59 total coded responses. Students feared thunder, lightning, or thunderstorms in general the most as children (n = 23, 39%), but tornadoes came in a close second (n = 21, 36%). Interestingly, no students from the West, Southwest, or Northwest listed tornadoes as a fear. Tornadoes are not prevalent in these regions of the country. On the other hand, 7 of the 13 participants from the Central region (n = 7, 54%), 5 of the 9 students from the South region (n = 5, 56%), 2 of the 3 students from the East North Central region (n = 2, 67%), and 2 out of 2 students from the West North Central region (n = 2, 100%) all listed tornadoes as a childhood fear. They were also mentioned as a fear by 3 students of the 8 from the Southeast (n = 3, 38%), and 1 student out of 14 from the Northeast (n = 1, 7%). All of the regions with over 50% of the students fearing tornadoes have consistent records of tornado touchdowns each year. Figure (6.1), illustrates tornado touch down day per year throughout the continental United States, and gives a visual representation of regional differences in tornado frequency. This figure was taken from Brook et. al., 2003. Some of the students who listed tornadoes as a fear have personal experience with tornadoes and mentioned accounts such as, "Yes. Had a tornado hit my neighborhood in Michigan. We didn't suffer major damage, but others did...," or, "We had a tornado come right by our house and hit our neighbor's house."

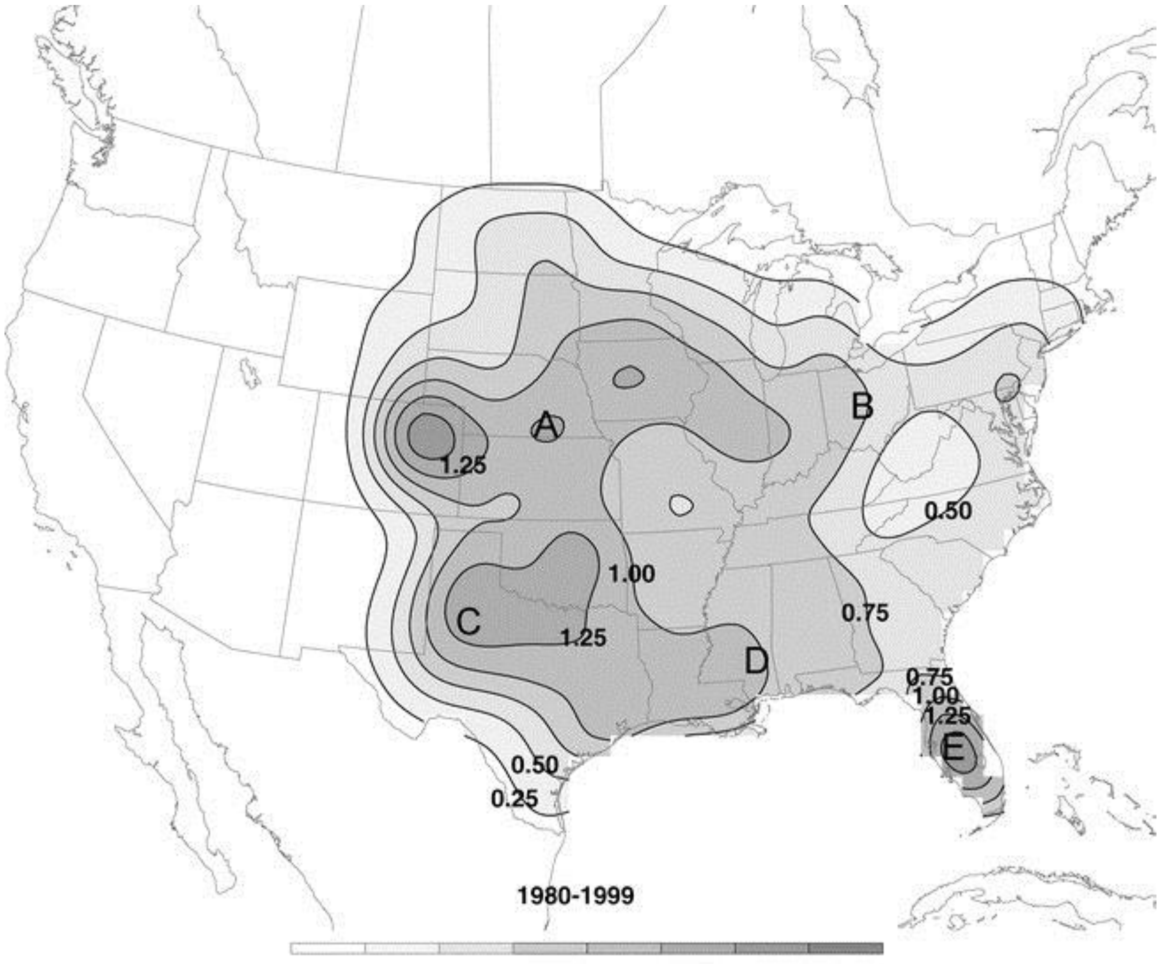

Figure 6.1 Number of Days that Tornadoes have touched Down Each Year 1980-1999

Tornado touch down days per year adopted from Brooks et al., 2003

The majority of students (n = 48, 89% of 54 students) listed at least one weather event that they will not forget. The top response was a blizzard or snowstorm (n = 14, 26%), hurricanes came in a close second at 22% (n = 12) of the total responses, and tornadoes were third with 17% (n = 9) of the total responses. The different events listed by students were then analyzed by region and some interesting themes were discovered with this question. Both of the students who described an ice storm that they will never forget were from the Central region. This area of the country is more susceptible to ice storms than other areas of the country (Hauer et al, 2006). The majority of the students that mentioned blizzards or snowstorms were from either the Northeast (n = 5 students) or the Central (n = 4 students) regions. Out of the 14 total students from the Northeast, 36% (n= 5) of them described a major snow event, and out of the 13 students from the Central region 31% (n = 4) of them described a snow event. All southern regions combined (South, Southeast, and Southwest) only had 3 students (one from each region) who, described a snow event. Considering the number of snow days received in the northern regions verse those in the southern regions, it is not surprising that the students from the northern and central regions described snow events more often in their answers.

On the other hand, 5 students out of 8 from the Southeast, and 4 out of 9 students from the South described a hurricane as the major event that they will never forget. There were also 3 out of the 14 students from the Northeast who mentioned hurricane or tropical storm events. Interestingly, no other students described an experience with hurricanes or tropical storms. The South and Southeast regions receive the most impacts from hurricane and tropical storm forced winds, and the Northeast region is also somewhat impacted by tropical storm and hurricane forced winds (Vickery et. al., 2000).

It is also interesting to note that tornadoes were again not mentioned by any students who grew-up in the West, Northwest, or Southwest regions of the country. As is noted in figure 6.1 showing the average touch down of tornado days per year (from 1980-1999), these regions of the country rarely experience tornadoes (Brook et. al., 2003). Instead, tornadoes were mentioned by students from the Central region (n = 5, 38% of the 13 students in that region), the South region (n = 2, 22% of the 9 students in that region), and one student each from the Northeast and the East North Central regions mentioned tornadoes. Students from the Central and Southern regions recalled events such as, "The tornado that hit our cousin's house on the same street as our house and it ripped the roof off. Our cousins lived with us for awhile." The Central and South regions are associated with Tornado Alley and Dixie Alley respectively. The history of these terms is outline in, "A Historical and Statistical Comparison of "Tornado Alley" to "Dixie Alley,"" a study comparing the frequency of tornados in these areas of the country (Gagan et. al., 2010). The term "Tornado Alley was first seen in an article in the Tinker, OK Air Force Base newspaper in 1953, and Mr. Alan Pearson, a former NSSFC director, claims to have coined the term Dixie Alley in a *USA Today Weather* article after working the 1971 Mississippi Delta tornado outbreak (Gagan et. al., 2010). The exact locations of both Tornado Alley and Dixie Alley are not exact, and are dependent on selected attributes by the authors of scholarly articles. In general, Tornado Alley represents a region in the central area of the country sometimes referred to as the Great Plains, and Dixie Alley consists of an area from Louisiana and Arkansas over to Central Georgia (Gagan et. al., 2010).

Most of the students (n = 32, 59% of 54 students) did not have parents with jobs that were dependent on the weather. Of the 22 students that did associate at least one of their parent's jobs with a weather dependent occupation, the jobs ranged from construction workers and farmers to teachers and emergency related fields.

Of the 32 students who read about specific weather events, the majority of them chose tornadoes (n = 12, 38%) and/or hurricanes (n = 9, 28%) to entertain them. When the categories were further vetted for regional interests, lack of consistency within regions was observed. It appears that students from all over are interested in reading about tornadoes and hurricanes, and students from every region have different reading interests.

The majority of students did not partake in weather dependent crafts (n = 37, 69% of total participants). It is interesting to note that many students may have misinterpreted and made comments about the phrase, “weather dependent” crafts. Rewording this question to say weather “related” crafts may give different results. Students who did remember creating weather dependent crafts (n= 17) described crafts such as, “Snowmen mainly,” “I made spin wheels and tried to make kites,” and, “I did enjoy making different types of forts and tunnels when it snowed.” Some students did interpret the question to mean weather related crafts and made comments such as, “Snow globes, cut out snowflakes [*sic*], tornado in a pop bottle, sun shadow pictures.”

Unfortunately, Most of the students (n = 35, 65% of total), did not have a weather mentor. Of the students that did have weather mentors (n = 19), 26% (n = 5) of them stated that their father mentored them, and another 26% (n = 5) of them stated that a teacher mentored them. Interestingly, another 21% (n= 4) of the students with mentors described a local or national weather person whom they enjoyed watching as a weather mentor. Other mentors included mothers and other family members.

Interestingly, out of the 54 participants, 25 (46%) either did not watch weather shows as a child, or said there were no weather shows to watch when they were children. Of the 22 students that listed specific weather related TV broadcasts, 27% (n = 6) said they watched the Weather Channel, and another 27% (n = 6) said that they enjoyed simply watching the daily weather forecasts. There were no patterns across regions.

When students were asked to describe memories of rain, 49 participants gave specific answers. The storms themselves were the main memory described by students (n = 13, 27%). Other students (n = 9, 18%) mentioned memories of playing in the rain, while 16% (n = 8) of the students describing rain memories discussed seasonal rain events, and another 16% (n = 8) discussed the effects of rain such as flooding. The students were also asked to discuss the smell of rain that they most remembered. Of the 46 students that gave specific responses, the vast majority (n = 31, 67%) described the smell of rain clean or fresh. Only 3 students (7%) remembered the smell of rain in a negative manner describing a moldy or sewage smell. Neither the memories of rain nor the smell of rain appeared to be distinct to any region.

The students gave a vast array of descriptions associated with the sound of rain that they remembered. Many of the students described different types of rain and the memories of each type; therefore, 72 responses were coded for this question in relation to the sounds of rain that the students remembered. The most prevalent descriptions for rain were loud or pounding (n = 16, 22% of total 72 responses) and the sound of thunder (n = 16, 22% of responses). Another 14% (n = 10) remember the pings and pellet noises on the roof, and only 6% (n = 4) remember the sounds of rain to be peaceful, quite, or soothing. The answers were coded for regional differences, but the only interesting finding was that 6 of the 14 students from the Northeast region described the sound of thunder.

When asked to describe a perfect weather day, the majority of responses (n = 20 of the 68 coded responses, 30%) were geared towards sunny warm to moderate days. Some students specified a temperature in the 70's Fahrenheit range. Many students listed multiple types of weather that they preferred, often based on the season, so there were 68 responses that were coded for the 54 respondents. Interestingly, all of the participating students from the East North Central region (3/3) indicated enjoying warm sunny days in the 70's Fahrenheit. The sunny days during the summer in the North East Central region are typical of this type of weather.

The next highest response (n = 12, 18%) for a perfect weather day was a cold day below 32 degrees Fahrenheit, after it snowed. Of the 12 students that responded liking snow days, 5 of them were from the Northeast. Surprisingly, 38% (n = 3) of the students from the Southeast stated that they liked snow days. Not surprisingly, only 33% (n = 4) of the 12 students who liked snow days were from southern regions.

Most of the students (n = 28, 53% of the respondents) stated that they did not fully understand humidity as a child. Interestingly, 20% (n = 11) of the respondents simply stated that they were "used to it," or made statements like, "In Houston, TX, you know what humidity feels like! I didn't really understand it, but I knew it felt awful, everyone complained about it, and it made the downtown skyscrapers sweat." Of the 9 students who grew-up in the South region, 44% (n = 4) of them stated that they were "used to" humidity, or related that it was a common experience. On the other hand, the only students that claimed humidity to be a non-issue where they grew-up were students from the Southwest, West, and Northwest regions. As can be seen in the map in Appendix E, areas of these regions are known for being dry with very little humidity throughout most of the year.

When describing a typical summer day where they grew-up, the students often mentioned a variety of weather types. Out of the 90 coded responses, the most prevalent description included blue or sunny skies (n = 40, 44%). The next most prevalent memory of summer skies included some clouds or partly cloudy skies (n = 24, 27%). Of the 7 students that described afternoon thunderstorms, all of them grew-up in the South (n = 2) or the Southeast (n = 5) regions. Florida and parts of the South and Southeast regions have rainy seasons in the summer that include afternoon showers. These showers are common and predictable. One student from Florida wrote,

> "As stated earlier, we could set our clocks by the thunderstorms in the summer. We would have partly cloudy skies until about 4pm, and then the Eastern horizon would begin turning dark and ominous. By 6pm, the storms would make their way to our house – nearly every day. This happened from mid-June through mid-September. The smell was of rain."

Students were also asked to describe a typical smell of summer, but a large portion of the students (n = 22, 41%) could not think of a typical smell, or they did not list a smell that sparked their memory. Of the 32 students who described a particular smell, 47% (n = 15) of them expressed some sort of vegetation as being the primary scent that they remembered. The smell of the beach, ocean, or bayou was the next most commonly mentioned odor (n = 6, 19%), and all of the students who described this smell grew up near the coast.

When discussing winter skies, the majority of the students (n = 32, 52%) described skies that were gray, overcast, or gloomy. The only students who specifically mentioned snow (n = 7 students) were all from Northern or Central regions. Again, many of the students (n = 24, 44%) could not recall a typical winter smell. Both of the students who distinctly remembered the smell of salt on the roads in the winter were from the

Central region, and both of the students who indicated, "it smelled like it was ready to snow," grew-up in the Northeast.

Not surprisingly, students from the Northern and Central regions had more insightful and vivid memories of the words "wind-chill." The need to dress warmer or wear more layers was the most common response for the participants overall (n = 12, 22%), but students from Northern and Central states made more specific comments such as, "Horrible, horrible things. Many times we wouldn't be allowed outside even in snow suits because of low temperatures and wind chill…" All of the students (n = 9) who described memories of "wind-chill" what meant it was too cold to go outside, or the cancelation of school, were from the Northern (n = 5) and Central (n = 4) regions. On the other hand, 22% (n = 12) of the students surveyed either did not remember the words wind-chill from childhood, or they stated that it was not an issue where they grew-up and made comments such as, "Not much! It wasn't very cold in Houston!" Not surprisingly, 75% (n = 9) of these 12 students spent their childhoods in Southern regions. Predictably, of the 7 students who described the words "wind-chill" as invoking memories of bitter cold or really cold weather, all of them were from Northern (n = 5) or Central (n = 2) regions. One student from a Northern region described remember "wind-chill" as, "That it meant is was REALLY cold outside – the tip of my nose would feel prickly and my parents would wrap a scarf tightly around my neck. I would look like a stuffed chicken on wind-chilled days."

Sadly, when asked about typical activities that they participated in as a child that were weather dependent, 3 students responded they did not go outside much as children or could not remember any. Of the remaining students (n = 51), many of them reported specific cold weather or snow related activities (n = 24, 47% of participants); while over half of the participants (n = 27, 53%) recalled some type of warm weather activity. As might be expected, 41% (n = 21) of the participants specifically mentioned an organized sporting activity such as baseball or softball. Not surprisingly, out of the 24 students that reported cold weather or snow dependent activities, 21 of them grew-up in Northern (n = 13) or Central (n = 8) regions. Shockingly, a very similar pattern was established when looking at warm weather activities. Of the 27 students who described warm weather activities such as beach trips, swimming, or riding bikes, 13 of the students were from Northern regions, 8 were from the Central region, and only 6 were from Southern regions. Interestingly, all of the students that do not remember weather related activities, or spending much time outdoors were from Southern regions. Many of the other students from Southern regions were less specific and stated "playing outside" or "sports" as weather dependent activities. It is unclear why the students from the Northern and Central regions may have discussed a greater number, and more specific outdoor activities. It is possible that the lifestyles and cultures of these regions may play a role in the lack of outdoor activities mentioned by students from Southern regions. According the Center for Disease Control, in 2013 Mississippi had the highest obesity rate, and all of the South and Southeast states accept for Florida, North Carolina, and Virginia had self-reported rates of obesity between 30-35% (CDC, 2013). It is unclear whether this is a culture phenomenon, or if it is also due to weather conditions in the area, or other factors such as economics. It is possible that the extreme heat in these areas may play a factor in the lack of outdoor activities mentioned by students.

As might be expected, of the 7 students who stated that they did not have memories that involved snow, 6 of them were from Southern regions. Oddly, the one student from the North who stated "no" for snow related childhood memories later went on to describe a large snow event in the essay portion of the survey. On the other hand, all of the 13 students who described having lots of snow memories and making statements such as, "LOTS of them!!! Many of my memories revolve around very snowy days," were from regions known for snow (Northern n = 9, Central n = 3, and West n = 1). Not surprisingly, 7 out of the 9 (78%) students from the South region had very few memories of snow, and could often list one specific event such as, "Snowed two days my 5th grade year and we were able to stay home and play in the slush." The other two students from the South region had no memories of snow.

The participating students had varying memories of how wind felt. The most common response (n = 20, 37%) described wind as being sharp, bitter, or cold. As expected, of the students who utilized these adjectives to describe the feeling of wind (n = 20), 40% (n = 8) of them were from Northern regions, and only 25% (n = 5) of them were from a Southern region. On the other hand, all 4 students who describe winds as hot, humid, and sand blown were from the South region. Not surprisingly, a large percentage (n = 6, 60%) of the 10 students who described wind as feeling cool and refreshing were from Southern regions. Interestingly, 17 students stated or implied that the feeling of the wind depended on the season. Interestingly, 82% (n = 14) of these 17 students were from Northern or Central regions that experience pronounced seasons. States in the North and Central regions typically have four distinct seasons with greater ranges of temperature than states in the South and Southeast regions.

There were an impressive amount of interesting stories related in the two essays by the students (Appendix D). Only 10 out of the possible 108 spaces for essays were either left blank or recorded a non-response such as, “I do not remember much about the weather.” In the essays students were asked to complete any of 6 different “take-off” sentences such as, “My memories revolve around….” Students were asked to complete one of the same 6 “take-off” sentences for both of the essays. The two most prominent take-off sentences chosen were “The weather process I learned the most about from practical experiences in my childhood was….,” and, “It was one of the very best days of my childhood, and it involved the weather event called…” with 28 responses each.

The students who responded to the take-off sentence, “The weather process I learned the most about from practical experiences in my childhood was….,” listed a large number of different processes that they remembered from childhood experiences. The most common essays revolved around thunderstorms or severe storms (n = 7, 25%), and the second most common experience listed by students involve hurricanes and tropical storms (n = 5, 18%). All of the students that described hurricanes and tropical storms as being the weather process they learned the most about through childhood experiences were from either the South (n = 2) or the Southeast (n = 3) regions where hurricanes and tropical storms are common yearly occurrences (Vickery, 2000). The only 2 students that mentioned experiences with snow and blizzards were both from the Northeast, and all 3 of the students who specifically discussed lake effect snow were from regions associated with the Great Lakes (Northeast, Central, and East North Central).

Students who responded to the take-off sentence, “I had been warned about the . . . (weather event), but I didn’t….,” most commonly discussed tornadoes (n = 5, 33% of 15 students). According to the NOAA tornado frequency map per county in Appendix E, all of these students grew-up in regions where tornadoes are common (South (n = 2), West North Central (n = 1), and Central (n = 2)). These students related stories such as, "The weather process I learned the most about from practical experiences in my childhood was a tornado. I experienced a tornado that missed our home by a few hundred yards or so. There were trees down everywhere and we were without power for a few days so we camped out." The next most common response involved hurricanes. All 3 students that had been warned about hurricanes were from coastal areas in the South, Southeast, and Northeast regions. All of these regions commonly experience hurricanes and tropical storms. The risk of these storms is most prevalent in the South and Southeast, but they also occur in the Northeast with less frequency (Vickery et. al., 2010).

The majority of weather events that students remembered being featured in stories involved tornadoes (4 students). Out of these 4 students, 3 of them recounted the story of The Wizard of Oz. Interestingly, all three of these students grew-up in the Central region. The Wizard of Oz takes place in Kansas. The regional map used for this research does not include Kansas within the Central region, but it is a boarder state to the Central region.

Of the 14 students who responded to the take-off sentence, "When I think of my grandmother/grandmother/father/mother, the meteorological phenomenon, weather event, or occurrence I associate most with that person is the," 64% of them described events related to one or both of their grandparents. Interestingly, out of the 4 students who recalled events associated with their fathers, 3 of them were from the Northeast region.

Most of the students who responded to the take-off sentence, "It was one of the very best days of my childhood, and it involved the weather event called . .„" mentioned a snow event. Interestingly, more students from Southern regions (n = 7) than the northern regions (n = 5) discussed snow events. Students from these Southern regions appeared to describe rare, fun events, such as, "It was one of the best days of my childhood, and it involved the weather event called snow. In the south, we rarely had snow and for it to snow one year for Christmas, it was a joy." On the other hand, students from the Northern regions described routine events such as, "One of the very best days of my childhood, was any day that we had a snow day. I've never been a very big fan of snow, but if it got me out of school, I would definitely take the opportunity to play in it."

Only 7 students responded to the take-off sentence, "My memories revolve around….." Out of these 7 students, 4 of them discussed hurricanes/tropical storms, and all of these students were from hurricane/tropical storm prone regions (South n =1), Southeast n = 1), and Northeast n = 2)). Students from these regions made comments such as, "Hurricane marked my youth. In the '60 we had four of them that caused alot [*sic*]of damage in Texas." The only two students who stated their memories revolved around snow were from the East North Central and the Northeast regions. Finally, the only student who discussed hot summers as a primary memory was from the South.

Conclusions

The online students who were involved in this survey had varying childhood experiences that may have impacted their previous knowledge and way of understanding the weather. Patterns were found within regions throughout the survey, but the most significant result was the overall lack of consistency between the students' experiences. This is evident in the essays given by the students that describe very specific weather events that related to personal experiences. As mentioned earlier, certain areas of the country are more susceptible to specific weather events such as tornadoes and hurricanes. Students from these regions of the country specifically discuss experiences with these types of weather events while students from other areas of the country may not mention them at all throughout the survey.

Both the Geological Sense of Place surveys and the Meteorological Sense of Place surveys showed regional differences between the students, but certain areas were more pronounced. For instance, the Meteorological Sense of Place survey allowed for more distinctions between regions for each of the questions that were asked. This distinction was not as pronounced in the Geologic Sense of Place until the overall surveys were coded for specific features. One possible reason for the discrepancy between the results of the two surveys is the fact that the regional map that was utilized by the researcher to define the different regions is a NOAA climatological map often used by meteorologists to define weather regions. This map may have been better suited to define the differences in weather between the regions than the differences in geology. We did still see differences between the regions in geology, but there also appeared to be more within region differences depending on the location of the students. For instance, the Southeast region consists of both the coastal zone as well as the Appalachian Mountains. Geologically speaking, these areas consist of completely different environments. In order to better define the regional differences for geology students, it may be appropriate to use a different regional, geology based, map for the students to define a home region.

CHAPTER VII

END OF YEAR ONE SURVEYS DATA AND RESULTS

Methods

Surveys were administered to students [N =27] following the end of year one. The surveys were only administered to students who completed Geology I at the end of the first year and they can be found in Appendix H. All but two of the students responded to the survey resulting in N=25 total responses. If the students followed the suggested schedule that allows them to graduate in two years they should have completed Meteorology I and Geology I, or approved advanced course substitutes with a demonstrated background in these areas. These surveys asked questions regarding the students' experiences in both Meteorology I and Geology I. Surveys were then coded following content analysis methods in order to discover overall themes (Neuendorf, 2002).

Data and Results

When students were asked about a favorite content area in Geology I, content dealing with geologic hazards was the dominant response (n = 10, 40%). Rocks and minerals (n = 7, 28%) and plate tectonics (n = 6, 24%) were the next most enjoyed content areas.

Interestingly, when asked why the students preferred a certain content area the ability to relate the material to past or present experiences was the most prevalent response (n = 8, 32%). Students made statements such as, “I enjoyed having an in depth experience in volcanoes and earthquakes. I live in an area that has active and dormant]volcanic [*sic*] activity and very high tectonic activity. I could apply what I learned to features located nearby,” and, “Oceans and shorelines- Living in florida [*sic*] my entire life and frequently visiting the coast, it was interesting to better understand the processes that shape the shorelines and affect the waves.” Other main reasons for choosing a particular geology content topic included usability in real life (n = 4, 16%) and because the topic was cool/radical (n = 4, 16%). When describing usability in real life students made comments such as, “The geologic hazards portion was my favorite because not only do we learn about the geologic hazards, but it also prepares us for real life scenarios,” and, “I enjoy the material and exercises with Topographic maps. My undergraduate degree is in Geography and I work in an industry that utilizes various types of mapping. Plus my hobbies are hunting, fishing, camping, etc and I utilize topographic maps for those activities as well. “The potential relationship between usability in real life and having past or present experiences related to the topic should be noted. Both of these categories encompass real life experiences and could be associated with a student’s geologic sense of place and underlying way of knowing.

Not surprisingly, when students were asked what homework/project/activity they liked the most in the Geology I course the overwhelming response was rocks and minerals (n = 19, 76%). For this activity the students actually received rock and mineral kits in the mail. Utilizing the procedure they learned in the course, students were required to identify the different rocks and minerals. The next most mentioned homework/project/activity was the activity dealing with topographic maps (n = 2, 25%). Applicability to past and present experiences (n = 7, 29%), Hands-on activity (n = 7, 29%), and the use of critical thinking skills (n = 6, 25%) were the dominant responses for why the students chose these particular activities. Students made comments such as,

> "I liked finding out more about glaciers through the glacier lab. I have spent a good bit of time in the Adirondacks, an area that has been thoroughly shaped by the last glaciation. I now have a better understanding of the different erosional and depositional glacial features I have experienced in the past,"
>
> and, "I liked the rock/mineral identification the most because it was hands-on and it made the material more relevant." It is again interesting to note that the students continued to relate favorite homework/project/activity with personal experiences and applicability to real life situations.

When students were asked to identify a favorite content area in the Meteorology I course the two main areas described were extreme weather (n = 7, 32%) and Midlatitude Traveling Cyclones (n = 6, 21%). The students seemed to have a broader range of interests in the meteorology material than the geology material as they mentioned 11 separate main areas of interest as opposed to the 7 main areas of interest in geology (Table 7.1).

Table 7.1 Students Interests After Year One

Geology	Meteorology
Interests	**Interests**
beach/water processes	Severe/extreme Weather
Erosion	Midlatitude Cyclones
Glaciers	atmospheric stability
Rocks/Minerals	Global circulation
Plate tectonics	condensation/precipitation
Geologic Hazards	El Nino
Mapping	Observable conditions
	Inversions
	Winter weather
	Weather charts
	Didn't enjoy anything

Geology and Meteorology interests of students after year one of the TIG program.

The majority of students chose a favorite topic because it was practical for past and present experiences or could be used daily (n = 13, 59%). Comments were made such as, "I loved learning about winter weather. Living in Boise, Idaho, I think that is the thing that I learned that applies most to where I live. We don't get a lot of severe weather here, but we do get some interesting winter weather occasionally," and, "In Meteorology 1, I enjoyed studying mid-latitude cyclones because they impact our daily lives." The next most noted reason for choosing a favorite topic was the informative aspect that allowed students to learn more about a topic they may not have known about before (n = 3, 14%). One student stated, "I enjoyed learning about all of the severe weather. It is something that often takes over the news (and can be blown out of proportion), so to be able to have the scientific knowledge to evaluate it as much as I can is beneficial."

The dominant homework/project/activity that the students enjoyed the most in Meteorology I was the fourth quarter homework assignment (n = 13, 52%). This assignment involved making observations of the student's local weather for a certain number of days, comparing it to another location (Starkville, MS in 2012 and Memphis, TN in 2013 course), and then making forecasts for the areas. The next most mentioned activity involved the identification of symbols on forecast maps (n = 3, 12%).

Not surprisingly, students most commonly identified a favorite topic because it was applicable to daily life or practical (n = 10, 40%). A typical comment made by a student in this category was, "Meaningful application makes this subject come alive." Student also enjoyed having a better understanding of a certain topic (n = 6, 24%), or they found that the activity brought everything that they learned in the course together (n = 4, 16%). One student stated, "I think the final homework assignment (4th quarter), where we did a 3 day analysis of our local weather and the weather in Starkville, MS along with upper air analysis was probably the best way to wrap up our course. That final assignment took all of the principles and topics we learned throughout the year and had us apply them to the assignment. This pretty much brought everything together for me as I applied my lessons to real-life weather scenarios…."

Conclusions

As is evident in the preceding data and results, there are a few dominant themes that can be identified throughout the surveys for both meteorology and geology questions. Students continually associated favorite topics with past and present experiences. These experiences may vary depending on the geographic location of the student. Therefore, students identified a vast array of favorite topics, but there is a consistent pattern observed in the reasons for choosing the favorite topics across both subject areas. When taking a closer look at the students' favorite homework/projects/activities, an interesting pattern is also observed. For both subject areas, the majority of students chose one particular homework/project/activity. Both the rock and mineral identification activity for geology and the observation forecasting activity for meteorology required hands-on activities that were applicable and related to past and present experiences. These assignment qualities are important to note for the creation of future online work.

Table 7.2 The Number of Survey Participants By Region at the End of Year One

End of Year One Survey Participants	
Regions	n
Central	7
Southeast	4
Northeast	3
East North Central	2
West North Central	1
Southwest	1
Northwest	1

End of year one number of participants by region

Due to the small number of participants per region, it was difficult to determine if these patterns were more prevalent in certain regions. As can be seen in table 7.2, there were not enough people in many of the regions to run any true comparisons between regions. Students were given the opportunity to take this survey in the Geology I course. If students took courses out of order, dropped the program, or were not in Geology I during the spring of their first year, they were not included in the survey. In order to determine regional difference between Geology and Meteorology preferences more data will need to be collected over a much longer period of time. The data that we do have indicates that the preferences appear to not be regionally dependent, but more data may reveal greater regionally dependent preferences.

CHAPTER VIII

COURSE GRADES RESULTS AND DISCUSSION

Methods

The assessment scores for both Meteorology I and Geology I of the TIG program were analyzed using a repeated measures test in SPSS software, and a Bonferroni adjustment was applied to reduce the possibilities of Type-I errors. These tests were performed in order to determine the relationships between the different assessments and whether or not certain assessments garnered high or lower means scores. This should help determine if certain assessments may have been harder or easier overall than other assessments. This could also help us to further understand larger variations within certain assessments for the overall group of students. There were N=31 participants who completed the Geology I course between the fall of 2012 and the spring of 2014, and there were N=52 participants who completed Meteorology I between the fall of 2012 and the spring of 2014. The tests yielded interesting results for both the Meteorology I course assessments and the Geology I course assessments.

Results

Figures (8.1, 8.2) below represent the distribution of mean values for the assessments in the Meteorology I and the Geology I TIG courses for the fall of 2012 to the spring of 2014. Table (8.1) reports the meaning of each assessment value. Overall, the quiz grades have higher relative means than the assignments, midterm, and the final exams. Specific areas of significance are found in Appendix F.

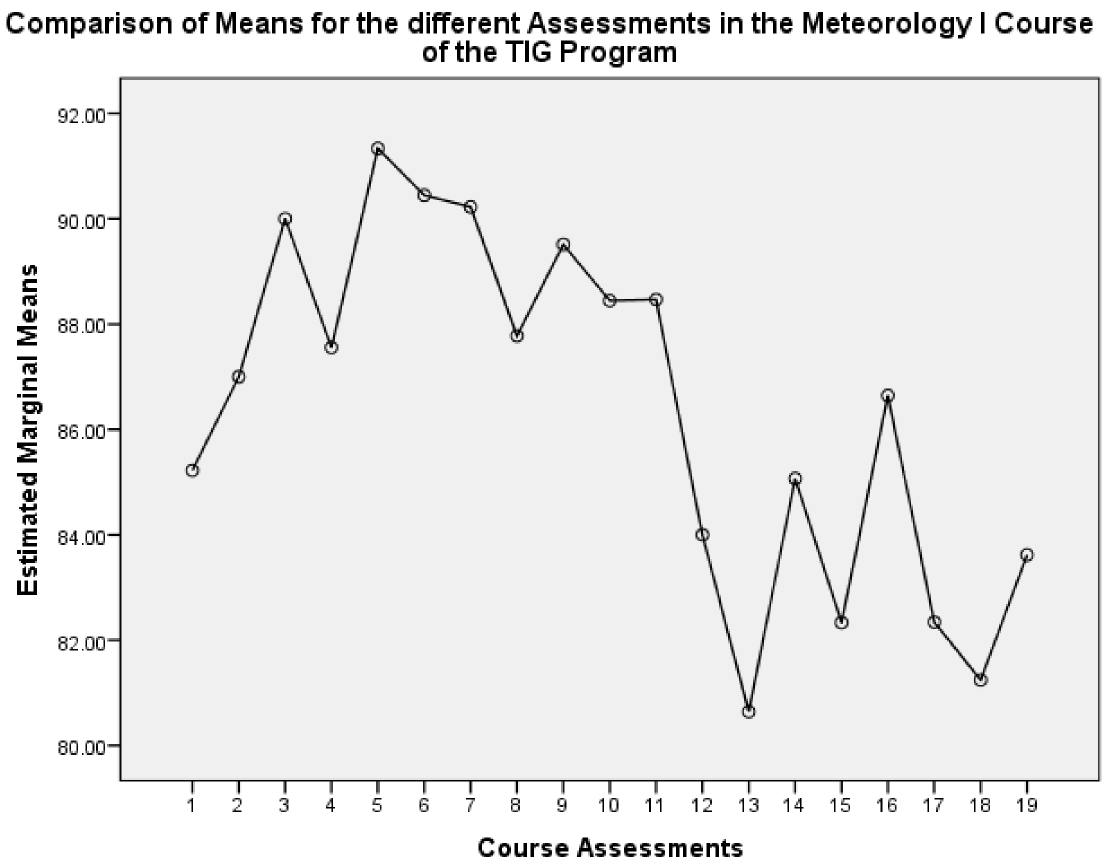

Figure 8.1 Comparison of Means for Meteorology I Assessments

Mean values for assessments from Meteorology I courses from the fall of 2012 to the spring of 2014.

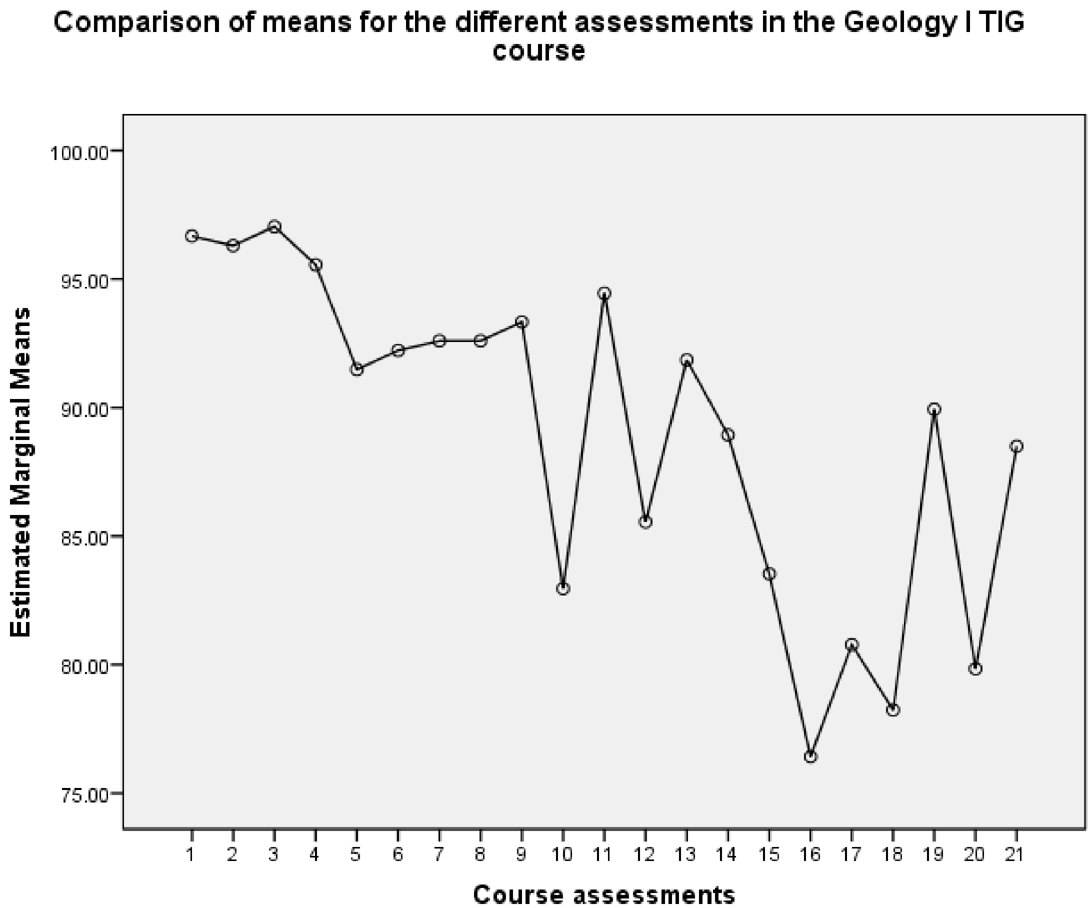

Figure 8.2 Comparison of Means for Geology I Assessments

Mean values for assessments from Geology I courses from the fall of 2012 to the spring of 2014

Table 8.1 Assessment Key for Figures 8.1 and 8.2

Geology Assessment Key		Meteorology Assessment Key	
Graph value	**Assessment**	**Graph Value**	**Assessment**
1	Quiz 1	1	Quiz 1
2	Quiz 2	2	Quiz 2
3	Quiz 3	3	Quiz 3
4	Quiz 4	4	Quiz 4
5	Quiz 5	5	Quiz 5
6	Quiz 6	6	Quiz 6
7	Quiz 7	7	Quiz 7
8	Quiz 8	8	Quiz 8
9	Quiz 9	9	Quiz 9
10	Quiz 10	10	Quiz 10
11	Quiz 11	11	Quiz 11
12	Quiz 12	12	Quiz 12
13	Mineral Quiz	13	1st Quarter Homework
14	Rock Quiz	14	2nd Quarter Homework
15	1st Quarter Homework	15	3rd Quarter Homework
16	2nd Quarter Homework	16	4th Quarter Homework
17	3rd Quarter Homework	17	Midterm
18	4th Quarter Homework	18	Final Exam
19	Midterm	19	Final Grade
20	Final Exam		
21	Final Grade		

Key for Figures 8.1 and 8.2 assessment names.

In order to determine the differences in mean assessment score values between the regions where students call “home,” Kruskal-Wallis ranking tests with an alpha of 0.05 were run in SPSS for each assessment. This non-parametric statistical analysis was performed multiple times for each assessment. The first time, all regions with two or more students were included in the test. The Kruskal-Wallis tests is known for being robust, but it is generally accepted to require at least three or more participants within a given category for more accurate results. Therefore, the test was run again for each assessment, and only regions with three or more students were included in the analysis (n=6 for Meteorology I) and (n = 3 for Geology I). Table (8.2) illustrates the number of students within each region for each of the courses.

Table 8.2 Number of Students Per Region in Geology I and Meteorology I

Geology I		**Meteorology I**	
Region	**n**	**Regions**	**n**
Central	12	Central	13
East North Central	2	East North Central	3
Northeast	6	Northeast	13
South	2	South	5
Southeast	5	Southeast	9
Northwest	1	Northwest	2
Southwest	1	Southwest	3
West	1	West	2
West North Central	1	West North Central	2

Meteorology I is typically one of the courses that an incoming TIG student will take during the fall of their first year. Specific Meteorology I assessments do show significance between certain regions. Table (8.3) represents the overall Kruskal-Wallis statistical values for each assessment. There was a significant difference in assessment scores between regions for Quiz 3, Quiz 4, Quiz 7, and Quiz 11. Quiz 3 shows significance between regions' assessment scores ($X^2(5) = 13.129$, $p = 0.022$), with a mean rank assessment score of 37.0 for the East North Central Region, 28.00 for the Northeast Region, 26.77 for the Central region, 15.61 for the Southeast region, 15.10 for the South region, and 14.00 for the Southwest region. Quiz 4 also indicates significant differences in assessment scores between regions ($X^2(5) = 12.846$, $p = 0.025$), with a mean rank assessment score of 22.0 for the East North Central Region, 30.88 for the Northeast Region, 23.42 for the Central region, 11.12 for the Southeast region, 24.30 for the South region, and 17.50 for the Southwest region. Quiz 7 values in assessment scores between regions show, ($X^2(5) = 18.683$, $p = 0.002$), with a mean rank assessment score of 31.50 for the East North Central Region, 33.35 for the Northeast Region, 19.04 for the Central region, 14.44 for the Southeast region, 28.0 for the South region, and 11.83 for the Southwest region. Finally, Quiz 11 values in assessment scores between regions show, ($X^2(5) = 14.033$, $p = 0.015$), with a mean rank assessment score of 37.0 for the East North Central Region, 31.96 for the Northeast Region, 20.15 for the Central region, 16.5 for the Southeast region, 19.10 for the South region, and 16.17 for the Southwest region. It is important to note that there was no significance found between regions for the overall final grade in the course.

Table 8.3 Kruskal-Wallis Values for Meteorology I Assessments

Assessment	Chi-square value	df	p-value
Quiz 1	7.074	5	0.215
Quiz 2	1.743	5	0.883
Quiz 3	13.129	5	0.022
Quiz 4	12.846	5	0.025
Quiz 5	3.758	5	0.585
Quiz 6	1.455	5	0.918
Quiz 7	18.683	5	0.002
Quiz 8	4.843	5	0.435
Quiz 9	3.310	5	0.652
Quiz 10	8.712	5	0.121
Quiz 11	14.033	5	0.015
Quiz 12	6.643	5	0.249
1st Quarter Homework	8.133	5	0.149
2nd Quarter homework	2.753	5	0.738
3rd Quarter Homework	7.058	5	0.216
4th Quarter Homework	1.758	5	0.882
Midterm	8.768	5	0.119
Final Exam	8.852	5	0.115
Final Grade	9.192	5	0.102

Statistical values of a Kruskal-Wallis test on each of the Meteorology I assessments. Assessments 3, 4, 7, and 11 show between region statistical significance.

In order to determine where the significance lies between the regions, a pairwise comparison was run and a Bonferroni adjustment was utilized to reduce Type-I errors when interpreting results. Pairwise comparison tables (8.4, 8.5, 8.6, 8.7) for each of the assessments showing significance were created to represent overall significance, and significance after the Bonferroni adjustment was applied. The adjustment, though limiting Type-I error is robust and can increase the chances of a Type-2 error (the acceptance of the null-hypothesis when it should be rejected). Therefore, both the unadjusted and the adjusted p-values for the regional pairwise comparisons are listed in the tables. A more detailed description of the assessment contents will be examined in the discussion section.

Table 8.4 Pairwise Comparisons For Meteorology I Quiz 3

Regional comparison	Test Statistic	Standard Error	Standard Test Statistic	p-value	adjusted p-value
Southwest-South	1.100	9.308	0.118	0.906	1.000
Southeast-Southwest	1.611	8.497	0.190	0.850	1.000
Southwest-Central	12.769	8.163	1.564	0.118	1.000
Southwest-Northeast	14.000	8.163	1.715	0.086	1.000
Southwest-East North Central	23.000	10.406	2.210	0.027	0.406
Southeast-South	-0.511	7.109	-0.072	0.943	1.000
Central-South	11.669	6.707	1.740	0.082	1.000
South-Northeast	12.900	6.707	1.923	0.054	0.816
East North Central-South	-21.900	9.308	-2.353	0.019	0.279
Southeast-Central	11.158	5.527	2.019	0.043	0.652
Southeast-Northeast	12.389	5.527	2.242	0.025	0.375
Southeast-East North Central	-21.389	8.497	-2.517	0.012	0.177
Central-Northeast	-1.231	4.999	-0.246	0.806	1.000
East North Central-Central	-10.231	8.163	-1.253	0.210	1.000
East North Central-Northeast	-9.000	8.163	-1.102	0.270	1.000

Pairwise comparison table indicating comparisons between specific regions for Quiz 3. Both the p-value and the adjusted p-values using the Bonferroni adjustment are provided.

Table 8.5 Pairwise Comparisons For Meteorology I Quiz 4

Regional comparison	Test Statistic	Standard Error	Standard Test Statistic	p-value	adjusted p-value
Southeast-Southwest	-6.375	8.533	-0.747	0.455	1.000
Southeast-East North Central	-10.875	8.533	-1.274	0.203	1.000
Southeast-Central	12.298	5.664	2.171	0.030	0.449
Southeast-South	13.175	7.185	1.834	0.067	1.000
Southeast-Northeast	19.760	5.664	3.489	0.001	0.007
Southwest-East North Central	4.500	10.291	0.437	0.662	1.000
Southwest-Central	5.923	8.073	0.734	0.463	1.000
Southwest-South	6.800	9.205	0.739	0.460	1.000
Southwest-Northeast	13.385	8.073	1.658	0.097	1.000
East North Central-Central	1.423	8.073	0.176	0.860	1.000
East North Central-South	2.300	9.205	0.250	0.803	1.000
East North Central-Northeast	8.885	8.073	1.101	0.271	1.000
Central-South	-0.877	6.633	-0.132	0.895	1.000
Central-Northeast	-7.462	4.944	-1.509	0.131	1.000
South-Northeast	6.585	6.633	0.993	0.321	1.000

Pairwise comparison table indicating comparisons between specific regions for Quiz 4. Both the p-value and the adjusted p-values using the Bonferroni adjustment are provided.

Table 8.6 Pairwise Comparisons For Meteorology I Quiz 7

Regional comparison	Test Statistic	Standard Error	Standard Test Statistic	p-value	adjusted p-value
Southeast-Southwest	2.611	8.390	0.311	0.756	1.000
Southwest-Central	7.205	8.060	0.894	0.371	1.000
Southwest-South	16.167	9.190	1.759	0.079	1.000
Southwest-East North Central	19.667	10.275	1.914	0.056	0.834
Southwest-Northeast	21.513	8.060	2.669	0.008	0.114
Southeast-Central	4.594	5.457	0.842	0.400	1.000
Southeast-South	13.556	7.019	1.931	0.053	0.802
Southeast-East North Central	-17.056	8.390	-2.033	0.042	0.631
Southeast-Northeast	18.902	5.457	3.464	0.001	0.008
Central-South	-8.962	6.622	-1.353	0.176	1.000
East North Central-Central	-12.462	8.060	-1.546	0.122	1.000
Central-Northeast	-14.308	4.936	-2.899	0.004	0.056
East North Central-South	-3.500	9.190	-0.381	0.703	1.000
South-Northeast	5.346	6.622	0.807	0.419	1.000
East North Central-Northeast	1.846	8.060	0.229	0.819	1.000

Pairwise comparison table indicating comparisons between specific regions for Quiz 7. Both the p-value and the adjusted p-values using the Bonferroni adjustment are provided.

Table 8.7 Pairwise Comparisons For Meteorology I Quiz 11

Regional comparison	Test Statistic	Standard Error	Standard Test Statistic	p-value	adjusted p-value
Southeast-Southwest	0.333	8.576	0.039	0.969	1.000
Southwest-South	2.933	9.394	0.312	0.755	1.000
Southwest-Central	3.987	8.239	0.484	0.628	1.000
Southwest-Northeast	15.795	8.239	1.917	0.055	0.829
Southwest-East North Central	20.833	10.503	1.984	0.047	0.710
Southeast-South	2.600	7.175	0.362	0.717	1.000
Southeast-Central	3.654	5.578	0.655	0.512	1.000
Southeast-Northeast	15.462	5.578	2.772	0.006	0.084
Southeast-East North Central	-20.500	8.576	-2.390	0.017	0.252
Central-South	1.054	6.769	0.156	0.876	1.000
South-Northeast	12.862	6.769	1.900	0.057	0.862
East North Central-South	-17.900	9.394	-1.905	0.057	0.851
Central-Northeast	-11.808	5.046	-2.340	0.019	0.289
East North Central-Central	-16.846	8.239	-2.045	0.041	0.613
East North Central-Northeast	-5.038	8.239	-0.612	0.541	1.000

Pairwise comparison table indicating comparisons between specific regions for Quiz 11. Both the p-value and the adjusted p-values using the Bonferroni adjustment are provided.

A Kruskal-Wallis statistical test was also run for each of the Geology I assessments. Students now typically take Geology I in the spring semester of their first year in the TIG program, but some opt to finish the meteorology courses first. We had a smaller number of total participants who finished the Geology I (n = 31) course than the Meteorology I (n = 52) course over the same time period. Due to the lack of numbers in certain regions, only 5 of the regions had 2 or more individuals to make comparisons between regions, and only 3 regions had 3 or more students to make comparisons. Unlike the Meteorology I assessments, the Geology I assessments showed no overall significance between the regions. Content areas for quizzes do suggest that certain quizzes, such as quizzes six and seven, list geographically specific concepts. But they may be broader concepts with less locational specificity than some of the meteorological topics and questions. For instance, quiz six encompasses concepts involved in deserts, wind, glacier and glaciation, and quiz seven tested the students on concepts regarding oceans and shorelines. Table (8.8) illustrates the statistical values for the different Geology I assessments.

Table 8.8 Kruskal-Wallis Values for Geology I Assessments

Test/assignment	Chi-square value	df	p-value
Quiz 1	2.322	2	0.313
Quiz 2	2.849	2	0.241
Quiz 3	0.117	2	0.943
Quiz 4	2.357	2	0.308
Quiz 5	0.863	2	0.650
Quiz 6	0.266	2	0.876
Quiz 7	1.708	2	0.426
Quiz 8	1.514	2	0.469
Quiz 9	1.908	2	0.385
Quiz 10	2.298	2	0.317
Quiz 11	4.285	2	0.117
Quiz 12	0.633	2	0.729
Mineral Q	1.828	2	0.401
Rock Q	0.631	2	0.730
1st Quarter Homework	4.010	2	0.135
2nd Quarter homework	1.765	2	0.414
3rd Quarter Homework	2.022	2	0.364
4th Quarter Homework	0.672	2	0.714
Midterm	2.993	2	0.224
Final Exam	1.043	2	0.594
Final Grade	0.966	2	0.617

Statistical values of a Kruskal-Wallis test on each of the Geology I assessments. No assessments show between region significance.

Discussion

When the Meteorology I and Geology I course assessment were analyzed using a repeated measures test it became clear that there were differences between the mean scores of individual assessments. As one might expect, the final comprehensive exam for both of the courses garnered one of the lowest mean values. It also became apparent that the homework assignments and midterm exams may have been more challenging for the students than the weekly quizzes. It is important to note that the quiz protocol was a possible reason for this difference in scores. Quizzes were open book and there were no time limits.

Though there was overall significance between certain assessments within the Meteorology I course, it is interesting to note that the individual assessments that showed regional significance were either not significant when compared to any other assessment overall, or only showed significance when compared to the final exam and the first quarter homework (refer to Appendices 8.1 and 8.2). The final exam and the first quarter homework had the lowest overall mean scores (80.644 and 81.244 respectfully) when compared to all other assessments. The four assessments that showed between region significance had mean scores that were neither the lowest or the highest when compared to all other assessments (Quiz 3 = 90.00, Quiz 4 = 87.556, Quiz 7 = 90.222, Quiz 11 = 88.467) suggesting that these four assessments were neither more or less challenging to the students overall when compared to other course assessments.

The final course grades were also included in the Kruskal-Wallis tests in order to determine if one region simply scored higher overall in the course than another region. If this were the case, it could be argued that there are many variables that could contribute to this variation in student abilities. For instance, students from one region were potentially smarter or simply more motivated than students from another region, or they could have been better prepared due to previous college courses and/or teaching experience in the subject matter. No significance between regions was found when the final course grades were analyzed, rejecting the hypothesis that one region may have "better" overall students than another region.

To better understand why students from one region might score significantly higher or lower than students from another region, a closer look at the assessments themselves is necessary. Quiz 3 encompassed concepts such as radiation, heating/cooling, and temperature. The questions focused on atmospheric concepts involving energy radiating to the earth from the sun, and back out to space. It also looked at questions involving temperature ranges between different geographic locations. One such question was stated, "Based on the concepts covered in Lecture #3, which of the following cities should have the greatest range between the average temperature in January and the average temperature in July?" Answers included, Miami, FL, Omaha, NE, San Antonio, TX, New York, NY, and Los Angeles, CA. There were also questions about daily heating and cooling of the atmosphere, the albedo effect, urban heat island effects, and reasons for geographic temperature differences. Interestingly, everyone from the East North Central region scored 100% on this particular quiz. This region scored significantly higher (without the very robust Bonferroni correction), than students from the Southwest, the South, and the Southeast regions. Students from the Northeast also scored significantly higher than students from the Southeast on this assessment. Because the researcher did not have full access to each course, it cannot be determined exactly which questions each student got wrong. It is still interesting to note that students from the southern regions scored more poorly on this assessment than those from some of the northern regions which experience marked seasonal changes in temperature and radiative heating throughout the year. Other possible explanations for this significant difference cannot be ruled out, but it should be noted that the one region where every student scored 100% on this assessment shows great seasonal radiative changes, producing large ranges in temperature, and snow events occur during the winter months (potentially helping with the understanding of the albedo effect).

Quiz 4 focused on atmospheric moisture, water phase changes, and Latent heat. The list of question included ones like, "Frost is an example of____?" With possible answers including: "Deposition, Evaporation, Sublimation, Transpiration, and Infiltration." Students from the Southeast scored significantly lower on this quiz than students from the Northeast and Students from the Central region. Even when the Bonferroni adjustment was used, students from the Southeast region still scored significantly lower than students from the Northeast region. Again, there are many possible explanations for this significant difference in scores between these two regions. It is possible that the students from the Southeast region simply did not study as much for this particular quiz as students from the Northeast region. It is also possible that the phase changes of water are more noticeable throughout the year for a students from the Northeast region and the Central region than students from the Southeast region.

Quiz 7 was geared towards the examination of precipitation processes, and different forms of precipitation. This quiz had multiple questions that pertained to precipitation that may typically be found in specific regions, but not others. For instance, there were multiple questions involving snow and other types of frozen precipitation such as sleet and freezing rain that is more commonly seen in northern regions. These included questions such as, “Which of the following statements are true regarding the measurement of snow fall?” Answers included, “Snow depth is often measured taking several readings using a calibrated stick, The ratio of snow to water is constant at exactly a 10:1 ratio, Usually only the snow depth is measured and recorded, All of the above, None of the above.” Students not familiar with frozen forms of precipitation may have a harder time with questions like this one. Students from the Southeast, Southwest, and Central region may not be as familiar with different forms of precipitation as students from the Northeast and the East North Central regions. Students from the Northeast region scored the highest of the regions overall, and students from the East North Central region also performed well on this assessment. Even with the Bonferroni correction, students from the Northeast region still performed higher on this quiz than students from the Southeast region.

Finally, quiz 11 discussed different air masses, fronts, and mid-latitude cyclones. Many of the questions on this quiz mentioned specific locations. The quiz also encompassed specific weather events that only occur in certain regional settings such as Lake Effect snow. One question asked, “Why are Marquette, MI, Rochester, NY, and Buffalo, NY among the snowiest cities in the United States?” Answers include: cP air crossing the Great Lakes during the winter warms and acquires moisture from below, and then produces lake effect snow in the lee of the lakes, mP air from the North Atlantic is forced upward by the extreme topography of the area, Alberta Chinooks bring frequent heavy snow squalls to this entire region, mT air crossing the Great Lakes during the winter cools and acquires moisture from below, and produces lake effect snow in the lee of the lakes, because these cities are close to Canada." Other questions included air masses moving over snow covered areas, weather associated with cold fronts and warm fronts, occlusions (which typically start out near the center of a low pressure system), and other specific geographic air mass questions. Students from the East North Central region (which surrounds most of the Great Lakes, and see most of the above mentioned air masses and fronts) all scored 100% on this quiz. Students from the Northeast, located next to the East North Central region (refer to Figure 3.1) and receiving much of the same weather systems, also scored high on this quiz. Students from the Central, Southeast, and Southwest regions all scored significantly lower on this quiz. The Central region does include a few small areas around the Great Lakes that would be included in the "Snow Belt", but all of the cities mentioned in this particular question were either in the East North Central region or the Northeast region. The other two regions do not see lake effect snow events, and some of the other air masses and occluded fronts may not be as typical.

None of the Geology I assessments showed between region significance. There are a few possible reasons for the lack of regional significance in this course as compared to the Meteorology I course. First, there are less survey participants that completed this course in the allotted time frame. The only regions with three or more participants were the Northeast, the Southeast, and the Central regions. These regions do have different some different geologic features, but they all include portions of the Appalachian Mountains, and none of them are none for active tectonic areas like the West and the Southwest. The differences may not be as great between these regions as other regions.

If this study were run over a 10 year period, significance between regions for both courses may increase. It is also possible that the Meteorology I course offered more regionally specific questions in the assessments than the Geology I course. Finally, it is possible that many of the weaker students that participated in the original surveys did not make it through Meteorology I with a B or higher grade. The TIG program is a graduate program that requires the students to obtain a B or higher in order to "pass" the course. It is possible that the students who made it to Geology I were better overall students, and therefore, there were not as many differences between the grades for any of the regions.

CHAPTER IX

FIELD INTERVIEWS AND OBSERVATIONS

Methods

Due to attrition and students taking longer to complete the program by opting to take one course at a time as opposed to two, out of the original 24 students who participated in all of the fall 2012 surveys, only 6 students were eligible to participate in the interview process during the summer of 2014. These students were able to select one of 5 potential field based capstone courses to attend in order to complete the requirements of the TIG program. Of the 6 students eligible for interviewing, 4 of them elected to participate in the Upstate New York field experience trip. The researcher was also able to attend this field based geology experience in order to interview and observe the students in a field setting. All 4 of the students agreed to continue participation in the study, and all 4 were interviewed both during and at the completion of the field experience. The students' birthdates covered four different age ranges, 1956-1960, 1961-1965, 1966-1970, and 1981-1985, which depicts a good representation of the overall TIG population. The 4 students that were willing and able to participate in the interview were superior students in the TIG program. It is also important to note that all of the subjects that were interviewed were females. Out of the 6 possible interview subjects 5 of them were females. The only possible male subject went on the Washington capstone trip. The total population of the TIG program by sex is skewed towards the female side with

65 females, 46 males, and 4 unknown (did not specify), students that entered the program in the fall of 2012 and 2013. This is still a skewed representation of the TIG program. The researcher recognizes that these 4 students are not in themselves a comprehensive representation across the TIG program. Though the interview results are a skewed representation of capability and gender, valuable information can still be gleaned from the field interviews and observations.

Each student was interviewed in a hotel room during the field course free time (typically in the evenings). The participants were each given a pseudonym in order to keep the identities of the students confidential and to better organize the data and results. It is important to note that the students mainly appeared interested in discussing the pros and cons of the TIG program itself, and they had to be directed to discuss just the questions that were being asked. The interviews were audio and video recorded with the permission of the students, and the researcher then transcribed them (Appendix G). The interviews were then coded in accordance with narrative summary analysis. This analysis revealed geographic differences between the students, but it also revealed similarities in certain aspects.

Data and Discussion

The pseudonyms given to the students were Laura, Nancy, Mary, and Karen. Each of these students shared a different experiential background that may have influenced the students' experiences within TIG program. The students' unique stories allow us to further understand geographic attachments throughout the students' lives. For instance, Laura moved a great deal as a child, and she falls into the 1956-1960 age range. Laura spent her childhood in seven different geographic locations from coast to coast, and she collected rocks at all of these locations. Laura's favorite place was, and still is, Lake Okoboji, Iowa where she spent much of her summers both as a child and as an adult. It appears to be the only constant in a life full of moves. Based on both her interview response, as well as her survey responses, her primary sense of place is a little harder to define than the other students' primary places. Though she currently lives in the South region (Houston, TX), her memories describe events primarily in the West (California) and the East North Central (Iowa) regions. It is interesting to note that during the interview, as well as during the field experience, she continually made comparisons with the geology and referred to the area around Lake Okoboji, Iowa, as well as other areas within the East North Central region. She was a more vocal student on the capstone trip, so more communications and observations were available to the researcher for interpretation. It should also be noted that Laura has an undergraduate degree in geology and worked as a geologist in the oil field for many years. Her husband still works in the oil industry. She has a great deal of practical geologic experiences that other students may not have. She currently teaches math at a local community college and hopes to be able to teach geology and geography when she completes the TIG program.

Unlike Laura, Nancy did not move a lot, but she did make one major move as a child. Nancy falls into the 1966-1970 age range. She moved from rural West Virginia to the Bay area of California. Most of Nancy's original survey responses were memories from her earlier childhood in West Virginia, but she continued to go back and forth between California and West Virginia throughout the interview when describing her experiences. She also made it clear that her activities changed a great deal with the move to California. Nancy's memories in West Virginia revolved around outdoor activities of her youth, but she stated, "They pretty much ceased," when describing her outdoor activities after moving to the Bay area of California. She has experienced more of California's geology as an adult living in a more rural area of California. Nancy, once a K-12 teacher and now an administrator and teacher educator, has taken many field trips with teachers in the area to learn about earth sciences and the geology of her local area. She also participated in field trips and courses put on by the local community college to learn more about the geology of California. Nancy described the area that she has lived most of her adult life as, "….it's just like West Virginia except it doesn't have humidity. And so it's just like being back home."

Karen falls into the 1960-1965 age range. She did not move around a great deal as a child, but she did travel all over the country during the summer months. Her summer memories revolved around trips out west with her family so that her father could conduct geology research, and her favorite travel destination as a child was the Grand Canyon. Karen did not describe too many of these memories during her interview unless prompted, or within her original surveys. She primarily discussed her childhood in the Northeast (western New York State) where she spent a great deal of time outdoors with her geology professor father, and her current place of residence in the Southeast (Virginia). She moved around extensively as an adult, but again, her comments focused on her time as a child in the Northeast and her current home in the Southeast, where she has spent the most time as an adult. Karen described her favorite place to live as an adult as Virginia, her current location, because, "I love the topography. We're in the foothills of the Blue Ridge Mountains, the Pepper basin, the Piedmont. We're close to DC. We get snow in the winter now and then. Summers are brutal, but not as bad as Louisiana." She has also been able to spend a lot of time outdoors in this location as an adult. Interestingly, she made it very clear in both the interview as well as the surveys that she was not a rock collector, and she did not collect rocks at her favorite place as a child. Karen's brother and her father collected rocks, and she mentioned that her house was like a rock museum. Karen also has her undergraduate degree in geology and once worked as a geologist in the oil industry. Her husband is still in the oil industry.

The fourth student, Mary, has never lived outside of her home state. Mary falls into the 1981-1985 age range. Besides the four years she spent as an undergraduate, she has lived within the same three county area. Mary did travel some as a teenager, but she primarily spent time in the Northeast region, even on vacation. Her memories in both the interview and the surveys revolve around her time in the Northeast region, and she defines "home" as being in the Adirondacks even though she is from New Jersey. Throughout the interview and in her survey answers, she describes many outdoor activities that she remembers doing in the Adirondacks on family vacations. Mary is a current K-12 science teacher who hopes that this degree will qualify her to expand her teaching abilities and allow her to teach earth science.

When asked where they enjoyed spending time as a child, all 4 students gave responses favorite places that differed geographically, yet all 4 of the students could remember being very active in outdoor endeavors at these locations throughout the continental United States. It is interesting to note that all 4 of these students were also able to remember specific geologic items that they used to play with at these locations, or that they were aware of as children. Karen may have been more aware of her geologic setting due to the fact that her father was, and her brother is now, a geology professor. During the interview and in the original Sense of Place surveys she mentioned her father taking her family along with students on field trips around her favorite location to look at the geology.

It is also interesting to note that when discussing outdoor activities, Karen, who grew-up in the Snowbelt region of the United States, primarily described snow related activities such as skiing and tobogganing. The other 3 students, even those from locations where it snows, focused on warmer weather related activities such as canoeing and playing in creeks.

All of the students were able to recall typical weather in the location where they lived or spent a great deal of time during childhood. They were also all able to recall the geologic setting of their favorite places. When asked whether or not they could have described the geologic background of their favorite places prior to the TIG program Karen and Laura stated that they definitely could, and Karen added, “I guess it’s kind of cheating with your dad as a geologist…” It is also important to note that the two students who stated “yes” to this question have undergraduate geology degrees and were actually practicing geologists.

Mary and Nancy stated that they could at least partially describe the geologic background prior to the TIG program. Mary stated,

> “I really, prior to TIG, would say…. Adirondacks were my favorite place, and so I knew at least about the glacial past of the Adirondacks. I didn’t necessarily know about all of the orogenies that necessarily happened that would’ve caused the mountain building events that yielded all of the different mountains. And I knew

that the lakes were mostly due in part to glacial activity that had happened around 11, 000 years ago when the Wisconsin glacier started to recede."

Both of these students have taught earth science course in a K-12 setting, but neither of them have been practicing geologist.

Thankfully, all 4 students felt that they learned more geologically about their favorite place after participating in the TIG program. The two students, Laura and Karen, who were practicing geologists in the past both stated that they felt they gained a more recent understanding of these places, due to changes in the geology field, but they also stated they got more out of learning in the TIG program. The two students who currently work in school districts, Mary and Nancy, both felt that they had a better holistic understanding, and Mary felt her understanding of her favorite place was continuing on the capstone trip.

Interestingly, when asked what area of the country they were most comfortable with describing the geology, some of the students continued to discuss their favorite childhood places while others discussed places they became attached to as adults. Karen stated that she felt most comfortable discussing the geology of Virginia, "because I'm most familiar with that. I spent more time outside in that place and I lived there the longest." Interestingly, she has lived there the longest as an adult, but has spent more overall time near Niagara falls throughout her life, and when asked if she would consider her favorite place to be "home" she stated, "Niagara Falls, yes I would consider that home, but Virginia is my place now…I don't know, I'm torn between the two. I spent so much time in both of them."

Laura describes the, "Midwest [including] Minnesota, Iowa, South Dakota, Wyoming, and Montana," as the area where she is most comfortable in describing the geology. This area includes what she considers to be "home." As a geologist she did a great deal of field work in this area, and she also mentioned other areas that she lived, but was only able to described the "subsurface" in those areas due to her work in the oil industry. Even though she has lived all over the United States, she still considers Iowa (Lake Okoboji area) to be home because, "my whole family is there."

Nancy considers California to be her home now, and is able to describe the geology of this area the best. She feels her knowledge of the area is a direct result of her job working with teachers. She stated, "Actually, I work with teachers and I have taken them now for 15 years, and working with the college, I take them on a geologic tour. Or it's actually an earth science course that we do for a week up there." Though she stated earlier in the interview that West Virginia was her "home," she states that California is her "home" now. She continued to recall memories from both areas.

Mary felt that she has the best overall geologic knowledge of the Adirondacks, and is now able to describe the different orogenies that affected the region. She summed up her view of "home" by stating, "home is where the heart is," and she continued to justify her response by stating the, "Adirondacks will always have part of my heart."

All four of the students stated that they found it interesting to learn about her own favorite place's geology during the TIG program. It is important to note that all 4 of the students also stated that they enjoyed learning about the geology of their favorite places more than the geology of other places. Mary summed up the reason for this by stating,

> “I mean the fact that I can remember some of the names of the orogenies. The fact that I know the transcontinental arc was here before any sort of Pangaea action was going on. Those are associated with the fact that it is close to me and that I’m connected to it in a more personal way. Some of the other formations, when they occurred, not as much.”

When specifically looking at what interested these students about the geology of their favorite place it is interesting to note that they all focused on historical geology. The students mentioned different aspects of historical geology such as orogenies, tectonics, red beds, and glaciations, but all 4 of the students focused on historical events as opposed to current geologic processes. They also all alluded to the holistic understanding of how the geology of a certain favorite place tied in with the whole timeline of historical events.

When asked about the interest in the meteorology of the students’ favorite place, they all stated that they found the new knowledge interesting. Most of them (3 out of 4) focused on specific meteorological aspects such as adiabatic cooling, thunderstorms, fronts, and new found knowledge of katabatic winds which directly affect them. On the other hand, Mary focused on the climatology aspect of the TIG program and why the leeward side of a mountain is different from the windward side of a mountain. This knowledge has helped her better understand the Adirondacks weather, and weather on the capstone trip near the Adirondacks.

Though the students enjoyed learning more about the meteorology of “home,” only Laura described it as being a favorite topic. All 4 of the students focused on the South or Dixie Alley, and what they described as either the Midwest or Tornado Alley.

Laura describes Iowa (part of Tornado Alley) as being "home," and she is also fascinated by the violent and interesting weather during the summer months there. All of the students described being fascinated, or in awe of the weather in these areas. Interestingly, the Nancy and Mary, who have not spent much time in these areas of the country, do not understand why anyone would want to live there. Mary stated, "Why are we building there? Why are we continuing to go back there if we know that this is a problem?" On the other hand, Karen lived through multiple tropical storms and hurricanes while living in the South, and she is still fascinated by them. All 4 students appear to be more interested in violent weather events than they are in specific events related to a "home" region. Overall, it appears that the geologic aspect of "home" was more appealing than the meteorological aspect of "home."

When asked where they would live if they could live anywhere in the world it was interesting to see that 3 of the 4 students chose a place in or near where they consider to be "home." All 3 of these students were familiar with the geology, meteorology, and climate of the region. Nancy, simply stated, "If I could live anywhere in the world, I mean, I'm there." Karen chose the Alps simply because she loves snow and mountains. This is the same student who focused on snow related activities in previous questions. It is interesting to note that all 4 students described aspects of the climate to be a major factor in their decisions. The attractiveness of having seasons was specifically mentioned by 3 of the students. Other deciding factors included the lack of catastrophic events such as tornadoes, volcanoes, and earthquakes, and the many outdoor activities that are offered in these locations as opposed to other areas of the country.

The students that were interviewed had a few different reasons for choosing the New York field experience TIG trip. Out of the 4 students, 3 of them wanted to see something new and experience geologic features and rocks that they do not normally get to see. Laura also stated that it fit her schedule better than other trips. Mary chose the trip for a few reasons including the proximity to home, cost, and she stated that it, "addresses some of the places that I really like, like the Adirondacks." Though the trip did address the area near her favorite place, she was also curious to learn about other areas and features such as caves and other new locations. Interestingly, the 3 students that wanted to see something new are also the 3 students that either moved around as children, or moved around as adults (Laura, Karen, and Nancy). The one student, Mary, who wanted to stay close to home is the same student that has lived in the same state her whole life. "Home" may be a stronger influence on those students who have left the area less often.

During the interview students were asked to identify specific regions or locations that immediately came to mind when asked about specific geological or meteorological events or features. These events and features included earthquakes, tornadoes, volcanoes, hurricanes, mountains, igneous and metamorphic rocks, sedimentary rocks, and glaciers. A distinct pattern was noticed when the students were asked why they associated these specific locations with the different events and features. There were N=31 total responses associated with this group of questions. Of the 31 total responses, 65% (n=20) related to having personal experiences with these events or features in the specific location identified by the student. Of the responses associated with personal experiences, 25% (n = 5) were reported as the student's first experience with the event or feature, or an experience from the student's "formative years." When discussing an experience with a volcano Laura commented, "That was the first volcano I ever went to." It is also important to note that of the 20 responses associated with personal experiences 75% (n = 15) of those experiences happened in a location where the student has lived or where they consider to be "home." Students, when asked why they associated a certain place with an event or feature made comments such as Karen's response, "Because I have personal experience living through hurricanes in Louisiana," and Laura stated, "Because it's home." Of the 31 total responses only 35% (n = 11) gave reasons other than having personal experience with the geographic location. Of those 11 reasons, 7 were related to students hearing about events on the news or in movies, or reading about events or features in class. For instance, when asked about the location associated with tornadoes Nancy stated, "Kansas. Wizard of Oz!" Based on the interview, surveys, and field observations, Nancy had no other experiences directly related to tornadoes. It is important to note that when personal experiences do not include a geological or meteorological event students immediately referred to events that have been portrayed in specific geographic locations by the media.

Interestingly, when asked to describe "dirt" all 4 of the students discussed the dirt that is associated with one of the places that they consider to be "home." As suggested by previous answers, a couple of the students are torn between 2 places that they consider to be home. They currently live away from where they grew-up, but at times consider "home" to be where they currently live, while at other times they consider "home" to be where they grew-up. Both Karen and Nancy described "dirt" typical to what can be found where they both currently live. The other two students, Laura and Mary, described the “dirt” that is associated with the place that they have continually identified as “home” from both childhood memories and adult memories.

Interestingly, it appears that more of the students that were interviewed had mentors in geosciences during adulthood than the overall survey group did during childhood. Out of the 4 participants, 2 of them had specific mentors that actually helped them choose a program, and Karen mentioned that her dad was her original mentor as an undergraduate in geology, but has since passed away.

These 4 students also had a higher percentage who collected rocks and fossils. The level of rock collecting, and types of rocks or fossils collected varied some due to previous knowledge prior to the TIG program, but 3 out of the 4 students did have some sort of rock or fossil collection prior to the program. The one student who did not collect rocks or fossils, Karen, stated that she, “lived in a museum. My father was a collector.” The 3 students who did collect rocks mentioned multiple locations. Only 1 of the 3 students, Mary, stated only 1 specific location within her region. The other two students discussed locations all over the country.

At the end of the field course the students were asked follow-up questions about the field course and the overall experience. As might be expected, when asked if the field experience changed the students’ opinions about their favorite places, all of them said no. Karen stated, “Well no. You can’t change something you have forever.” All 4 students did, on the other hand, feel that the TIG field trip experience expanded the knowledge that they had about a new location. Interestingly, two of the students, Laura and Karen, noted that they specifically learned a great deal more about carbonate rocks and karst features. Karen stated, “The carbonates and the karst…processes. I learned much more about them. I guess I never dealt with them before." It should be noted that when the students discussed sedimentary rocks in the initial interviews, none of them specified carbonate rocks such as limestone as a sedimentary rock that initially came to mind. It was apparent that none of the students lived near carbonate dominant areas, or that they were at least not aware that they lived near these areas. A couple of these students, Nancy and Karen, realized after the trip that karst features are located not far from where they currently live, and this revelation was very exciting to them.

Besides expanding the knowledge base in a new area, all 4 of the students also felt that the field experience helped them to better understand certain features and processes related to area that they consider to be "home." Some of the specific processes and features that students mentioned included, glacier landscapes, orogenic processes, and limestone/karst features.

Interestingly, 3 out of the 4 students felt that past experiences really helped them both in the classroom during the TIG program and on the TIG field experience trip. Even though none of these students had a great deal of experience with all of the locations that we studied on the field experience trip, all 3 of them felt that they were able to relate these new experiences back to geological, meteorological, or even ecological experiences that they had in the past. Some of these students specified specific experiences or courses they felt helped them the most on the field trip. Laura specified Historical Geology as being extremely helpful for this particular trip, and she mentioned her past fieldwork as being helpful in identifying features. The only student that felt her past experiences had hindered her throughout the TIG program, Nancy, referenced the fact that she had been out of school for so long and was lacking in some of the geology and math courses that would be relevant to the TIG experience. She also felt that her lack of knowledge about the geology and geography of New York, and the East Coast in general, made it little more difficult for her than for someone who had at least heard of these places prior to the trip. The one area that she felt may have helped her was the little knowledge that she did have about limestone. Though she did not mention it prior to this point in the interview, she felt like she was able to better understand limestone in her own home area, and recognized what she already knew, once she learned about it in more detail on the trip.

All 4 of the students felt that the TIG field experience was a very positive aspect of the TIG program. When asked whether or not it was a positive or negative experience, students made comments such as, “Very positive!” And, “Mylroie’s a hoot!” And, “Oh positive! Absolutely! I think they should do one in year one! Or at least a mini one after the first year one, and then do the second year one as well.” Karen specifically mentioned the cave as her favorite part of the trip, “The cave! That was so Awesome! Ha haha! ….It’s just an experience that you don’t get every day. Or I’ve ever had…..I haven’t been into wild caves.” It is interesting to note that none of these 4 students had anything negative to say about the TIG field experience after the trip.

Conclusions

Overall, it is clear that moving around during adulthood and childhood does have an effect on an individual’s primary sense of place. All of the study subjects did report some attachment to a specific prominent geographic location from childhood, but attachments to other locations became evident in the subjects that moved during childhood or adulthood. Mobility matters. It was also evident that areas where the subjects spent a lot of time engaged in outdoor activities appear to hold a stronger attachment than areas where outdoor activities were not a part of their regular life. This conclusion is especially evident in the students' interviews. The two locations that Nancy considers to be home were both areas where she spent a lot of time outdoors, West Virginia and her current home in the mountains of California. She lived in other areas of California, but never reporting these locations as having an enhanced attachment. This pattern is also evident in Laura who lives in Houston, but considers Lake Okoboji to be home, and Karen, who has lived in many different locations as an adult, is torn between her childhood home and her current home as to where she considers "home" to be. Finally, Mary, who has lived in the same state her entire life, was consistent throughout both the interview and the surveys that the Adirondacks are her "home." Interestingly, she does not live in the Adirondacks, but that is where she has taken her vacations throughout childhood and adulthood, and it is in the same region as where she grew-up. She also described a great deal of outdoor activities that she participated in with her family including canoeing, swimming, and hiking in the Adirondacks.

The level of geological attachment verses meteorological attachment is another interesting theme to note. As can be seen in the results of the interviews, the students referred back to areas they considered to be "home," or personal experiences when discussing geologic features. On the other hand, the students that were interviewed predominantly discussed violent meteorological events and areas outside of their home regions when asked about meteorological interests or places that they thought of when asked about specific meteorological events. Some students who lived through violent weather such as hurricanes did mention the place that they lived at the time of this occurrence, but that was not always the case. Mary who recently lived through Super storm Sandy stated "Florida" when asked where she thought about when I mentioned the word hurricane. Another student, though she described a time in which Meteorology II saved here from being in a tornado near her home, thought of "Oklahoma City" when asked about tornadoes. Unlike geological features, it appears that experience with these events is not the only factor in determining student's thoughts on the geographic occurrences of the events. It appears that the media may also play a large role in these thoughts. Students did mention enjoying learning more about the weather near "home," but some of the students described the weather near this particular location as being boring when compared to weather elsewhere. This is an important note to make, and it should be considered when teaching specific topics in geology and meteorology. Violent weather appears to appeal to all students at least at some level, while local geology may have more of an effect on the students' geologic interest. This hypothesis needs to be tested in greater detail in order to fully understand interest levels in different geologic topics as related to sense of place. It is also possible that these conclusions could be skewed by the fact that the trip these students chose was a geology based field course.

Finally, it should be noted that one of the main reasons that these students chose to take this particular field experience course was to see something different. All of these students felt that this experience strengthened their knowledge levels in both the area of study as well as wherever they considered "home" to be. The main area of new knowledge mentioned by the students involved karst features and carbonate rocks. Though multiple students appear to live in areas near carbonate rocks and karst features, most of them were not fully aware of these features, or they did not fully understand the processes involved in the production of these features. This is another important aspect to note when teaching online courses where the student population is geographically diverse. Though the students may be aware and interested in certain geologic features and processes near "home," they may not be even aware of all of the features near "home" let alone knowledgeable about them. Using a students' sense of place is a good starting point for basic understanding, but it does not assure knowledge of local geologic features and processes. On the other hand, it does appear that an individual's sense of place plays a large role in geologic interests. These interests and knowledge of "home" could be better utilized in online courses that emphasize projects and homeworks based on encouraging local interactions.

CHAPTER X

CONCLUSIONS

As instructors of online courses, trying to deliver the educational material in a way that is personalized to individual students is a challenge; especially with the knowledge that an individual's way of knowing and understanding the world is intricately linked to his or her primary sense of place. The great geographic differences in our online student populations can exaggerate these different ways of knowing. This may differ from traditional classrooms at regional universities where the demographics and geographic understanding of the student population are similar. The focus of this dissertation was to determine how an individual student's geological and meteorological sense of place may play a role in his or her, previous knowledge, interests, and grasp of concepts in an online geoscience program.

Throughout the study, there were subtle differences found between the different regional groups of students. Some areas of the study identified greater differences between regions than others, but overall it became clear that differences were present. . The pre-surveys that were administered to the students at the start of the program indicated pre-existing regional knowledge differences for both meteorology and geology when specific questions were analyzed. When these questions were further vetted for regional associations, knowledge of specific geographically associated meteorological and geological events was identified for three questions of the meteorological pre-survey and two questions of the geological pre-survey (Tables 4.2 and 4.3). The first 20 questions of each survey were general knowledge questions, but the next ten for each survey were geographically centered questions. All of the questions showing significance could be related to geographic knowledge differences. Specific regions showing differences can be seen in Tables 4.2 and 4.3. Only the regions that had at least two or more participants were included in this analysis. The low numbers of participants in certain regions may have played a role in the difficulty to show significance in these regions.

More pronounced differences were noticed in the meteorological pre-survey than the geological pre-survey, but this disparity could be due to a few factors other than a student's sense of place. For instance, the students were asked to designate a home region based on a regional map provided by the researcher. This regional map is a regional climate map produced by NOAA, and it is best associated with specific climatic regions that are often specified in meteorological research. This map may not have been the best indicator for geologic regions because the designated regions often encompassed great differences in geology within each region.

Both of the sense of place surveys also indicated vast differences in geological and meteorological sense of place associations. This is opposite of the research findings of an in-person geology course by Clary and Wandersee (2006). In an in-person setting at a regional university it was found that the students had the same general geologic sense of place that could be best defined as local (to the university) geologic knowledge and sense of place. These findings draw into question how an online course should differ from an in-person course to better address these variances between students.

Though the overall conclusions of geographic differences could be seen across both sense of place surveys and many similarities were observed, the Meteorological sense of place survey once again differed slightly from the geological sense of place survey. Both surveys did show great interest by students in violent events. This interests appeared across regions, and experience with the events was not always necessary. Though students did focus on these violent events such as tornadoes, earthquakes, and hurricanes, the meteorological sense of place survey did find regional differences in the descriptions within individual questions associated with these violent events. For instance, regions with more than 50% of students reporting that they feared tornadoes were all regions that are considered prone to tornadoes (Brook et. al., 2003). Students' most memorable weather events such as snowstorms, ice storms and hurricanes were also described predominantly by students who lived in regions that are prone to these weather phenomenon. Interestingly, students from the West, Northwest, or Southwest Regions did not mention tornadoes at all when discussing memorable events. These regions are not prone to tornadoes (Brook et al. 2003). The meteorological sense of place survey also showed a great number of between region differences for individual questions, and patterns associated with season differences (snow related, extreme temperatures, humidity and wind chill) and seasonal severity was pronounced throughout the survey. For instance, of the 9 students from the South region, when asked to describe humidity, 4 (44%) of them stated that they were "used" to it. Students from the Southwest, West, and Northwest regions claimed that humidity was not an issue where they grew-up. On the other hand, 9 out of the 12 students who do not remember much about the concept of wind-chill were from Southern regions. It is also interesting to note that students from regions with pronounced seasons often made multiple comments on questions and justified their responses by stating that it depends on the season. For example, when asked about memories involving wind, students from the Northern regions often specified that the memories depended on the season. Wind could feel good during the summer, or biting cold during the winter. The Geological Sense of Place survey also showed regional differences when the whole survey was analyzed, but within questions regional differences were not as pronounced as the Meteorological Sense of Place survey until the essay section.

When the entire survey was analyzed by region, patterns between regions were observed for both sense of place surveys. In the geological sense of place survey differentiated regional patterns associated with specific geologic features such as oceans and glaciers was a prominent theme. For instance, the only students that mentioned glacial processes throughout the surveys were students from the Northeast, Central, and the East North Central regions. All of these regions were recently, geologically speaking, covered by glaciers; and they all have features that can be associated with glacial processes. Not surprisingly, students from the South and Southeast region mentioned beaches and the ocean the most throughout the survey. Both of these regions are known for beaches and ocean related processes. Specific differences between regions based on geologic features, such as the ones listed above, can be seen throughout the Geological Sense of Place survey. As previously discussed, one predominant overall theme seen throughout the Meteorological Sense of Place survey was the differences in seasonal patterns mentioned by students from regions with more pronounced seasons.

The numbers of individual study participants within each region for the end of year one surveys were two small to reliably determine between region differences, but important conclusions can still be drawn from these data. The end of year one survey also showed an interest by the students in extreme and violent meteorological and geological events, but interestingly, many of these events were related to students' past or present experiences. Students also overwhelmingly chose the same favorite course material and activities for both Meteorology I and Geology I. The rock and mineral identification activity for geology and the observation forecasting activity for meteorology were the dominant favorite activities. Both of these assignments required hands-on activities that were applicable and related to past and present experiences. The main reasons students' listed for these choices included the practicality and because of past or present experiences with the material or assignments. Students continually referred to specific assignments as "practical," "hands-on," or "can use daily." When discussing weather related homework students specifically reiterated the importance of understanding local weather patterns, and the homework that focused on local weather patterns verses the weather patterns of a different location. These patterns are important for online instructors and reiterate the need for place-based interest related assignments.

The grade data also revealed interesting statistically significant results related to regional differences. It is important to note that there was no statistical significance between regions for the Geology I course or for the Meteorology I course when the students overall grades were examined. Statistical differences between regions were found in quizzes 3, 4, 7, and 11when analyzing specific assessments within the Meteorology course. Regional significance can be seen in Tables 8.4-8.7. These differences may be associated with the material that was covered, and the specific, potentially regionally significant, questions that were asked on the assessments. For instance, Quiz 7 was geared towards the examination of precipitation processes, and different forms of precipitation. This quiz had multiple questions that pertained to precipitation that may typically be found in specific regions, but not others. For instance, there were multiple questions involving snow and other types of frozen precipitation such as sleet and freezing rain that is more commonly seen in northern regions. These included questions such as, “Which of the following statements are true regarding the measurement of snow fall?” Answers included, “Snow depth is often measured taking several readings using a calibrated stick, The ratio of snow to water is constant at exactly a 10:1 ratio, Usually only the snow depth is measured and recorded, All of the above, None of the above.” Students not familiar with frozen forms of precipitation may have a harder time with questions like this one. Students from the Southeast, Southwest, and Central region may not be as familiar with different forms of precipitation as students from the Northeast and the East North Central regions. Students from the Northeast region scored the highest of the regions overall, and students from the East North Central region also performed well on this assessment. Even with the Bonferroni correction, students from the Northeast region still performed higher on this quiz than students from the Southeast region.

No significance was found between assessments for the Geology I course, and there are a few possible reasons for this difference. First, the Geology I course is typically taken in the Spring of a TIG student’s first year, whereas Meteorology I is often the first course that incoming TIG students take during the fall of the first year. There were more study participants who finished the Meteorology I course (N = 52) in the allotted two year time frame than the Geology I course (N = 31). Regional differences were harder to detect with these smaller numbers. It is also possible that the material covered, and questions asked, for each of the assessments in Geology I was less regionally driven.

Interestingly, the participants who were interviewed at the end of the TIG program showed more geologically specific attachments as opposed to meteorologically specific attachments to areas that they considered to be "home." This is contrary to other measurements of the study. As noted in Chapter 9, the interviewees were not necessarily a representative group of the TIG program. All four of these students were female, and all four of them were "A" students. Two of them had also worked as geologists in the past. The demographics and backgrounds of these students may have skewed the data for the interview section. It became clear that geologic experiences and associations clearly mattered to these four students. It is possible that the geological side of the study was emphasized due to the geologically focused capstone course that was chosen by these particular students, and the dominance of geology backgrounds among these students. It also became clear that mobility throughout life matters when assessing geological and meteorological sense of place and experiences. All four of the students stated different levels of mobility throughout life, and these levels along with outdoor activities in specific geographic locations appeared to play a large role in the individual's sense of place. Finally, the link between the media and student perception was also further revealed in the interview sessions. Geological and meteorological hazards are continually portrayed in the media. When a student lacked a personal experience with an event, he or she immediately turned to media based knowledge of these events to give geographic associations.

Based on the findings of this dissertation, implications for future research can be drawn. Future studies to better evaluate meteorological and geological sense of place in an online setting could take many different directions from here. This particular study revolved around an online Master's program. More variance in geological and meteorological sense of place may be revealed in undergraduate online courses. More data over a longer period of time, allowing for a greater number of participants per region, may also enhance the results. A study that better evaluates the geologic sense of place using a more geologically significant regional map may also garner greater sense of place and knowledge base differences among regions.

Though future studies could go many directions from here, the findings of this study show overall importance for both online geology and meteorology instructors. This study of an online Master's program concludes that geographic differences and moving/travel experiences among students matters to education in an online setting. Understanding the students' sense of place may better help online instructors to evaluate students' pre-existing knowledge base. This previous knowledge can often be assumed as "local" in an in-person classroom as a regional university, but that is not the case for the geographically diverse population of an online course. Armed with this knowledge, an online instructor may be better able to address potential geographic based issues that may arise in an online setting. An online instructor of meteorology or geology may be better able to evaluate areas of content that need to take precedence, or areas that the instructor does not need to explain in as great of detail. In-person instructors may already find themselves doing this without even realizing it. For instance, the concept of humidity may be readily accepted and understood by students in a meteorology classroom in Houston, TX, but the concept of Lake Effect snow may take extra time to explain. The opposite may be true in Buffalo, New York. Time considerations on these subjects may need to be reconsidered by online instructors.

This dissertation illustrates that online instructors may also benefit from the knowledge that "place-based" assignments allowing students to evaluate the meteorology or geology of "home" may fair better and hold the students' interest better than rigid assignments or projects that only allow for one geographic place to be studied by all students. Overall, this study emphasizes the importance for online instructors to evaluate teaching techniques based on geological and meteorological sense of place. By taking this into account in an online classroom, geographic disparities could be minimized and content interest levels could be increased.

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APPENDIX A

IRB FOR DISSERTATION RESEARCH

Accepted IRB

July 24, 2012

Jeanne Sumrall

Geosciences

Mississippi State, MS 39762

RE: IRB Study #12-213: Investigation of Sense of Place Effects in an Online Learning Environment

Dear Ms. Sumrall:

This email serves as official documentation that the above referenced project was reviewed and approved via administrative review on 7/24/2012 in accordance with 45 CFR 46.101(b)(2). Continuing review is not necessary for this project. However, any modification to the project must be reviewed and approved by the IRB prior to implementation. Any failure to adhere to the approved protocol could result in suspension or termination of your project. The IRB reserves the right, at anytime during the project period, to observe you and the additional researchers on this project.

Please note that the MSU IRB is in the process of seeking accreditation for our human subjects protection program. As a result of these efforts, you will likely notic! e many changes in the IRB's policies and procedures in the coming months.

These changes will be posted online at http://www.orc.msstate.edu/human/aahrpp.php. The first of these changes is the implementation of an approval stamp for consent forms. The approval stamp will assist in ensuring the IRB approved version of the consent form is used in the actual conduct of research. Your stamped consent form will be attached in a separate email. You must use copies of the stamped consent form for obtaining consent from participants.

Please refer to your IRB number (#12-213) when contacting our office regarding this application.

Thank you for your cooperation and good luck to you in conducting this research project. If you have questions or concerns, please contact me at jroberts@research.msstate.edu or call 662-325-2238. **In addition, we would greatly appreciate your feedback on the IRB approval process. Please take a few minutes to complete ou! r survey at http://www.surveymonkey.com/s/YZC7QQD.**

Sincerely,

Jodi Roberts, Ph.D.

IRB Officer

IRB Document

MISSISSIPPI STATE UNIVERSITY HUMAN RESEARCH PROTECTION PROGRAM	**Application for Administrative Review** ***Version 9-29-2011***

Use this application if you believe your project will qualify for Administrative Review. Please note you may always use the Protocol Submission form for initial submission if you are unsure which application form to use. If the Application for Administrative Review is submitted and it is determined by the IRB that your project does not qualify for administrative review, you will be required to submit the Supplemental Application Form to provide information needed by the IRB that is not requested on the Application for Administrative Review.

Note: Administrative review may not be used for research involving prisoners, some research involving children (individuals less than 18 years of age), or FDA regulated research (except category 6). Use the Administrative Review Criteria tool to determine if your research qualifies for administrative review.

This form is locked; however, you may unlock the form for features such as spell checking if you wish. If you change the form in any way, you will be required to resubmit the protocol.

Investigator's Checklist for Submission

Before submitting your protocol for IRB review, make sure you have included the following (if applicable):

☒ Survey, Questionnaire or Interview Questions
☒ Consent and Assent forms
☐ Recruiting materials
☐ Permission letters from participating institutions
☐ Signed Investigator Assurance form
☒ Clear, concise description of procedures to be used (Feel free to also attach any proposals that may further explain your project. However, the study must be fully describe within the application.)
☒ All personnel listed must have completed IRB/Human Subjects Training. If not, your application cannot be approved until the training has been completed. Information regarding training options can be found at http://www.orc.msstate.edu/quicklinks/training.php. You can check your training records from the "Check your training records" link from http://orc.msstate.edu/.

PLEASE NOTE:

The determination of the IRB will be communicated to you in writing. Submission of an application to the IRB does not equal IRB approval. You may not begin this research until you have received written notification of IRB approval.

MSU Campus Mail: Mailstop 9563	**US Mail:** PO Box 6223 MS State, MS 39762	**Physical Location:** 53 Morgan Avenue MS State, MS 39762
Fax: 662-325-8776	E-mail: irb@research.msstate.edu	
If you have any questions, please feel free to contact our office at 325-3294 or by e-mail at irb@research.msstate.edu		

Project Title: Investigation of Sense of Place Effects in an Online Learning Environment

PRINCIPAL INVESTIGATOR'S ASSURANCE

As Primary Investigator, I have ultimate responsibility for the performance of this study, the protection of the rights and welfare of the human subjects, and strict adherence by all co-investigators and research personnel to all Institutional Review Board (IRB) requirements, federal regulations, and state statutes for human subjects research. I hereby assure the following:

The information provided in this application is accurate to the best of my knowledge.

All named individuals on this project have been given a copy of the protocol and have acknowledged an understanding of the procedures outlined in the application.

All experiments and procedures involving human subjects will be performed under my supervision or that of another qualified professional listed on this protocol.

I understand that, should I use the project described in this application as a basis for a proposal for funding (either intramural or extramural), it is my responsibility to ensure that the description of human subjects use in the funding proposal(s) is identical in principle to that contained in this application. I will submit modifications and/or changes to the IRB as necessary to ensure concordance.

I and all the co-investigators and research personnel in this study agree to comply with all applicable requirements for the protection of human subjects in research including, but not limited to, the following:

- Obtaining the legally effective informed consent of all human subjects or their legally authorized representatives, and using only the currently approved, consent form with the IRB approval stamp (if applicable); and
- Obtaining written notification of approval from the IRB before implementation of any changes to the project (except when necessary to eliminate apparent immediate hazards to the subject); and
- Reporting via the Problem Report any unanticipated problem; and
- Promptly providing the IRB with any information requested relative to the project; and
- Promptly and completely complying with an IRB decision to suspend or withdraw its approval for the project; and
- Obtaining continuing review prior to the date approval for this study expires; and
- Granting access to any project-associated records to the IRB to ensure compliance with the approved protocol.

Name of Principal Investigator / Researcher: Jeanne Lambert Sumrall

Signature:

ADVISOR'S ASSURANCE (if applicable)

As Advisor, I assume responsibility for ensuring the competence, integrity and ethical conduct of the investigator(s) for this research project. The investigator(s) is/are fully competent to accomplish the goals and techniques stated in the attached proposal. Further, I certify that I have thoroughly reviewed this application for readability and accuracy and the study is clearly described herein.

Name of Advisor: Dr. Renee Clary

Signature:

I. Project Information

Type of submission:

☒ Original Submission

☐ Requesting Developmental Approval* only

Include a timeline for development of the project. Estimated date for submission of a revised IRB application: _____

☐ Revision to previous Developmental Approval

If you already have developmental approval, list the docket number assigned to the first submission of the study: _____

**Also referred to as "118 designation" - see http://www.orc.msstate.edu/irb/118.php for more details. No human subjects (including use of identifiable data) may be involved in the research prior to final IRB approval.*

Project Period: **from** upon IRB approval **to** 8/31/16

Includes both data collection and data analysis

- *Start date cannot predate IRB approval date; may be "upon IRB approval"*

Study Funding:

☐ External Funding

Agency: _____

SPA Proposal or Fund/Account Number: _____

PI of Award (if different than Principal Investigator/Researcher listed above): _____

☐ Department Funds

☒ Other, specify: Personal Funding

II. Personnel & Qualifications

- In the table below, describe the role and responsibilities of all research personnel and describe their qualifications as they relate to their abilities to perform responsibilities associated with the study.
- As principal investigator, it is your responsibility to ensure that all individuals conducting procedures described in this application are adequately trained prior to involving human participants.
- All personnel listed on this application are required to successfully complete the MSU IRB & Human Subjects training course or an IRB-approved alternative. Training will be verified by IRB staff before approval is granted.

Names of all research personnel involved in the design, conduct, or reporting of the research - *Use additional copies of this page as needed.*

Complete and attach a Contact Information Form for all new individuals and individuals with updated information.

Name	Institutional Affiliation(1) (Choose only one for each individual)	Does this person or an immediate family member have a financial interest related to the research? (2) Yes***	No
Principal Investigator: Jeanne Lambert Sumrall Net ID: jml605	☒ MSU Faculty, Staff, or Student ☐ MSU Adjunct or Visiting Faculty* ☐ Other:**	☐	☒

MSU Department: Geosciences Preferred phone number: 8136248888 Email: jml605@msstate.edu			
Role, responsibilities and qualifications: PI, Data Collection, analysis, interpretation and publication. PhD student in Earth and Atmospheric Sciences			
Advisor (if applicable): Dr. Renee Clary Net ID: rmc192	☒ MSU Faculty, Staff, or Student ☐ MSU Adjunct or Visiting Faculty* ☐ Other:**	☐	☒
Role, responsibilities and qualifications: Advisory role for data collection, analysis, and interpretation, and co-author for publications, Associate Professor, PhD in Geology			
Name: Net ID:	☐ MSU Faculty, Staff, or Student ☐ MSU Adjunct or Visiting Faculty* ☐ Other:**	☐	☐
Role, responsibilities and qualifications:			
Name: Net ID:	☐ MSU Faculty, Staff, or Student ☐ MSU Adjunct or Visiting Faculty* ☐ Other:**	☐	☐
Role, responsibilities and qualifications:			
Name: Net ID:	☐ MSU Faculty, Staff, or Student ☐ MSU Adjunct or Visiting Faculty* ☐ Other:**	☐	☐
Role, responsibilities and qualifications:			
Name: Net ID:	☐ MSU Faculty, Staff, or Student ☐ MSU Adjunct or Visiting Faculty* ☐ Other:**	☐	☐
Role, responsibilities and qualifications:			
☐ Check here to indicate additional investigator(s) are listed on a separate form.			

(1) **Individuals not classified as regular MSU Faculty, Staff, or Students may only be covered by the MSU IRB under limited circumstances.**
***MSU Adjunct or Visiting Faculty** may be covered by the MSU IRB for activities conducted in association with their MSU appointment. Confirmation of Adjunct or Visiting status must be conveyed to the IRB by the appropriate department head, the individual's MSU offer letter, or current listing in the MSU Employee Directory.
****Non-MSU affiliates** may only be covered at the discretion of the MSU IRB. The Individual Investigator Agreement (IIA) must be completed for each non-affiliate whose activities the MSU IRB is being petitioned to cover. The IIA is not necessary for individuals who will receive approval of their activities from an IRB at another institution.

(2) Financial interest

- "Immediate Family" means spouse and dependent children.
- "Financial Interest Related to the Research" means any of the following interests in the sponsor, product or service being tested, or competitor of the sponsor held by the individual or the individual's immediate family:
  - Ownership interest of any value including, but not limited to stocks and options exclusive of interests in publicly-traded, diversified mutual funds.
  - Compensation of any amount including, but not limited to honoraria, consultant fees, royalties, or other income.
  - Proprietary interest of any value including, but not limited to, patents, trademarks, copyrights, and licensing agreements.
  - Board or executive relationship, regardless of compensation.

*****If yes, submit a Financial Interest Disclosure Form.**

III. Administrative Review Categories

In order to qualify for administrative review, all of the procedures of your study must fit into one or more of the categories below (for example, if you are doing a survey and using an existing data set, you might indicate both categories 2 and 4). If all procedure(s) in the research do not fall into at least one of these categories, the study does not qualify for administrative review and you must use the Protocol Submission Form.

The categories are provided for your reference but it is not mandatory that you check the applicable category(ies) below.
☐ (Category 1) Educational research (study must meet (i) <u>and</u> either (ii)(a) and/or (ii)(b)) ☐ (i) Research conducted in established or commonly accepted educational settings, **and** ☐ (ii) involving normal educational practices, such as ☐ (a) research on regular and special education instructional strategies, **or** ☐ (b) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
☒ (Category 2) Research involving the use of educational tests, survey procedures, interview procedures and/or observation of public behavior, if (i) applies or both (ii)(a) and (ii)(b) below apply. If research involves children, see Section II-1 below for restrictions on this category. ☐ (i) responses are recorded in a completely anonymous manner – that is, information obtained is recorded in such a manner that human subjects can not be identified, directly or through identifiers linked to the subjects (for example, demographics sufficient to identify respondents considering the participant population); **<u>or</u>** ☒ (ii) responses are identifiable but there is no reasonable risk of harm to participants (a) responses are recorded with direct or indirect identifiers, and (b) disclosure outside the research (such as a breach of confidentiality) would not reasonably put subjects at any risk whatsoever. Consider risk of criminal or civil liability and/or damage to subjects' financial standing, employability, insurability, or reputation. For example, (1) will information be collected on unethical business practices that could affect respondents' reputations if their supervisors, business partners, or customers were made aware of those responses, or (2) will information be collected on illegal activities?
☐ (Category 3) Research involving the use of educational tests, survey procedures, interview procedures, or observation of public behavior that is not exempt under Category 2 above, if: ☐ (i) the human subjects are elected or appointed public officials or candidates for public office; or ☐ (ii) federal statute(s) require(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.
☐ (Category 4) Research involving the collection or study of existing* data, documents, records, pathological specimens, or diagnostic specimens, if ☐ (i) these sources are publicly available, or ☐ (ii) if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects. *"Existing" means existing before the research is proposed.

☐ (Category 5) Research and demonstration projects which are conducted by or subject to the approval of federal department or agency heads, and which are designed to study, evaluate, or otherwise examine:
- ☐ (i) Public benefit or service programs;
- ☐ (ii) procedures for obtaining benefits or services under those programs;
- ☐ (iii) possible changes in or alternatives to those programs or procedures; or
- ☐ (iv) possible changes in methods or levels of payment for benefits or services under those programs.

☐ (Category 6) Taste and food quality evaluation and consumer acceptance studies. You must be able to check one of the boxes below.
- ☐ (i) if wholesome foods without additives are consumed, or
- ☐ (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the Food and Drug Administration or approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.

IV. Research Protocol

1. Will your project include any of the following vulnerable populations?
   - ☐ Minors (under age 18) – Note: Category 2 above is restricted to only observations of public behavior when the investigator(s) do not participate in the activities being observed. Research involving survey or interview procedures of minors is not eligible for administrative review under Category 2.
   - ☐ Pregnant women/Fetuses
   - ☐ Prisoners – **STOP!** You must submit the Protocol Submission Form instead of this application.
   - ☒ None of the above

2. Site of work:
   List each MSU site where the research procedures will be performed. Please be as descriptive as possible (e.g., building, room number, Drill Field).

   Distance learning courses through the teachers in geosciences master's degree program. 101-F Hilbun Hall, Department of Geosciences, Mississippi State University, TIG Field Trip

   Please provide information below if any of the research activities will be conducted at a performance site that is geographically separate from MSU or at a site that does not fall under the MSU IRB's authority (e.g., school, prison, hospital). For additional sites, use the External Site Form.

Site	Has the site given permission for the research to be conducted?	Will the site receive federal funding passed through from your grant?	Will the site's IRB review the research?	Will the site rely on MSU's IRB to review the research?
Site name: Address:	☐Yes ☐No ☐ N/A	☐Yes ☐No	☐Yes ☐No	☐Yes* ☐No
Site name: Address:	☐Yes ☐No ☐ N/A	☐Yes ☐No	☐Yes ☐No	☐Yes* ☐No

Site name: Address:	☐Yes ☐No ☐ N/A	☐Yes ☐No	☐Yes ☐No	☐Yes* ☐No
Site name: Address:	☐Yes ☐No ☐ N/A	☐Yes ☐No	☐Yes ☐No	☐Yes* ☐No
☐ Check here to indicate additional site(s) listed on separate form.				
*Not allowed for Veterans Affairs research.				

3. Give details of the procedures that relate to the subjects' participation.
   - *If the procedures are in an existing document (for example, a grant or dissertation proposal), you may attach the document or the pertinent parts of the document that further explain your project. However, the study must be fully described within the application. Be sure to reference any attachment.*
   - Append a copy of all questionnaires or test instruments. If the procedures involve observation, please include the type of behavior or action you expect to observe and record. If the procedures involve an interview, attach a sample of questions you plan to ask.
   - *Describe all interactions (contacts, interventions, observations, etc.) between the researchers and participants.*
   - *Describe procedures being performed already for diagnostic or treatment purposes, if any.*

   attached

4. Describe the recruitment and enrollment procedures. Include a final copy of any recruitment letter, advertisement, e-mail, transcript of verbal recruitment announcement, audio/video recording, etc., and state the mode of its communication.

   All newly enrolled (for the fall 2012) students in the Teachers In Geosciences (TIG) Masters distance learning program will be asked to participate in this study. All who take the survey and pre-quiz will be involved in the study, but certain participants, using purposeful techniques for outliers and random sampling techniques for the overall homogenous group, will be asked to participate in the interview process. These individuals will be selected based on the analysis of the previously collected data, willingness to participate, and availability based on their field course selection.

5. Describe the process for obtaining consent from participants. Projects eligible for Administrative Review must include the following four disclosures to participants unless there is justification for not doing so: (1) a statement that the study involves research, (2) the procedures of the study, (3) contact information for the researcher (and advisor, if applicable), and (4) that participation is voluntary.

   Please attach the consent form, script, or process to be used to provide these disclosures to participants. Describe how consent will be obtained or provide justification for why consent will not be obtained. While *documentation* of consent is not required, projects involving (but not limited to) interactions with participants must include a consent process.

   both forms are attached

6. a. Will the study involve recording identifiable information, including direct identifiers (such as name, student ID number, Net ID, etc.) or indirect identifiers (such as demographics sufficient to identify individual considering the study population)? ☒ Yes ☐ No

b. If yes (the study will involve recording identifiable information), describe provisions to maintain the confidentiality of the data.

All data will be stored on a secure, password protected MSU computer. Participants will be de-linked from data through the use of randomly generated numbers. The data will be stored under lock and key in the researchers office at MSU.

7. Describe provisions to protect the privacy of participants during the course of the study, including recruitment and data collection activities. For example, might participants be publicly identified or embarrassed (i.e., “outed”), or during the conduct of the study, might participants’ responses be overheard or observed by individuals outside the research team (e.g., might participants see other participants’ responses on a survey in a crowded classroom or overhear interview responses)?

To protect the confidentiality of the participants, a randomly generated number will be used as an identifier for each participant. This identifier will be placed on each survey. The identifier will be used to link the students to their surveys, test grades, and interview sessions. The identifier data will be stored on a secure, password protected MSU computer seperately from document data in the researcher's office. Identifiers will be removed when the data collection has been completed.

8. Is there any additional information you would like to provide?

I completed the IRB training under my maiden name, Jeanne Marie Lambert. I have since changed my name to Jeanne Lambert Sumrall

Consent Forms IRB Approval

Mississippi State University
Informed Consent Form for Participation in Research

Title of Research Study: Investigation of Sense of Place Effects in an Online Learning Environment

Study Site: Mississippi State University

Researchers: Jeanne Lambert Sumrall, PhD Student in Earth and Atmospheric Sciences, Mississippi State University, and Dr. Renee Clary, Mississippi State University

We would like to ask you to participate in a research study.

A sense of place has become a topic of interest in the geoscience community in recent years. There are many different constructs that involve how individuals develop a sense of place, and how this place attachment may benefit an individual's acquisition of knowledge. In this research project, we will try to develop a better understanding of how an individual's sense of place can affect him or her throughout his or her academic experiences within the TIG program at MSU. This study will begin August 2012 and conclude with the expected graduation of the research subjects in August 2014, and subsequent analysis. From the results of this research, potential teaching strategies may be developed within the geosciences online environment that will benefit future learners.

YOUR PARTICIPATION IN THIS STUDY WILL NOT AFFECT YOUR PERFORMANCE IN THE TIG PROGRAM. If you participate in this study, you (a) will be asked to partake in a knowledge based geoscience benchmark pre-survey. This survey This pre-survey will benefit both this research project as well as each individual learner in the TIG program. You will be given the survey again at the end of the TIG Master's program so you can identify your own individual progress throughout the program. These surveys will NOT affect your grades in anyway. (b) You will also be asked to take a short 10 minute survey to help identify your primary sense of place attachment. (c)Your grades throughout the program will be linked to your pre-survey and place attachment through a randomly generated identifier in order to show progress in different academic areas. (d) You may also be selected to be interviewed during the capstone field trips at the end of your course work. These interviews will take no more than 45 minutes (with a 30 minute follow-up interview if necessary), and will be conducted as a part of the MSU field experience. You can participate in the study without accepting the interview invitation.

Throughout the process, the information you provide will be kept private (i.e. no names will ever be reported, and all identifiers will be destroyed at the end of the data collection process).

Mississippi State University
Informed Consent Form for Participation in Research

Title of Research Study: Investigation of Sense of Place Effects in an Online Learning Environment

Study Site: Mississippi State University

Researchers: Jeanne Lambert Sumrall, PhD Student in Earth and Atmospheric Sciences, Mississippi State University, and Dr. Renee Clary, Mississippi State University

We would like to ask you to participate in the interview portion of our research study._

A sense of place has become a topic of interest in the geoscience community in recent years. There are many different constructs that involve how individuals develop a sense of place, and how this place attachment may benefit an individual's acquisition of knowledge. In this research project, we will try to develop a better understanding of how an individual's sense of place can affect them throughout their academic experiences with-in the TIG program at MSU. This portion of the study will involve interviews that take place during the summer of 2014. From the results of this research, potential teaching strategies may be developed within the geosciences online environment that will benefit future learners.

If you participate in this portion of the study, you (a) will be interviewed initially for about 45 minutes (with a 30 minute follow-up interview if needed) about your interaction with different geographic places. The interviews will take place on your TIG field trip but will not interfere with your field trip course grade or field trip experiences in any way.

Participation in this study is voluntary, you may refuse to participate or withdraw from the study at any time. If you participate in the study, you can refuse to answer any questions you do not want to answer. The information you provide will be kept private (i.e. no names will ever be reported).

If you should have any questions about this project, please feel free to contact Jeanne Lambert Sumrall at (662.325.3915) or by email at jml605@msstate.edu. You may also contact Dr, Renee Clary at (662.325.3915) or by email at RClary@geosci.msstate.edu. For more information about human participation in research, please feel free to contact the MSU Regulatory Compliance Office at (662) 325-3294.

Please take all the time you need to read through this document and decide whether you would like to participate in this research study. **If you choose to take part in this portion of the study, please sign and scan and email the form back to me at jml605@msstate.edu, or fax the form to (662) 325-2657.**

If you agree to participate in this research study, please sign below. Please keep a copy of this form for your records.

_______________________________ __________

Spring Survey Questions Approval

RECEIVED

APR 0 3 2013

MISSISSIPPI STATE UNIVERSITY HUMAN RESEARCH PROTECTION PROGRAM	Procedural Modification Form *Version 08-01-2012*

The Procedural Modification should be used by Principal Investigators to request a change in procedures.
Please note: This form may NOT be used for personnel changes or time extensions.

IRB Study#: 12-213
Principal Researcher/Investigator: Jeanne Sumrall
Study Title: Investigation of Sense of Place Effects in an Online Learning Environment

1. Summarize / Itemize requested changes and provide a justification for each.

   I am adding a small survey in order to better understand the study subjects interest areas in the Geosciences. I have attached the questions that will be asked.

2. Do changes require revisions to the assessment of risk of harm to the subjects?
   ☐ YES - *If yes, explain.*
   ☒ NO

3. Do changes require revisions to the methods of ensuring anonymity or confidentiality?
   ☐ YES - *If yes, explain.*
   ☒ NO

4. Are there new findings that may relate to a participant's willingness to continue taking part in the research study?
   ☐ YES - *If yes, explain whether these findings need to be provided to participants, and if so, how this will be accomplished.*
   ☒ NO

5. Do changes require a REVISED CONSENT statement or procedure?
   ☐ YES - *If yes, attach a revised consent form with the changes tracked, and a clean copy for the IRB approval stamp.*
   ☒ NO

Name of Principal Investigator / Researcher: Jeanne Sumrall

Signature ________________ Date 4/2/13

Name of Advisor (If applicable): Renee Clary

Signature ________________ Date 4-2-13

Internal Use Only: Updated investigator training: ( )

New Survey Questions

What content area in your GEOLOGY I course did you like the most? (it is okay to list more than one if you explain why) Why?

What homework/project/activity did you like the most in your GEO I course? (it is okay to list more than one if you explain why) Why?

What content area in your METEOROLOGY I course did you like the most? (it is okay to list more than one if you explain why) Why?

What homework/project/activity did you like the most in your MET I course? (it is okay to list more than one if you explain why) Why?

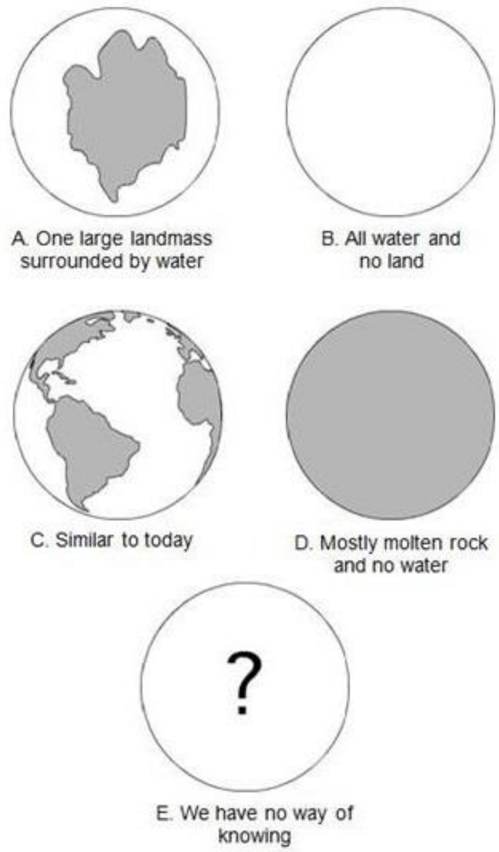
MSU IRB #12-213
Approved: 04/05/13
Expires: 07/24/17

APPENDIX B

PRE-SURVEYS

Geology Pre-survey

1. What would happen if a significant portion of the sea ice floating in the Arctic Ocean were to melt?
    a. An increase in the amount of water in the ocean would lead to more coastal flooding.
    b. An increase in the absorption of solar energy would lead to warming of the planet.
    c. An increase in the occurrence of extreme weather events would lead to more hurricanes.
    d. A decrease in the temperature of the ocean would lead to a cooling of the planet.
    e. A decrease in the reflection of solar energy would lead to cooling of the planet.



2. What did the Earth's surface look like when it first formed? (Based on the figure above)

    a. A

    b. B

    c. C

    d. D

    e. E

3. If you could travel back in time to when the Earth first formed as a planet, how big would the Earth be?
    a. The Earth would be smaller than it is today
    b. The Earth would be larger than it is today
    c. The Earth would be the same size as it is today
4. If you could travel back in time to when the Earth first formed as a planet, approximately how many years back in time would you have to travel?
    a. 4 hundred years
    b. 4 hundred-thousand years
    c. 4 million years
    d. 4 billion years
    e. 4 trillion years
5. Which of the following statements about the age of rocks is most likely true?
    a. Rocks found in the ocean are about the same age as rocks found on continents
    b. Rocks found on continents are generally older than rocks found in the ocean
    c. Rocks found in the ocean are generally older than rocks found on continents
    d. Ages of rocks are not precise enough to determine which rock type is older

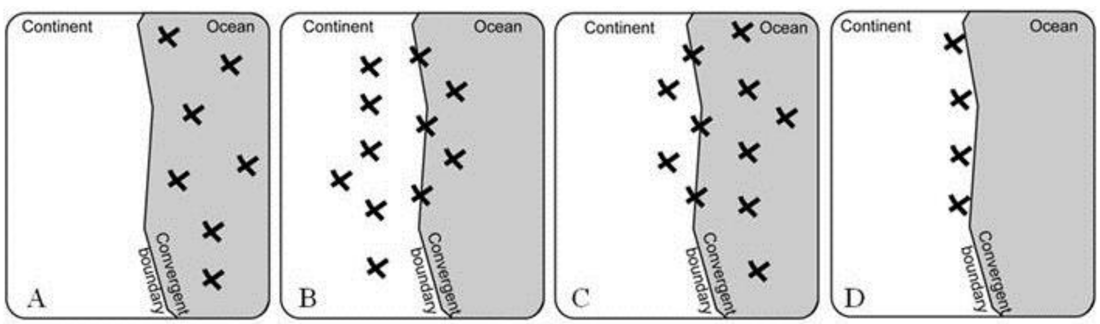
6. Which of the following techniques do you think scientists can use to gather evidence about whether the very center of the Earth is mostly a solid, a liquid, or a gas? Choose all that apply.

    a. Drilling through the center of the Earth

    b. Studying motion caused by earthquakes

    c. Analyzing pictures taken by satellites

    d. Scientists cannot study the center of the Earth



7. The images below show the surface of the Earth as viewed from the sky. Which image best illustrates where earthquake epicenters, marked with an X, would be located?

    a. A

    b. B

    c. C

    d. D

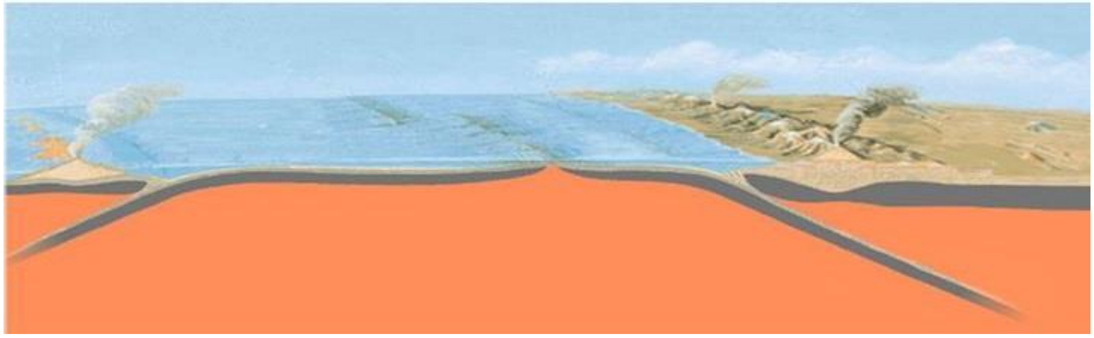
8. Which of the following responses best summarizes the relationship between volcanoes, large earthquakes, and tectonic plates?
   a. Volcanoes typically occur on islands, earthquakes typically occur on continents, and both occur near tectonic plates
   b. Volcanoes and large earthquakes both typically occur along the edges of tectonic plates
   c. Volcanoes typically occur in the center of tectonic plates and large earthquakes typically occur along the edges of tectonic plates
   d. Volcanoes and large earthquakes both typically occur in warm climates
   e. Volcanoes, large earthquakes, and tectonic plates are not related, and each can occur in different places
9. Which of the following can be reliably used to determine if a structure is an anticline or syncline? CHOOSE ALL THAT APPLY.
   a. Age of the rock layers in the fold
   b. Dip of the rock layers in the fold
   c. Surface topography
   d. River flow direction
   e. Both 1 and 2 are correct

10. Fossils are studied by scientists interested in learning about the past. Which of the following can become fossils?

   a. Bones
   b. Plant material
   c. Marks left by plants
   d. Marks left by animals
   e. Animal material
   f. All of the above
   g. Answers 1 and 2 are correct

11. A scientist collects all of the fossils ever discovered into one room. This room now contains:

   a. Fossils of a few of the plants and animals that ever lived
   b. Fossils of most of the plants and animals that ever lived
   c. Fossils of most of the types of plants and animals that ever lived
   d. Fossils of all of the plants and animals that ever lived
   e. Fossils of all of the types of plants and animals that ever lived



12. How many tectonic plates are illustrated in the image?

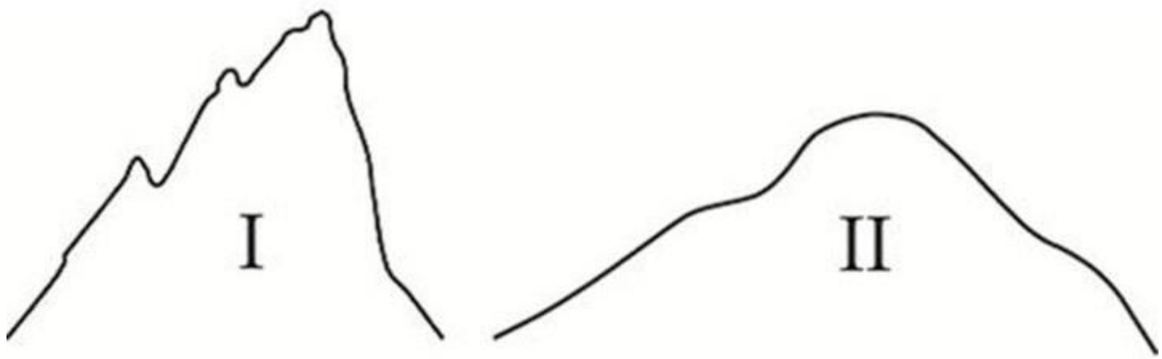
    a. 2

    b. 1

    c. 3

    d. 4

    e. 5



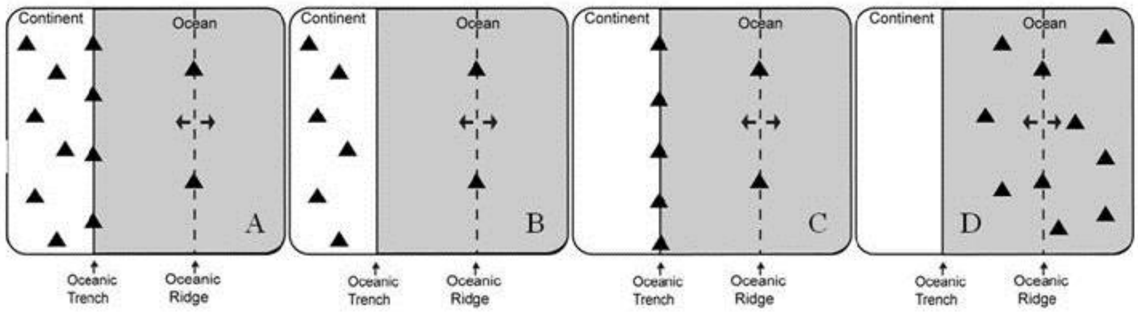
13. The sketches above represent the outlines of two mountains made up of the same type of rock. The mountains have finished growing. Which of the following reasons best explains the differences in the two sketches?

    a. Mountain I is older than Mountain II

    b. Mountain II is older than Mountain I

    c. Mountain I is on a continent that is moving faster than the continent Mountain II is on

    d. Mountain I is on a continent that is moving slower than the continent Mountain II is on



14. The maps below show the surface of the Earth as viewed from the sky. Which map best illustrates where volcanoes, marked with a bold triangle, would be located?

    a. A

    b. B

    c. C

    d. D

15. How far do you think continents move in a single year?

    a. A few inches

    b. A few hundred feet

    c. A few miles

    d. We have no way of knowing

    e. Continents do not move

16. Which of the following can directly affect weathering rates?

    a. Rock type

    b. Earthquakes

    c. Time

    d. Climate

    e. Both 1 and 4 are correct

17. If you put a fist-sized rock in a room and left it alone for millions of years, what would happen to the rock?

    a. The rock would almost completely turn into dirt

    b. About half of the rock would turn into dirt

    c. The top few inches of the rock would turn into dirt

    d. The rock would be essentially unchanged

18. Which of the following can be caused by wind?

    a. Tectonic plate motion

    b. Tsunami Waves

    c. Earthquakes

    d. Mountain-building

    e. None of the above

19. Are rocks and minerals alive?

    a. Yes, rocks and minerals grow

    b. Yes, rocks are made up of minerals

    c. Yes, rocks and minerals are always

    d. No, rocks and minerals do not reproduce

    e. No, rocks and minerals are not made up of atoms

20. How can rocks in the ocean be formed?

    a. By animals

    b. From continental rocks

    c. By volcanic activity

    d. All of the above

21. What causes most of the waves in the ocean?

    a. Tides

    b. Earthquakes

    c. Wind

    d. Tsunamis

22. Sinkholes are most often formed by:

    a. Meteorite impacts on soft sediments

    b. Roof collapse of a dissolutional feature

    c. An avalanche debris pile that caves in on itself

    d. A tsunami event that penetrates into the water table

    e. All of the above

23. Why do Minnesota and Wisconsin have so many lakes?

    a. They were mainly formed by collapsed sinkholes

    b. They are remnants of the last glaciation

    c. They are mainly human made dammed features

    d. They are collapsed, extinct, volcanic features

24. With sea-level remaining constant, barrier islands migrate over time because of:

    a. Long-shore currents

    b. They would not move naturally if humans did not disturb them

    c. Rip-currents

    d. None of the above

25. Mountains ranges are often formed at:

    a. Two continental plates colliding boundary

    b. A continental plate spreading center

    c. When lava dries too quickly causing a damming event that piles-up debris

    d. The moons gravitational pull increases for too long over a specific area of the earth

26. A delta environment contains:

    a. A single dominant river channel that continues to erode over long periods of time

    b. Multiple river channels that the river switches to over long periods of time

    c. Soil poor in nutrients

    d. Low chances of flood events

27. What is the biggest coal producing state?

    a. Kentucky

    b. West Virginia

    c. Wyoming

    d. Utah

28. In the provided picture of sand ripples, in which direction is the dominant wind blowing?

   a. From A to B

   b. From B to A

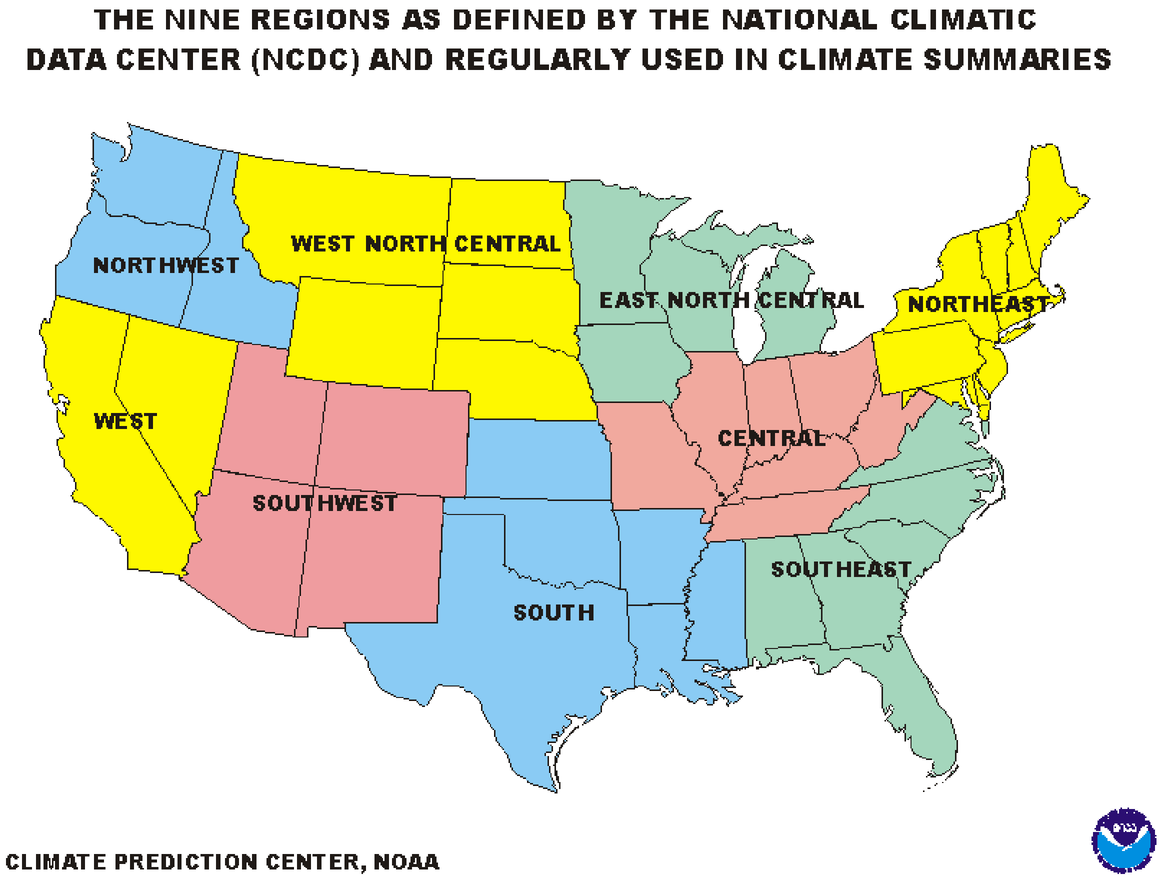
   c. From C to D

   d. From D to C

29. Based on the provided picture of a river, which direction is the river flowing?

    a. From A to B

    b. From B to A



30. Please look at the provided map of the continental United States. Identify which region you consider to be your "home" region, and write the name of this region in the space provided. If you consider Hawaii or Alaska, please state that in the space provided.

31. If your current zip-code is the same as where you consider "home" to be, write "same" in the space provided. If your current zip-code is different than your "home" region, please list the state and location that you consider to be home. Examples: Coastal North Carolina, Los Angelos, California, etc.

Meteorology Pre-survey

1. At what rate does the Chinook wind warm?
    a. dry adiabatic lapse rate
    b. wet adiabatic lapse rate
    c. environmental lapse rate
    d. dew point lapse rate
2. What is a "chinook" wind?
    a. Another name for the monsoon in the SW
    b. A land/sea breeze common to the Pacific coast
    c. A warm, downslope wind common to the Northern Plains
    d. Cold wind found in the Cumberland Plateau region of Tennessee
3. Which of the following is true of the Bermuda-Azores high:
    a. It helps steer hurricanes in the Atlantic
    b. It is a semi-permanent feature found near 30 N
    c. May lead to very warm conditions over the SE U.S. during the summer
    d. All of the above
    e. None of the above
4. Streaks or precipitation that fall from clouds but evaporate prior to reaching the ground are called:
    a. Sublimation
    b. Virga
    c. Partial Precipitation
    d. Atmospheric Evaporites

5. Maritime Polar (mP) air masses in the North Atlantic are commonly associated with this type of storm:

    a. Hurricane

    b. Midlatitude cyclone

    c. Atlantic surge

    d. Nor'easter

6. Where is the "dry-line" generally located during the spring and early summer?

    a. Running north and south in the high plain states

    b. Running east and west in the southwest states

    c. Running north and south in the western states

    d. Running east and west in the southeastern states

7. For a snow storm to be categorized as a "blizzard", what conditions need to be met?

    a. More than six inches of snow within a six hour period

    b. Snow falling fast enough to reduce visibility below 10 feet

    c. Sustained winds with gust 35 miles an hour or greater, and dry snow that reduces visibility to less than 1 mile

    d. Gusty winds over 20 miles an hour and heavy snow falling faster than one inch a minute.

8. What climatic event is the "pineapple express" associated with?

    a. Heavy precipitation

    b. High winds

    c. La Nina

    d. Dry, windy conditions

9. Fog, when produced by cooling of air from the ground-up, can mean:

    a. An increase in atmospheric instability

    b. An increase in atmospheric stability

    c. A decrease in upper level clouds

    d. An increase in upper level clouds

10. When warm moist air moves over a cold surface, fog may result.

    a. Advection

    b. Radiation

    c. Upslope

    d. Steam

11. Frigid polar air that passes over relatively warmer waters often brings ___ downwind.

    a. Crisp temperatures and beautiful clear winter skies

    b. Cloudy, gloomy skies and bitterly cold temperatures

    c. Lake-effect snows and relatively warmer temperatures

    d. Acid rain

12. An Alberta Clipper is associated with:

    a. Heavy rains

    b. Light snow, high winds, and bitter cold

    c. Warm, summer-like conditions

    d. Unstable atmospheric conditions associated with tornados

13. On the average, for every 1,000 meter increase in altitude in the troposphere the air temperature:

   a. Drops about 6.5^0C

   b. Rises about 6.5^0C

   c. Remains unchanged for the first 500 meters and then drops

   d. Rises by day and drops by night

   e. None of these

14. Which of the following represents higher than normal atmospheric pressure?

   a. 29.85" hg

   b. 30.01" hg

   c. 992 mb

   d. 1013 mb

   e. none of these

15. Which of the following statements is true of tornadoes:

   a. Occur most frequently in winter

   b. Usually occur along the warm front of a mid-latitude cyclone

   c. Most common in Midwest, Great Plains, and Southeast

   d. All the statements are false

16. What determines when a tropical storm is given hurricane status?

   a. wind speed

   b. central pressure

   c. diameter

   d. water temperature

17. Why do hurricanes initially form only in the tropics?

    a. stronger pressure gradients are found there

    b. warm water temperatures are found there

    c. subsiding air currents are found there

    d. Coriolis is weaker there

18. What is needed for cold air damming to occur?

    a. Two low pressure systems colliding

    b. Two high pressure systems colliding

    c. A mountain range and a high pressure system passing to the north

    d. Cold ocean currents and a sub-tropical low

19. Santa Anna winds predominantly blow in which direction?

    a. East

    b. West

    c. South

    d. North

20. The warming of air and dissipation of cloudiness as air descends the lee side of a barrier is often referred to as:

    a. The rain shadow effect

    b. Lee cyclogenesis

    c. A hail storm

    d. The steam point

21. Since the 1970's, what has been the most lethal weather phenomenon?

   a. Hurricanes

   b. Tornados

   c. Floods

   d. Heat waves

22. The wind direction in a mid-latitude travelling cyclone is:

   a. from the south

   b. from the north

   c. from the east

   d. from the northeast

   e. dependent on your location relative to the storm center

23. Sea breezes are most common at what time of the day?

   a. Morning

   b. Mid-day

   c. Afternoon

   d. Nighttime

24. Which location sees the greatest average range in yearly temperatures?

   a. Biloxi, Mississippi

   b. Anchorage, Alaska

   c. Minneapolis, Minnesota

   d. Orlando, Florida

25. Atmospheric pressure is caused by:

    a. the air's motion.

    b. earth's magnetic field.

    c. the weight of the air above.

    d. solar radiation.

26. The vertical temperature structure of the troposphere is described by

    a. the wind speed.

    b. its density.

    c. the lapse rate.

    d. the barometric pressure.

    e. none of these

27. The primary cause of the earth's seasons is

    a. inclination and parallelism of earth's axis of rotation

    b. varying orbital speed during revolution around the sun

    c. varying distance from the sun because of an elliptical orbit of revolution

    d. regular changes in radiation emitted by the sun

    e. changes in atmospheric thickness

28. The cloud droplets in a cloud are formed by water vapor molecules and

    a. molecules of air

    b. other water vapor molecules

    c. condensation nuclei

    d. protons

    e. ions

29. The force that governs wind speed is:

    a. coriolis
    b. centrifugal force
    c. gravity
    d. pressure gradient

30. How does air tend to rise in a mid-latitude traveling cyclone?

    a. warm air is forced up along the cold front
    b. converging surface winds make the air rise
    c. warm air glides upward along the warm front
    d. winds in the upper atmosphere exert a lifting effect
    e. all of the above

APPENDIX C

SENSE OF PLACE SURVEYS

Geological Sense of Place Survey

***Geological Sense of Place* Writing Template (A copyright of EarthScholars, reprinted with permission form the authors)**

The goal of this learning tool is to help you recall, and connect, the experiences you had with geological products, landforms, and

processes as a youth with the concepts you are learning about physical geology this semester.

PART I: Write short answers to each of the 17 "memory probes" below.

1. Which geological product was an important part of "playtime" in your yard?
2. What part of the earth interested you the most as a child?
3. Was there a particular rock or earth-related item that you enjoyed collecting during your childhood?
4. Did you have a particular chore or job as a youth that involved rocks or minerals?
5. Was there a favorite rock or landform you used to sit on or climb in your neighborhood?
6. As a youth, what was your favorite geological process to read about, view on television, or experience?
7. Did any of your childhood crafts involve making things from rocks or geological products?
8. Did any particular kind of rock have a texture you enjoyed touching as a youth?
9. What was the most unusual rock, landform, or geological process you encountered as a child?
10. Did you have your own rock or fossil collection? If so, which types did you have?
11. What geological formation or product was your town or geographic area most famous for?
12. Was there any particular geological object or landform you avoided, or were afraid of as a child?
13. What exotic geologic location made a big impression on you as a child?
14. Were there any sounds associated with geological processes or events you can remember from your childhood?
15. Did you have a person in your youth who was your geology mentor, and what did you learn from her/him about identifying or

understanding rocks, fossils, or earth processes?

16. What was your favorite gemstone as a child, and why?
17. When you hear the word *rock*, which color do you associate with the word?

PART II: Complete two mini-essays using memories that you've "tapped into" during PART ONE. Choose any of these

"take-off sentences" to begin each essay you write. Use the two attached blank pages for the actual essay writing.

A. It was one of the very best days of my childhood, and it involved the rock/mineral/landform called . . . .

B. The geological process I learned the most about from practical experiences in my childhood was . . . .

C. I had been warned about the . . . (geological object, landform, or process), but I didn't . . . .

D. When I think of my grandmother/grandmother/father/mother (circle one), the geological object, event, or landform I associate
most with that person is the . . . . My memories revolve around . . . .

E. From my youth, I remember this geological object/process/landform was featured in the story . . . , most prominently--of all the
children's books that I read--because . . . .

PART III: What connections do you NOW see between your own memories of your geological sense of place and three
selected physical geology concepts that you are learning about in this geology course?

Geology concept A: ____________ Connection: . . . .
Geology concept B: ____________ Connection: . . . .
Geology concept C: ____________ Connection: . . . .

Students will also be asked to click on an electronic map of the United States to indicate the geographic region that they consider to be "home".

For research purposes, students will also be asked basic demographic information such as:

Age, sex, current zip-code, and ethnic background

Meteorological Sense of Place Survey

PART I: Write short answers to each of the 18 "memory probes" below.

1. What were your favorite weather events as a child? Why?
2. Do you remember ever fearing any type of weather as a child?
3. Is there one particular weather event you experienced growingup that you will never forget?
4. Did your parents have a job that was dependent on or influenced by the weather? Explain.
5. Did you have a favorite type of weather event that you enjoyed reading about as a child?
6. Were any of your childhood crafts weather dependant?

7. Did you have any person in your youth who was a "weather mentor?"

8. Did you enjoy watching weather-type shows on TV as a child?

9. When you think of a rain event from your youth, what comes to mind? What did it smell like?

10. When you think of a rain storm, can you remember how a typical one sounded in your childhood?

11. Describe your perfect weather day as a child.

12. When you were growingup, did you understand what humidity was, and how it affects temperature? What did it feel like?

13. What did the sky typically look like during the summer where you lived as a child? What did it smell like?

14. What did the sky typically look like during the winter where you lived as a child? What did it smell like?

15. As a child, what do you remember about the words "wind-chill?"

16. What were typical activities that you participated in as a child that were weather dependent?

17. Do you have many childhood memories that involve snow?

18. When you think of wind hitting your skin, how do you remember it feeling?

PART II: Complete two mini-essays using memories that you've "tapped into" during PART ONE. Choose any of these "take-off sentences" to begin each essay you write.

A. It was one of the very best days of my childhood, and it involved the weather event called . . . .

B. The weather process I learned the most about from practical experiences in my childhood was . . . .

C. I had been warned about the . . . (weather event), but I didn't . . . .

D. When I think of my grandmother/grandmother/father/mother (circle one), the meteorological phenomenon, weather event, or occurrence I associate most with that person is the . . . . My memories revolve around . . . .

E. From my youth, I remember this weather event was featured in the story . . . , most prominently--of all the children's books that I read--because . . . .

PART III: What connections do you NOW see between your own memories of your meteorological sense of place and three

selected physical geology concepts that you are learning about in this geology course?

Meteorological concept A: _____________ Connection: . . . .
Meteorological concept B: _____________ Connection: . . . .
Meteorological concept C: _____________ Connection: . . . .

Students will also be asked to click on an electronic map of the United States to indicate the geographic region that they consider to be "home".

APPENDIX D

SENSE OF PLACE SURVEY RESULTS

Refer to Supplemental File:

SenseofPlaceSurveyResults.docx

Created in Microsoft Word 2007

12/2/2014

APPENDIX E

METEOROLOGICAL PHENOMENON MAPS

Reported Tornado Frequency Map By County

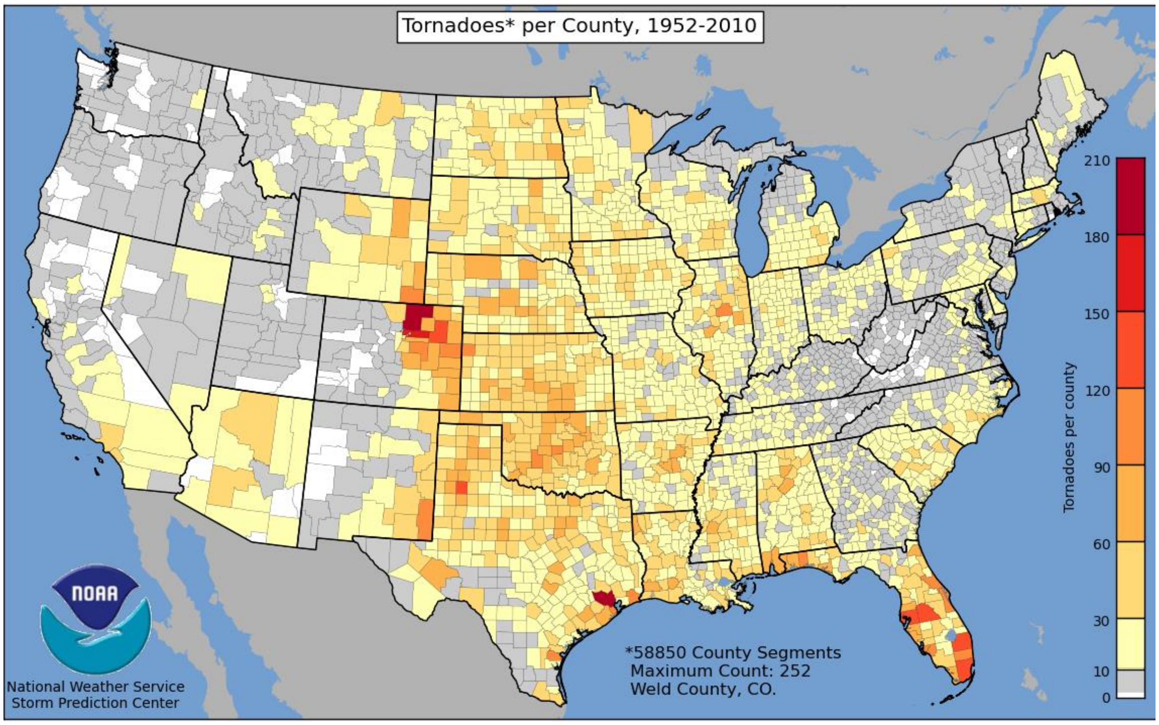


Figure E.1 The total number of tornadoes per county in the continental U.S. from 1952-2012 as reported by NOAA.

Humidity Map

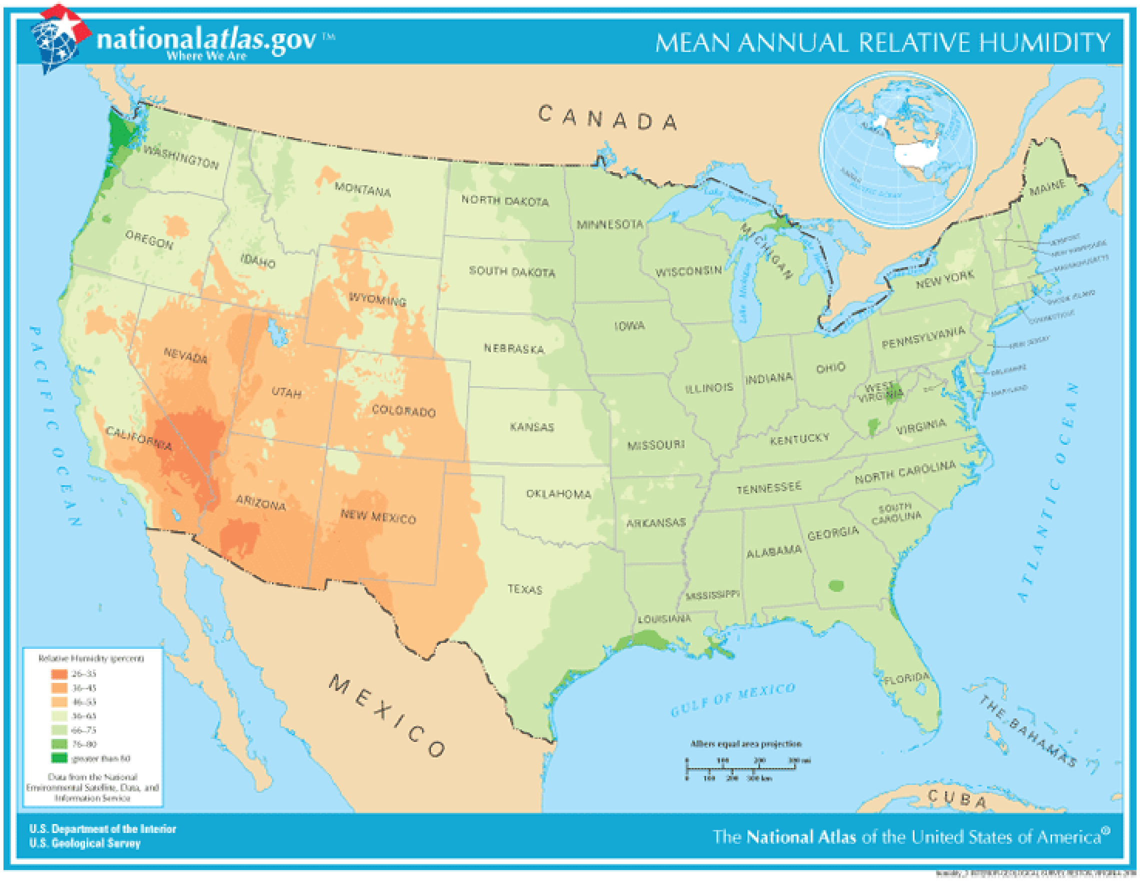


Figure E.2 The mean annual relative humidity for the continental U.S. as reported by the U.S. Department of Interior and the U.S. Geological Survey

APPENDIX F

STATISTICS TABLES

Geological Statistical Analysis

Table F.1 Geology Pairwise Comparisons for Each Geology I Assessment

Geology Pairwise Comparisons

(I) assessments	(J) assessments	Mean Difference (I-J)	Std. Error	Sig.b	95% Confidence Interval Lower Bound	Upper Bound
1	2	.370	1.130	1.000	-4.441	5.181
	3	-.370	1.250	1.000	-5.691	4.950
	4	1.111	1.445	1.000	-5.043	7.265
	5	5.185	1.347	.145	-.551	10.921
	6	4.444	1.541	1.000	-2.116	11.005
	7	4.074	3.895	1.000	-12.511	20.659
	8	4.074	1.791	1.000	-3.552	11.700
	9	3.333	1.925	1.000	-4.861	11.527
	10	13.704*	2.677	.005	2.307	25.100
	11	2.222	1.875	1.000	-5.759	10.203
	12	11.111	3.934	1.000	-5.640	27.863
	13	4.815	1.884	1.000	-3.207	12.837
	14	7.731	1.985	.129	-0.721	16.184
	15	13.131*	2.193	.001	3.794	22.468
	16	20.241*	2.110	.000	11.255	29.226
	17	15.889*	2.390	.000	5.711	26.066
	18	18.426*	2.909	.000	6.039	30.812
	19	6.733*	1.512	.030	0.295	13.172
	20	16.822*	3.575	.015	1.602	32.042
	21	8.172*	1.482	.002	1.864	14.479
2	1	-.370	1.130	1.000	-5.181	4.441
	3	-.741	1.185	1.000	-5.785	4.303
	4	.741	1.185	1.000	-4.303	5.785
	5	4.815	1.634	1.000	-2.142	11.771
	6	4.074	1.438	1.000	-2.049	10.197
	7	3.704	3.665	1.000	-11.901	19.308
	8	3.704	1.427	1.000	-2.372	9.780
	9	2.963	2.189	1.000	-6.356	12.282
	10	13.333*	2.504	.003	2.674	23.993
	11	1.852	1.852	1.000	-6.033	9.736

Table F.1 (continued)

	12	10.741	4.027	1.000	-6.406	27.887
	13	4.444	2.083	1.000	-4.423	13.311
	14	7.361	2.224	.576	-2.108	16.831
	15	12.761*	2.263	.001	3.127	22.395
	16	19.870*	2.276	.000	10.178	29.563
	17	15.519*	2.474	.000	4.987	26.050
	18	18.056*	3.061	.001	5.024	31.087
	19	6.363	1.555	.077	-0.259	12.985
	20	16.452	3.894	.054	-0.127	33.030
	21	7.801*	1.610	.011	0.948	14.654
3	1	.370	1.250	1.000	-4.950	5.691
	2	.741	1.185	1.000	-4.303	5.785
	4	1.481	1.663	1.000	-5.598	8.561
	5	5.556	1.716	.689	-1.750	12.861
	6	4.815	1.449	.557	-1.355	10.985
	7	4.444	3.749	1.000	-11.518	20.407
	8	4.444	1.233	.272	-.804	9.693
	9	3.704	2.336	1.000	-6.241	13.648
	10	14.074*	2.461	.001	3.596	24.553
	11	2.593	2.039	1.000	-6.089	11.274
	12	11.481	3.234	.313	-2.287	25.250
	13	5.185	2.092	1.000	-3.722	14.092
	14	8.102	2.228	.251	-1.382	17.586
	15	13.501*	2.416	.002	3.213	23.790
	16	20.611*	2.286	.000	10.878	30.344
	17	16.259*	2.655	.000	4.954	27.565
	18	18.796*	3.043	.000	5.841	31.751
	19	7.104*	1.514	.016	0.658	13.549
	20	17.193*	3.789	.024	1.060	33.325
	21	8.542*	1.546	.002	1.961	15.123
4	1	-1.111	1.445	1.000	-7.265	5.043
	2	-.741	1.185	1.000	-5.785	4.303
	3	-1.481	1.663	1.000	-8.561	5.598
	5	4.074	1.710	1.000	-3.205	11.353
	6	3.333	1.412	1.000	-2.679	9.346
	7	2.963	3.368	1.000	-11.377	17.303
	8	2.963	1.911	1.000	-5.172	11.098
	9	2.222	2.222	1.000	-7.239	11.684

Table F.1 (continued)

	10	12.593*	2.593	.010	1.554	23.631
	11	1.111	1.541	1.000	-5.449	7.672
	12	10.000	4.065	1.000	-7.308	27.308
	13	3.704	2.203	1.000	-5.677	13.084
	14	6.62	2.343	1.000	-3.353	16.594
	15	12.020*	2.402	.007	1.793	22.247
	16	19.130*	2.395	.000	8.931	29.328
	17	14.778*	2.637	.001	3.551	26.005
	18	17.315*	3.109	.002	4.079	30.550
	19	5.622	1.598	.339	-1.180	12.425
	20	15.711*	3.684	.049	0.027	31.396
	21	7.060*	1.518	.018	0.596	13.525
5	1	-5.185	1.347	.145	-10.921	.551
	2	-4.815	1.634	1.000	-11.771	2.142
	3	-5.556	1.716	.689	-12.861	1.750
	4	-4.074	1.710	1.000	-11.353	3.205
	6	-.741	1.919	1.000	-8.911	7.430
	7	-1.111	4.006	1.000	-18.168	15.946
	8	-1.111	2.285	1.000	-10.842	8.620
	9	-1.852	1.691	1.000	-9.052	5.348
	10	8.519	2.758	0.996	-3.225	20.262
	11	-2.963	1.911	1.000	-11.098	5.172
	12	5.926	3.895	1.000	-10.659	22.511
	13	-0.37	1.694	1.000	-7.583	6.842
	14	2.546	1.457	1.000	-3.658	8.750
	15	7.946	1.930	.072	-0.271	16.163
	16	15.056*	1.993	.000	6.570	23.541
	17	10.704*	1.772	.000	3.159	18.248
	18	13.241*	2.202	.001	3.864	22.617
	19	1.548	1.868	1.000	-6.404	9.500
	20	11.637	3.357	.388	-2.656	25.930
	21	2.986	1.582	1.000	-3.749	9.722
6	1	-4.444	1.541	1.000	-11.005	2.116
	2	-4.074	1.438	1.000	-10.197	2.049
	3	-4.815	1.449	.557	-10.985	1.355
	4	-3.333	1.412	1.000	-9.346	2.679
	5	.741	1.919	1.000	-7.430	8.911
	7	-.370	3.438	1.000	-15.007	14.267

Table F.1 (continued)

	8	-.370	1.554	1.000	-6.989	6.248
	9	-1.111	2.285	1.000	-10.842	8.620
	10	9.259	2.383	.132	-.885	19.404
	11	-2.222	1.716	1.000	-9.528	5.083
	12	6.667	3.958	1.000	-10.187	23.521
	13	0.37	2.231	1.000	-9.129	9.870
	14	3.287	2.460	1.000	-7.188	13.762
	15	8.687	2.558	.463	-2.204	19.577
	16	15.796*	2.664	.001	4.455	27.138
	17	11.444	2.919	.121	-0.984	23.872
	18	13.981*	3.216	.039	0.289	27.674
	19	2.289	1.789	1.000	-5.330	9.908
	20	12.378	3.759	.600	-3.626	28.382
	21	3.727	1.647	1.000	-3.287	10.741
7	1	-4.074	3.895	1.000	-20.659	12.511
	2	-3.704	3.665	1.000	-19.308	11.901
	3	-4.444	3.749	1.000	-20.407	11.518
	4	-2.963	3.368	1.000	-17.303	11.377
	5	1.111	4.006	1.000	-15.946	18.168
	6	.370	3.438	1.000	-14.267	15.007
	8	.000	3.886	1.000	-16.545	16.545
	9	-.741	4.399	1.000	-19.471	17.989
	10	9.630	4.481	1.000	-9.450	28.709
	11	-1.852	3.461	1.000	-16.586	12.883
	12	7.037	5.669	1.000	-17.101	31.175
	13	0.741	4.314	1.000	-17.626	19.107
	14	3.657	4.537	1.000	-15.659	22.974
	15	9.057	4.771	1.000	-11.255	29.369
	16	16.167	4.735	.443	-3.995	36.329
	17	11.815	4.690	1.000	-8.152	31.782
	18	14.352	5.279	1.000	-8.127	36.830
	19	2.659	3.961	1.000	-14.207	19.526
	20	12.748	5.714	1.000	-11.580	37.076
	21	4.097	4.035	1.000	-13.081	21.276
8	1	-4.074	1.791	1.000	-11.700	3.552
	2	-3.704	1.427	1.000	-9.780	2.372
	3	-4.444	1.233	.272	-9.693	.804
	4	-2.963	1.911	1.000	-11.098	5.172

Table F.1 (continued)

	5	1.111	2.285	1.000	-8.620	10.842
	6	.370	1.554	1.000	-6.248	6.989
	7	.000	3.886	1.000	-16.545	16.545
	9	-0.741	2.611	1.000	-11.857	10.375
	10	9.630	2.295	.059	-.140	19.400
	11	-1.852	2.329	1.000	-11.768	8.064
	12	7.037	3.533	1.000	-8.006	22.080
	13	0.741	2.533	1.000	-10.043	11.524
	14	3.657	2.624	1.000	-7.516	14.831
	15	9.057	2.723	.552	-2.536	20.650
	16	16.167*	2.685	.000	4.734	27.599
	17	11.815	3.077	.149	-1.288	24.918
	18	14.352	3.423	.059	-0.224	28.927
	19	2.659	1.740	1.000	-4.751	10.069
	20	12.748	3.894	.629	-3.830	29.327
	21	4.097	1.738	1.000	-3.302	11.497
9	1	-3.333	1.925	1.000	-11.527	4.861
	2	-2.963	2.189	1.000	-12.282	6.356
	3	-3.704	2.336	1.000	-13.648	6.241
	4	-2.222	2.222	1.000	-11.684	7.239
	5	1.852	1.691	1.000	-5.348	9.052
	6	1.111	2.285	1.000	-8.620	10.842
	7	.741	4.399	1.000	-17.989	19.471
	8	0.741	2.611	1.000	-10.375	11.857
	10	10.370	2.586	.096	-.642	21.383
	11	-1.111	1.875	1.000	-9.092	6.870
	12	7.778	4.180	1.000	-10.020	25.576
	13	1.481	2.025	1.000	-7.141	10.103
	14	4.398	2.195	1.000	-4.949	13.745
	15	9.798	2.461	.103	-0.679	20.274
	16	16.907*	2.549	.000	6.056	27.759
	17	12.556*	2.109	.001	3.578	21.533
	18	15.093*	2.568	.001	4.160	26.025
	19	3.4	2.390	1.000	-6.775	13.575
	20	13.489*	2.471	.002	2.968	24.010
	21	4.838	1.556	.948	-1.788	11.465
10	1	-13.704*	2.677	.005	-25.100	-2.307
	2	-13.333*	2.504	.003	-23.993	-2.674

Table F.1 (continued)

	3	-14.074*	2.461	.001	-24.553	-3.596
	4	-12.593*	2.593	.010	-23.631	-1.554
	5	-8.519	2.758	0.996	-20.262	3.225
	6	-9.259	2.383	.132	-19.404	.885
	7	-9.630	4.481	1.000	-28.709	9.450
	8	-9.630	2.295	.059	-19.400	.140
	9	-10.370	2.586	.096	-21.383	.642
	11	-11.481	2.706	.052	-23.003	.040
	12	-2.593	4.120	1.000	-20.136	14.951
	13	-8.889	2.539	.355	-19.698	1.920
	14	-5.972	2.863	1.000	-18.160	6.216
	15	-0.573	3.256	1.000	-14.435	13.290
	16	6.537	3.332	1.000	-7.650	20.724
	17	2.185	3.151	1.000	-11.229	15.600
	18	4.722	3.635	1.000	-10.755	20.199
	19	-6.97	2.485	1.000	-17.549	3.608
	20	3.119	3.971	1.000	-13.791	20.028
	21	-5.532	2.266	1.000	-15.179	4.115
11	1	-2.222	1.875	1.000	-10.203	5.759
	2	-1.852	1.852	1.000	-9.736	6.033
	3	-2.593	2.039	1.000	-11.274	6.089
	4	-1.111	1.541	1.000	-7.672	5.449
	5	2.963	1.911	1.000	-5.172	11.098
	6	2.222	1.716	1.000	-5.083	9.528
	7	1.852	3.461	1.000	-12.883	16.586
	8	1.852	2.329	1.000	-8.064	11.768
	9	1.111	1.875	1.000	-6.870	9.092
	10	11.481	2.706	.052	-.040	23.003
	12	8.889	4.077	1.000	-8.468	26.246
	13	2.593	2.225	1.000	-6.882	12.068
	14	5.509	2.325	1.000	-4.392	15.410
	15	10.909*	2.492	.036	0.300	21.517
	16	18.019*	2.473	.000	7.490	28.547
	17	13.667*	2.550	.003	2.810	24.524
	18	16.204*	2.778	.001	4.374	28.033
	19	4.511	1.661	1.000	-2.559	11.582
	20	14.600*	3.066	.013	1.545	27.655
	21	5.949*	1.296	.021	0.432	11.467

Table F.1 (continued)

12	1	-11.111	3.934	1.000	-27.863	5.640
	2	-10.741	4.027	1.000	-27.887	6.406
	3	-11.481	3.234	.313	-25.250	2.287
	4	-10.000	4.065	1.000	-27.308	7.308
	5	-5.926	3.895	1.000	-22.511	10.659
	6	-6.667	3.958	1.000	-23.521	10.187
	7	-7.037	5.669	1.000	-31.175	17.101
	8	-7.037	3.533	1.000	-22.080	8.006
	9	-7.778	4.180	1.000	-25.576	10.020
	10	2.593	4.120	1.000	-14.951	20.136
	11	-8.889	4.077	1.000	-26.246	8.468
	13	-6.296	4.367	1.000	-24.890	12.297
	14	-3.38	4.399	1.000	-22.111	15.352
	15	2.02	4.559	1.000	-17.390	21.430
	16	9.13	3.969	1.000	-7.769	26.028
	17	4.778	4.672	1.000	-15.113	24.669
	18	7.315	4.210	1.000	-10.611	25.241
	19	-4.378	3.327	1.000	-18.545	9.789
	20	5.711	4.079	1.000	-11.655	23.077
	21	-2.94	3.292	1.000	-16.954	11.075
13	1	-4.815	1.884	1.000	-12.837	3.207
	2	-4.444	2.083	1.000	-13.311	4.423
	3	-5.185	2.092	1.000	-14.092	3.722
	4	-3.704	2.203	1.000	-13.084	5.677
	5	0.37	1.694	1.000	-6.842	7.583
	6	-0.37	2.231	1.000	-9.870	9.129
	7	-0.741	4.314	1.000	-19.107	17.626
	8	-0.741	2.533	1.000	-11.524	10.043
	9	-1.481	2.025	1.000	-10.103	7.141
	10	8.889	2.539	.355	-1.920	19.698
	11	-2.593	2.225	1.000	-12.068	6.882
	12	6.296	4.367	1.000	-12.297	24.890
	14	2.917	1.096	1.000	-1.751	7.585
	15	8.316*	1.726	.011	.967	15.666
	16	15.426*	2.313	.000	5.578	25.274
	17	11.074*	1.827	.000	3.293	18.855
	18	13.611*	2.221	.000	4.156	23.067
	19	1.919	2.377	1.000	-8.200	12.037
	20	12.007	3.953	1.000	-4.823	28.838

Table F.1 (continued)

	21	3.357	2.160	1.000	-5.839	12.552
14	1	-7.731	1.985	.129	-16.184	0.721
	2	-7.361	2.224	.576	-16.831	2.108
	3	-8.102	2.228	.251	-17.586	1.382
	4	-6.62	2.343	1.000	-16.594	3.353
	5	-2.546	1.457	1.000	-8.750	3.658
	6	-3.287	2.460	1.000	-13.762	7.188
	7	-3.657	4.537	1.000	-22.974	15.659
	8	-3.657	2.624	1.000	-14.831	7.516
	9	-4.398	2.195	1.000	-13.745	4.949
	10	5.972	2.863	1.000	-6.216	18.160
	11	-5.509	2.325	1.000	-15.410	4.392
	12	3.38	4.399	1.000	-15.352	22.111
	13	-2.917	1.096	1.000	-7.585	1.751
	15	5.400	1.445	.194	-0.752	11.551
	16	12.509*	2.166	.001	3.289	21.730
	17	8.157*	1.543	.003	1.588	14.727
	18	10.694*	1.927	.002	2.489	18.900
	19	-0.998	2.364	1.000	-11.063	9.067
	20	9.091	3.782	1.000	-7.010	25.192
	21	.440	2.180	1.000	-8.842	9.723
15	1	-13.131*	2.193	.001	-22.468	-3.794
	2	-12.761*	2.263	.001	-22.395	-3.127
	3	-13.501*	2.416	.002	-23.790	-3.213
	4	-12.020*	2.402	.007	-22.247	-1.793
	5	-7.946	1.930	.072	-16.163	0.271
	6	-8.687	2.558	.463	-19.577	2.204
	7	-9.057	4.771	1.000	-29.369	11.255
	8	-9.057	2.723	.552	-20.650	2.536
	9	-9.798	2.461	.103	-20.274	0.679
	10	0.573	3.256	1.000	-13.290	14.435
	11	-10.909*	2.492	.036	-21.517	-0.300
	12	-2.02	4.559	1.000	-21.430	17.390
	13	-8.316*	1.726	.011	-15.666	-.967
	14	-5.400	1.445	.194	-11.551	0.752
	16	7.110	1.876	.169	-0.878	15.097
	17	2.758	1.457	1.000	-3.444	8.960
	18	5.295	1.817	1.000	-2.440	13.030

Table F.1 (continued)

	19	-6.398	2.447	1.000	-16.816	4.020
	20	3.691	3.746	1.000	-12.257	19.639
	21	-4.960	2.279	1.000	-14.664	4.745
16	1	-20.241*	2.110	.000	-29.226	-11.255
	2	-19.870*	2.276	.000	-29.563	-10.178
	3	-20.611*	2.286	.000	-30.344	-10.878
	4	-19.130*	2.395	.000	-29.328	-8.931
	5	-15.056*	1.993	.000	-23.541	-6.570
	6	-15.796*	2.664	.001	-27.138	-4.455
	7	-16.167	4.735	.443	-36.329	3.995
	8	-16.167*	2.685	.000	-27.599	-4.734
	9	-16.907*	2.549	.000	-27.759	-6.056
	10	-6.537	3.332	1.000	-20.724	7.650
	11	-18.019*	2.473	.000	-28.547	-7.490
	12	-9.13	3.969	1.000	-26.028	7.769
	13	-15.426*	2.313	.000	-25.274	-5.578
	14	-12.509*	2.166	.001	-21.730	-3.289
	15	-7.110	1.876	.169	-15.097	0.878
	17	-4.352	1.811	1.000	-12.061	3.357
	18	-1.815	1.959	1.000	-10.155	6.525
	19	-13.507*	1.958	.000	-21.845	-5.170
	20	-3.419	3.705	1.000	-19.192	12.355
	21	-12.069*	2.036	.001	-20.739	-3.400
17	1	-15.889*	2.390	.000	-26.066	-5.711
	2	-15.519*	2.474	.000	-26.050	-4.987
	3	-16.259*	2.655	.000	-27.565	-4.954
	4	-14.778*	2.637	.001	-26.005	-3.551
	5	-10.704*	1.772	.000	-18.248	-3.159
	6	-11.444	2.919	.121	-23.872	0.984
	7	-11.815	4.690	1.000	-31.782	8.152
	8	-11.815	3.077	.149	-24.918	1.288
	9	-12.556*	2.109	.001	-21.533	-3.578
	10	-2.185	3.151	1.000	-15.600	11.229
	11	-13.667*	2.550	.003	-24.524	-2.810
	12	-4.778	4.672	1.000	-24.669	15.113
	13	-11.074*	1.827	.000	-18.855	-3.293
	14	-8.157*	1.543	.003	-14.727	-1.588
	15	-2.758	1.457	1.000	-8.960	3.444

Table F.1 (continued)

	16	4.352	1.811	1.000	-3.357	12.061
	18	2.537	1.732	1.000	-4.837	9.911
	19	-9.156	2.645	.393	-20.417	2.106
	20	.933	3.635	1.000	-14.541	16.408
	21	-7.717	2.369	.656	-17.804	2.369
18	1	-18.426*	2.909	.000	-30.812	-6.039
	2	-18.056*	3.061	.001	-31.087	-5.024
	3	-18.796*	3.043	.000	-31.751	-5.841
	4	-17.315*	3.109	.002	-30.550	-4.079
	5	-13.241*	2.202	.001	-22.617	-3.864
	6	-13.981*	3.216	.039	-27.674	-0.289
	7	-14.352	5.279	1.000	-36.830	8.127
	8	-14.352	3.423	.059	-28.927	0.224
	9	-15.093*	2.568	.001	-26.025	-4.160
	10	-4.722	3.635	1.000	-20.199	10.755
	11	-16.204*	2.778	.001	-28.033	-4.374
	12	-7.315	4.210	1.000	-25.241	10.611
	13	-13.611*	2.221	.000	-23.067	-4.156
	14	-10.694*	1.927	.002	-18.900	-2.489
	15	-5.295	1.817	1.000	-13.030	2.440
	16	1.815	1.959	1.000	-6.525	10.155
	17	-2.537	1.732	1.000	-9.911	4.837
	19	-11.693	2.781	.057	-23.532	.147
	20	-1.604	3.419	1.000	-16.162	12.954
	21	-10.254	2.493	.073	-20.870	.362
19	1	-6.733*	1.512	.030	-13.172	-0.295
	2	-6.363	1.555	.077	-12.985	0.259
	3	-7.104*	1.514	.016	-13.549	-0.658
	4	-5.622	1.598	.339	-12.425	1.180
	5	-1.548	1.868	1.000	-9.500	6.404
	6	-2.289	1.789	1.000	-9.908	5.330
	7	-2.659	3.961	1.000	-19.526	14.207
	8	-2.659	1.740	1.000	-10.069	4.751
	9	-3.4	2.390	1.000	-13.575	6.775
	10	6.97	2.485	1.000	-3.608	17.549
	11	-4.511	1.661	1.000	-11.582	2.559
	12	4.378	3.327	1.000	-9.789	18.545
	13	-1.919	2.377	1.000	-12.037	8.200

Table F.1 (continued)

	14	0.998	2.364	1.000	-9.067	11.063
	15	6.398	2.447	1.000	-4.020	16.816
	16	13.507*	1.958	.000	5.170	21.845
	17	9.156	2.645	.393	-2.106	20.417
	18	11.693	2.781	.057	-.147	23.532
	20	10.089	3.402	1.000	-4.394	24.572
	21	1.438	1.042	1.000	-3.000	5.876
20	1	-16.822*	3.575	.015	-32.042	-1.602
	2	-16.452	3.894	.054	-33.030	0.127
	3	-17.193*	3.789	.024	-33.325	-1.060
	4	-15.711*	3.684	.049	-31.396	-0.027
	5	-11.637	3.357	.388	-25.930	2.656
	6	-12.378	3.759	.600	-28.382	3.626
	7	-12.748	5.714	1.000	-37.076	11.580
	8	-12.748	3.894	.629	-29.327	3.830
	9	-13.489*	2.471	.002	-24.010	-2.968
	10	-3.119	3.971	1.000	-20.028	13.791
	11	-14.600*	3.066	.013	-27.655	-1.545
	12	-5.711	4.079	1.000	-23.077	11.655
	13	-12.007	3.953	1.000	-28.838	4.823
	14	-9.091	3.782	1.000	-25.192	7.010
	15	-3.691	3.746	1.000	-19.639	12.257
	16	3.419	3.705	1.000	-12.355	19.192
	17	-.933	3.635	1.000	-16.408	14.541
	18	1.604	3.419	1.000	-12.954	16.162
	19	-10.089	3.402	1.000	-24.572	4.394
	21	-8.651	2.563	.488	-19.563	2.261
21	1	-8.172*	1.482	.002	-14.479	-1.864
	2	-7.801*	1.610	.011	-14.654	-0.948
	3	-8.542*	1.546	.002	-15.123	-1.961
	4	-7.060*	1.518	.018	-13.525	-0.596
	5	-2.986	1.582	1.000	-9.722	3.749
	6	-3.727	1.647	1.000	-10.741	3.287
	7	-4.097	4.035	1.000	-21.276	13.081
	8	-4.097	1.738	1.000	-11.497	3.302
	9	-4.838	1.556	.948	-11.465	1.788
	10	5.532	2.266	1.000	-4.115	15.179
	11	-5.949*	1.296	.021	-11.467	-0.432

Table F.1 (continued)

	12	2.94	3.292	1.000	-11.075	16.954
	13	-3.357	2.160	1.000	-12.552	5.839
	14	-.440	2.180	1.000	-9.723	8.842
	15	4.960	2.279	1.000	-4.745	14.664
	16	12.069*	2.036	.001	3.400	20.739
	17	7.717	2.369	.656	-2.369	17.804
	18	10.254	2.493	.073	-.362	20.870
	19	-1.438	1.042	1.000	-5.876	3.000
	20	8.651	2.563	.488	-2.261	19.563

Based on estimated marginal means

* The mean difference is significant at the .05 level.

b Adjustment for multiple comparisons: Bonferroni.

Meteorology Statistical Analysis

Table F.2 Meteorology Pairwise Comparisons for Each Meteorology I Assessment

Meteorology Pairwise Comparisons

(I) assessments	(J) assessments	Mean Difference (I-J)	Std. Error	Sig.b	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-1.778	2.271	1.000	-10.712	7.156
	3	-4.778	1.839	1.000	-12.014	2.459
	4	-2.333	2.769	1.000	-13.228	8.561
	5	-6.111	1.580	.061	-12.329	0.107
	6	-5.222	1.853	1.000	-12.513	2.068
	7	-5.000	2.314	1.000	-14.104	4.104
	8	-2.556	2.088	1.000	-10.770	5.659
	9	-4.289	2.106	1.000	-12.575	3.997
	10	-3.222	3.028	1.000	-15.137	8.693
	11	-3.244	1.971	1.000	-11.000	4.511
	12	1.222	2.287	1.000	-7.777	10.221
	13	4.578	1.784	1.000	-2.441	11.597

Table F.2 (continued)

	14	0.156	1.683	1.000	-6.466	6.777
	15	2.889	2.509	1.000	-6.982	12.760
	16	-1.422	2.012	1.000	-9.337	6.493
	17	2.878	1.673	1.000	-3.705	9.460
	18	3.978	1.734	1.000	-2.846	10.802
	19	1.604	1.323	1.000	-3.600	6.807
2	1	1.778	2.271	1.000	-7.156	10.712
	3	-3	1.670	1.000	-9.570	3.570
	4	-.556	2.982	1.000	-12.290	11.179
	5	-4.333	2.408	1.000	-13.807	5.141
	6	-3.444	2.630	1.000	-13.791	6.902
	7	-3.222	2.548	1.000	-13.249	6.804
	8	-.778	2.649	1.000	-11.202	9.646
	9	-2.511	2.753	1.000	-13.343	8.320
	10	-1.444	3.282	1.000	-14.359	11.470
	11	-1.467	2.553	1.000	-11.513	8.580
	12	3	2.474	1.000	-6.735	12.735
	13	6.356	1.857	0.231	-.950	13.661
	14	1.933	2.541	1.000	-8.063	11.930
	15	4.667	2.195	1.000	-3.969	13.302
	16	0.356	2.231	1.000	-8.421	9.133
	17	4.656	2.298	1.000	-4.385	13.697
	18	5.756	1.952	.870	-1.924	13.435
	19	3.382	1.764	1.000	-3.561	10.324
3	1	4.778	1.839	1.000	-2.459	12.014
	2	3	1.670	1.000	-3.570	9.570
	4	2.444	2.810	1.000	-8.611	13.500
	5	-1.333	1.923	1.000	-8.899	6.232
	6	-.444	1.984	1.000	-8.249	7.360
	7	-.222	2.144	1.000	-8.656	8.212
	8	2.222	2.245	1.000	-6.610	11.055
	9	.489	2.707	1.000	-10.164	11.141
	10	1.556	2.696	1.000	-9.052	12.163
	11	1.533	2.103	1.000	-6.740	9.807
	12	6.000	2.408	1.000	-3.474	15.474
	13	9.356*	2.006	0.005	1.461	17.250
	14	4.933	2.465	1.000	-4.764	14.631
	15	7.667	2.655	1.000	-2.780	18.113

Table F.2 (continued)

	16	3.356	2.070	1.000	-4.790	11.501
	17	7.656	2.172	.171	-0.889	16.200
	18	8.756*	1.696	.001	2.084	15.427
	19	6.382	1.628	.052	-0.024	12.787
4	1	2.333	2.769	1.000	-8.561	13.228
	2	0.556	2.982	1.000	-11.179	12.290
	3	-2.444	2.810	1.000	-13.500	8.611
	5	-3.778	2.918	1.000	-15.258	7.703
	6	-2.889	2.818	1.000	-13.977	8.199
	7	-2.667	2.778	1.000	-13.597	8.264
	8	-.222	2.472	1.000	-9.948	9.503
	9	-1.956	3.491	1.000	-15.692	11.781
	10	-.889	3.479	1.000	-14.577	12.799
	11	-.911	2.680	1.000	-11.457	9.635
	12	3.556	2.444	1.000	-6.062	13.173
	13	6.911	3.006	1.000	-4.916	18.738
	14	2.489	3.194	1.000	-10.080	15.058
	15	5.222	3.512	1.000	-8.594	19.039
	16	0.911	3.155	1.000	-11.502	13.324
	17	5.211	2.801	1.000	-5.809	16.231
	18	6.311	2.914	1.000	-5.153	17.776
	19	3.937	2.673	1.000	-6.578	14.452
5	1	6.111	1.580	.061	-0.107	12.329
	2	4.333	2.408	1.000	-5.141	13.807
	3	1.333	1.923	1.000	-6.232	8.899
	4	3.778	2.918	1.000	-7.703	15.258
	6	0.889	1.583	1.000	-5.341	7.119
	7	1.111	2.161	1.000	-7.391	9.613
	8	3.556	2.317	1.000	-5.562	12.673
	9	1.822	2.484	1.000	-7.950	11.595
	10	2.889	2.614	1.000	-7.394	13.172
	11	2.867	1.981	1.000	-4.928	10.662
	12	7.333	2.387	.622	-2.058	16.725
	13	10.689*	2.347	0.007	1.454	19.924
	14	6.267	1.975	0.471	-1.506	14.039
	15	9.000	2.898	0.567	-2.402	20.402
	16	4.689	2.158	1.000	-3.804	13.181
	17	8.989*	1.679	0.001	2.384	15.593

Table F.2 (continued)

	18	10.089*	1.705	0.000	3.382	16.795
	19	7.715*	1.487	0.001	1.865	13.565
6	1	5.222	1.853	1.000	-2.068	12.513
	2	3.444	2.630	1.000	-6.902	13.791
	3	0.444	1.984	1.000	-7.360	8.249
	4	2.889	2.818	1.000	-8.199	13.977
	5	-0.889	1.583	1.000	-7.119	5.341
	7	0.222	2.096	1.000	-8.024	8.469
	8	2.667	2.069	1.000	-5.476	10.809
	9	0.933	2.815	1.000	-10.141	12.007
	10	2	2.763	1.000	-8.873	12.873
	11	1.978	2.055	1.000	-6.109	10.065
	12	6.444	2.136	0.723	-1.959	14.848
	13	9.800*	2.490	0.050	0.002	19.598
	14	5.378	2.465	1.000	-4.321	15.077
	15	8.111	2.956	1.000	-3.520	19.742
	16	3.800	2.310	1.000	-5.288	12.888
	17	8.100	2.209	0.113	-0.592	16.792
	18	9.200*	1.997	0.006	1.344	17.056
	19	6.826	1.854	0.108	-0.470	14.122
7	1	5.000	2.314	1.000	-4.104	14.104
	2	3.222	2.548	1.000	-6.804	13.249
	3	.222	2.144	1.000	-8.212	8.656
	4	2.667	2.778	1.000	-8.264	13.597
	5	-1.111	2.161	1.000	-9.613	7.391
	6	-0.222	2.096	1.000	-8.469	8.024
	8	2.444	2.360	1.000	-6.843	11.731
	9	0.711	3.137	1.000	-11.631	13.053
	10	1.778	2.702	1.000	-8.854	12.410
	11	1.756	1.985	1.000	-6.055	9.566
	12	6.222	2.115	.887	-2.100	14.544
	13	9.578	2.698	.159	-1.037	20.193
	14	5.156	2.786	1.000	-5.806	16.117
	15	7.889	3.070	1.000	-4.191	19.968
	16	3.578	2.605	1.000	-6.672	13.828
	17	7.878	2.101	0.088	-.390	16.145
	18	8.978*	1.785	0.001	1.956	15.999
	19	6.604	1.871	0.169	-.759	13.967

Table F.2 (continued)

8	1	2.556	2.088	1.000	-5.659	10.770
	2	.778	2.649	1.000	-9.646	11.202
	3	-2.222	2.245	1.000	-11.055	6.610
	4	.222	2.472	1.000	-9.503	9.948
	5	-3.556	2.317	1.000	-12.673	5.562
	6	-2.667	2.069	1.000	-10.809	5.476
	7	-2.444	2.360	1.000	-11.731	6.843
	9	-1.733	3.243	1.000	-14.495	11.028
	10	-0.667	3.120	1.000	-12.944	11.611
	11	-0.689	1.775	1.000	-7.674	6.296
	12	3.778	1.834	1.000	-3.437	10.993
	13	7.133	2.409	.842	-2.345	16.611
	14	2.711	2.013	1.000	-5.209	10.631
	15	5.444	2.732	1.000	-5.305	16.194
	16	1.133	1.835	1.000	-6.086	8.353
	17	5.433	2.097	1.000	-2.817	13.684
	18	6.533	1.833	.153	-0.679	13.745
	19	4.159	1.659	1.000	-2.367	10.686
9	1	4.289	2.106	1.000	-3.997	12.575
	2	2.511	2.753	1.000	-8.320	13.343
	3	-.489	2.707	1.000	-11.141	10.164
	4	1.956	3.491	1.000	-11.781	15.692
	5	-1.822	2.484	1.000	-11.595	7.950
	6	-.933	2.815	1.000	-12.007	10.141
	7	-.711	3.137	1.000	-13.053	11.631
	8	1.733	3.243	1.000	-11.028	14.495
	10	1.067	3.753	1.000	-13.701	15.834
	11	1.044	3.040	1.000	-10.916	13.005
	12	5.511	3.043	1.000	-6.463	17.485
	13	8.867	2.501	.162	-0.974	18.707
	14	4.444	2.637	1.000	-5.932	14.821
	15	7.178	2.790	1.000	-3.799	18.154
	16	2.867	2.881	1.000	-8.467	14.201
	17	7.167	2.857	1.000	-4.073	18.406
	18	8.267	2.705	0.651	-2.378	18.911
	19	5.893	2.446	1.000	-3.733	15.518
10	1	3.222	3.028	1.000	-8.693	15.137
	2	1.444	3.282	1.000	-11.470	14.359

Table F.2 (continued)

	3	-1.556	2.696	1.000	-12.163	9.052
	4	.889	3.479	1.000	-12.799	14.577
	5	-2.889	2.614	1.000	-13.172	7.394
	6	-2.000	2.763	1.000	-12.873	8.873
	7	-1.778	2.702	1.000	-12.410	8.854
	8	.667	3.120	1.000	-11.611	12.944
	9	-1.067	3.753	1.000	-15.834	13.701
	11	-0.022	2.634	1.000	-10.387	10.343
	12	4.444	3.311	1.000	-8.584	17.473
	13	7.8	3.435	1.000	-5.715	21.315
	14	3.378	3.303	1.000	-9.618	16.373
	15	6.111	3.703	1.000	-8.459	20.681
	16	1.8	3.107	1.000	-10.426	14.026
	17	6.1	3.045	1.000	-5.881	18.081
	18	7.2	2.860	1.000	-4.055	18.455
	19	4.826	2.810	1.000	-6.232	15.883
11	1	3.244	1.971	1.000	-4.511	11.000
	2	1.467	2.553	1.000	-8.580	11.513
	3	-1.533	2.103	1.000	-9.807	6.740
	4	0.911	2.680	1.000	-9.635	11.457
	5	-2.867	1.981	1.000	-10.662	4.928
	6	-1.978	2.055	1.000	-10.065	6.109
	7	-1.756	1.985	1.000	-9.566	6.055
	8	0.689	1.775	1.000	-6.296	7.674
	9	-1.044	3.040	1.000	-13.005	10.916
	10	0.022	2.634	1.000	-10.343	10.387
	12	4.467	2.193	1.000	-4.162	13.096
	13	7.822	2.149	.122	-0.632	16.276
	14	3.4	2.026	1.000	-4.571	11.371
	15	6.133	2.480	1.000	-3.626	15.892
	16	1.822	1.842	1.000	-5.425	9.069
	17	6.122	1.815	.267	-1.020	13.265
	18	7.222	2.013	.143	-0.700	15.144
	19	4.848	1.548	.527	-1.242	10.939
12	1	-1.222	2.287	1.000	-10.221	7.777
	2	-3	2.474	1.000	-12.735	6.735
	3	-6.000	2.408	1.000	-15.474	3.474
	4	-3.556	2.444	1.000	-13.173	6.062

Table F.2 (continued)

	5	-7.333	2.387	0.622	-16.725	2.058
	6	-6.444	2.136	0.723	-14.848	1.959
	7	-6.222	2.115	0.887	-14.544	2.100
	8	-3.778	1.834	1.000	-10.993	3.437
	9	-5.511	3.043	1.000	-17.485	6.463
	10	-4.444	3.311	1.000	-17.473	8.584
	11	-4.467	2.193	1.000	-13.096	4.162
	13	3.356	2.283	1.000	-5.628	12.339
	14	-1.067	2.259	1.000	-9.954	7.821
	15	1.667	2.616	1.000	-8.625	11.959
	16	-2.644	2.254	1.000	-11.513	6.224
	17	1.656	2.124	1.000	-6.701	10.012
	18	2.756	1.863	1.000	-4.574	10.085
	19	0.382	1.715	1.000	-6.365	7.128
13	1	-4.578	1.784	1.000	-11.597	2.441
	2	-6.356	1.857	.231	-13.661	0.950
	3	-9.356*	2.006	.005	-17.250	-1.461
	4	-6.911	3.006	1.000	-18.738	4.916
	5	-10.689*	2.347	.007	-19.924	-1.454
	6	-9.800*	2.490	.050	-19.598	-.002
	7	-9.578	2.698	.159	-20.193	1.037
	8	-7.133	2.409	0.842	-16.611	2.345
	9	-8.867	2.501	0.162	-18.707	.974
	10	-7.800	3.435	1.000	-21.315	5.715
	11	-7.822	2.149	0.122	-16.276	.632
	12	-3.356	2.283	1.000	-12.339	5.628
	14	-4.422	1.853	1.000	-11.714	2.869
	15	-1.689	1.930	1.000	-9.284	5.906
	16	-6.000	1.865	0.416	-13.339	1.339
	17	-1.7	2.247	1.000	-10.539	7.139
	18	-0.6	1.940	1.000	-8.235	7.035
	19	-2.974	1.530	1.000	-8.995	3.047
14	1	-0.156	1.683	1.000	-6.777	6.466
	2	-1.933	2.541	1.000	-11.930	8.063
	3	-4.933	2.465	1.000	-14.631	4.764
	4	-2.489	3.194	1.000	-15.058	10.080
	5	-6.267	1.975	.471	-14.039	1.506
	6	-5.378	2.465	1.000	-15.077	4.321

Table F.2 (continued)

	7	-5.156	2.786	1.000	-16.117	5.806
	8	-2.711	2.013	1.000	-10.631	5.209
	9	-4.444	2.637	1.000	-14.821	5.932
	10	-3.378	3.303	1.000	-16.373	9.618
	11	-3.4	2.026	1.000	-11.371	4.571
	12	1.067	2.259	1.000	-7.821	9.954
	13	4.422	1.853	1.000	-2.869	11.714
	15	2.733	2.247	1.000	-6.109	11.576
	16	-1.578	1.516	1.000	-7.541	4.386
	17	2.722	1.916	1.000	-4.815	10.260
	18	3.822	1.859	1.000	-3.494	11.138
	19	1.448	1.374	1.000	-3.959	6.855
15	1	-2.889	2.509	1.000	-12.760	6.982
	2	-4.667	2.195	1.000	-13.302	3.969
	3	-7.667	2.655	1.000	-18.113	2.780
	4	-5.222	3.512	1.000	-19.039	8.594
	5	-9	2.898	.567	-20.402	2.402
	6	-8.111	2.956	1.000	-19.742	3.520
	7	-7.889	3.070	1.000	-19.968	4.191
	8	-5.444	2.732	1.000	-16.194	5.305
	9	-7.178	2.790	1.000	-18.154	3.799
	10	-6.111	3.703	1.000	-20.681	8.459
	11	-6.133	2.480	1.000	-15.892	3.626
	12	-1.667	2.616	1.000	-11.959	8.625
	13	1.689	1.930	1.000	-5.906	9.284
	14	-2.733	2.247	1.000	-11.576	6.109
	16	-4.311	2.150	1.000	-12.771	4.149
	17	-0.011	2.593	1.000	-10.212	10.189
	18	1.089	2.498	1.000	-8.741	10.919
	19	-1.285	2.009	1.000	-9.191	6.620
16	1	1.422	2.012	1.000	-6.493	9.337
	2	-0.356	2.231	1.000	-9.133	8.421
	3	-3.356	2.070	1.000	-11.501	4.790
	4	-0.911	3.155	1.000	-13.324	11.502
	5	-4.689	2.158	1.000	-13.181	3.804
	6	-3.8	2.310	1.000	-12.888	5.288
	7	-3.578	2.605	1.000	-13.828	6.672
	8	-1.133	1.835	1.000	-8.353	6.086

Table F.2 (continued)

	9	-2.867	2.881	1.000	-14.201	8.467
	10	-1.800	3.107	1.000	-14.026	10.426
	11	-1.822	1.842	1.000	-9.069	5.425
	12	2.644	2.254	1.000	-6.224	11.513
	13	6	1.865	.416	-1.339	13.339
	14	1.578	1.516	1.000	-4.386	7.541
	15	4.311	2.150	1.000	-4.149	12.771
	17	4.3	2.173	1.000	-4.249	12.849
	18	5.4	1.930	1.000	-2.193	12.993
	19	3.026	1.475	1.000	-2.777	8.828
17	1	-2.878	1.673	1.000	-9.460	3.705
	2	-4.656	2.298	1.000	-13.697	4.385
	3	-7.656	2.172	.171	-16.200	0.889
	4	-5.211	2.801	1.000	-16.231	5.809
	5	-8.989*	1.679	.001	-15.593	-2.384
	6	-8.100	2.209	.113	-16.792	0.592
	7	-7.878	2.101	.088	-16.145	0.390
	8	-5.433	2.097	1.000	-13.684	2.817
	9	-7.167	2.857	1.000	-18.406	4.073
	10	-6.100	3.045	1.000	-18.081	5.881
	11	-6.122	1.815	0.267	-13.265	1.020
	12	-1.656	2.124	1.000	-10.012	6.701
	13	1.7	2.247	1.000	-7.139	10.539
	14	-2.722	1.916	1.000	-10.260	4.815
	15	0.011	2.593	1.000	-10.189	10.212
	16	-4.3	2.173	1.000	-12.849	4.249
	18	1.1	1.469	1.000	-4.681	6.881
	19	-1.274	1.015	1.000	-5.267	2.719
18	1	-3.978	1.734	1.000	-10.802	2.846
	2	-5.756	1.952	.870	-13.435	1.924
	3	-8.756*	1.696	.001	-15.427	-2.084
	4	-6.311	2.914	1.000	-17.776	5.153
	5	-10.089*	1.705	.000	-16.795	-3.382
	6	-9.200*	1.997	.006	-17.056	-1.344
	7	-8.978*	1.785	.001	-15.999	-1.956
	8	-6.533	1.833	.153	-13.745	0.679
	9	-8.267	2.705	.651	-18.911	2.378
	10	-7.200	2.860	1.000	-18.455	4.055

Table F.2 (continued)

	11	-7.222	2.013	0.143	-15.144	0.700
	12	-2.756	1.863	1.000	-10.085	4.574
	13	0.600	1.940	1.000	-7.035	8.235
	14	-3.822	1.859	1.000	-11.138	3.494
	15	-1.089	2.498	1.000	-10.919	8.741
	16	-5.4	1.930	1.000	-12.993	2.193
	17	-1.1	1.469	1.000	-6.881	4.681
	19	-2.374	0.835	1.000	-5.661	0.913
19	1	-1.604	1.323	1.000	-6.807	3.600
	2	-3.382	1.764	1.000	-10.324	3.561
	3	-6.382	1.628	.052	-12.787	0.024
	4	-3.937	2.673	1.000	-14.452	6.578
	5	-7.715*	1.487	.001	-13.565	-1.865
	6	-6.826	1.854	.108	-14.122	0.470
	7	-6.604	1.871	.169	-13.967	0.759
	8	-4.159	1.659	1.000	-10.686	2.367
	9	-5.893	2.446	1.000	-15.518	3.733
	10	-4.826	2.810	1.000	-15.883	6.232
	11	-4.848	1.548	0.527	-10.939	1.242
	12	-0.382	1.715	1.000	-7.128	6.365
	13	2.974	1.530	1.000	-3.047	8.995
	14	-1.448	1.374	1.000	-6.855	3.959
	15	1.285	2.009	1.000	-6.620	9.191
	16	-3.026	1.475	1.000	-8.828	2.777
	17	1.274	1.015	1.000	-2.719	5.267
	18	2.374	0.835	1.000	-0.913	5.661

Based on estimated marginal means

* The mean difference is significant at the .05 level.

b Adjustment for multiple comparisons: Bonferroni.

APPENDIX G

INTERVIEW TRANSCRIPTS

Refer to Supplemental File:

InterviewsResponses.docx

Created in Microsoft Word 2007

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