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Critical Intersections of Knowledge and Pedagogy: Why the Geographic Literacy of Preservice Elementary Teachers Matter?

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Abstract

This research examines the geographic literacy of a group of preservice elementary (K-5) teachers in a mid-sized university located in America's Midwest Rust Belt. The research sought to achieve three main aims using a geographic literacy survey. The first aim was to examine the approximate geographic literacy of the participants. The second aim was to determine how comfortable the participants were with teaching geography content in the future, and the third aim was to determine the extent to which preservice teachers demonstrated the ability and willingness to adopt a critical stance to spatial thinking in the future. From the geographic literacy survey, we found that many of the preservice teachers demonstrated adequate place-based and geographic knowledge. However, many of the participants also showed some deficits in spatial thinking skills, and in the application and contextualization of geospatial knowledge beyond map-based activities. The research also found that the participants expressed an overall discomfort with teaching geography materials in the future, this indicated their inadequate mastery of key geographic literacy skills. To arrive at these findings, this research used a multi-method approach that was epistemologically framed by Kolb's Experimental Learning Theory (KELT) and Critical Literacy Theory (CL).

Keywords: Geographic literacy, Geospatial thinking, Preservice teachers, Geography education

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Introduction

Why Examine the Geographic Literacy of Preservice Elementary Teachers

Teacher education is primarily geared at equipping preservice teachers with the requisite knowledge, skills, and competencies necessary for their future jobs. This research examined how knowledge and pedagogy in geography intersects among a group of preservice teachers. The research used a Likert scale (Silverman 2000) in conjunction with narrative analysis to evaluate the preservice teachers' comfort levels with teaching geography materials in the future. It is the assertion of this piece that learning environments influence students' outcomes. Therefore, the geospatial knowledge base of some K-5 students is to some degree predicated upon their teachers' efforts to achieve the subject-specific learning goals. This, we agree, is hinged on the teachers' own geographic literacy and performance after their teacher training (Fraser 2012; Wai 2009).

This research has three main aims; each represents one component of geographic literacy as defined by this piece. The first was to ascertain, using the survey instrument, the approximate geographic literacy of the preservice teachers who participated, i.e. did they demonstrate the habit of mind of thinking spatially? Second was to, examine the preservice teachers' levels of comfort in teaching geography content in the future while juxtaposing comfort levels with their actual geographic literacy and the existing body of knowledge, i.e. do they demonstrate the ability and willingness to practice spatial thinking in an informed way? Third, assess the extent to which the preservice teachers demonstrated the ability and willingness to adopt a critical stance to spatial thinking in the future. To achieve the aims of this study, the researchers administered a survey that borrowed some questions from the National Geographic Roper Reports in 2002 and 2006 and is supported by the assertions and findings of the National Research Council, 2006 report on *Learning to Think Spatially*. Additionally, the conversations in this piece are mindful of the fact that in K-5 classrooms, geography is subsumed within the broader social studies curriculum and content standards.

Think of geographic literacy as an individual's ability to first acquire geographic knowledge, skills and practices and then apply these to their understanding of the world in solving real-world problems. To be geographically literate an individual should be able to both recognize and apply spatial relationships as analytical tools. Individuals should be able to read maps, recognize, think about, analyze and make evidence-based claims about various spatial patterns and processes. Additionally, a geographically literate individual should be able to hypothesize about the relationships among various phenomena, recognizing that geography is the occurrence of events in space. Geographic literacy is the ability to analytically function; being able to demonstrate an understanding of the structure of objects; cognition in space and thinking with or through the medium of space in the abstract, and thinking about the world in which we live. These are intellectual skills that determine how we speak about and act towards places, systems, patterns, and the ability to draw logical-informed conclusions that are

inherently geographical (National Research Council, 2006; Geography Education Standards Project, 1994).

In this paper, these components of geographic literacy begin with the participants' place-based and geographic knowledge, as applied to spatial patterns and relationships. This application of geographic knowledge encourages one to become more habitual in thinking and reasoning about the when, the where, the how and the whys of spatially based phenomena and events. Geography fosters comprehension and appreciation for the reciprocities of the content, tools, skills, practices and perspectives on various peoples, places, and environments" (Geography For Life, National Geography Standards, 1994 p. 29; Duschl, 2008).

Research context

Concerns about the geographic literacy of preservice teachers are not new. In 1984, the joint committee on geographic education released guidelines aimed at improving K-12 geography instructions by targeting in-service teachers (Bednarz & Bednarz, 1995). This move precipitated investigations into the particular geospatial skills, competences and tools that preservice and in-service teachers should be exposed to and master, in order to ensure their proficiency as geography teachers (Jan Bent, Bakx, & den Brok, 2013; den Brok, 2001; Bradbeer, 1999; Henry, 1989; Stoltman, 1988). Despite concerns about the geographic literacy of preservice teachers, and many initiatives to remediate the knowledge base and key mastery of in-service teachers, not much academic research has focused on the preservice teachers' geographic literacy over the last few decades.

The outcomes of the geographic literacy survey, data analysis and discussion of findings in this piece are contextualized using a two-fold theoretical framework. The first theoretical context is Kolb's Experimental Learning Theory (KELT), which demonstrated to the preservice teachers how to become more efficient geospatial thinkers through the analysis and discussion of real-life geographical events (Jan Bent, Bakx, & den Brok 2013; Abdulwahed & Nagy, 2009; Healey & Jenkins, 2000). This theory is used as both an explanatory framework for the analysis of the preservice teachers' geographic literacy, and for the KELT workshop that was used to improve the preservice teachers' geographic literacy. The latter point is the core of our ongoing research not reported on in this piece. According to (Kolb, 1984), the KELT perspective of learning is experimental. It is epistemologically rooted in the works of Dewey, Lewin, and Piaget. The KELT places emphasis on the role of experience in the learning process. Healey and Jenkins (2000) posit that Kolb's Experimental Theory (KELT) has influenced the work of teachers and trainers since the mid-1980s, particularly those involved with students 16 years and older. These writers asserted that KELT "presents a way of sequencing the curriculum to improve students learning" (p. 185). Using a cyclical approach, KELT suggests that learning takes place through four stages; (1) concrete experience (CE), (2) reflective observation (RO), (3) abstract conceptualization/ forming generalizations (AC) and (4) active experimentation or testing (AE) (Abdulwahed & Nagy 2009; Garner, 2000; Healey & Jenkins, 2000; Kolb, 1984). The four stages in this learning spiral-cycle follow each other; however, the

learner may enter the cycle at any stage and systematically proceed through each stage while paying homage to the inherent reciprocities.

The second theoretical frame is Critical Literacy (CL). Critical Literacy was used to position and examine the desired and actual learning outcomes of both the preservice elementary teachers and their future students within complex real-world scenarios (Wolk, 2003). Critical Literacy (CL) fosters the active analysis of educational materials in an effort to unravel underlying perspectives and deeper meaning of materials through the process of applying analytical questions (Freire, 2010; Sinfield, 2006; Hagood, 2002). For Vygotsky (1986) CL is teaching so that we come to understand others, the world and ourselves more deeply, through intersections with praxis and practice in Critical Pedagogy. The CL approach encourages the teacher and the learner to question dominant ideologies, perspectives, understandings and practices. Subsequently, CL used dialogues in this piece to construct the geospatial knowledge and reasoning of the participants within the broader interconnected society (Stevens, 2000). The core of the theoretical framework of this piece is to judge the alignment of the research findings with three analytical stances put forward by the National Research Council (2006, p. 4) "(1) the existence of habit of mind of thinking spatially, (2) the practice of spatial thinking in an informed way, and (3) the ability to adopt a critical stance to spatial thinking". In concert, all these foreshadow the preservice teachers' comfort levels with teaching and interacting with geographic materials and classroom lessons in the future (Edelson, 2009; Fien 1986; Freundschuh & Sharma, 1995).

The Purpose of Study

This study aims to examine the extent to which the geographic literacy of a group of preservice elementary teachers' geographic literacy influences their levels of comfort with teaching geography materials in the future.

Methodology

Participants

Data was collected on 92 preservice elementary teachers who were either in their second (sophomore), or third (junior) year enrolled in the elementary teacher preparation program at a mid-sized university in the Midwest. The participants consisted of 89 females and three males. Sixty-five of the preservice teachers were Caucasian, including the three males who participated. Among the participants, were 27 minority preservice teachers, eighteen of whom were female and self-identified as Middle Eastern, Arabic and/or Mediterranean. Of the remaining preservice teachers, nine individuals were African American, Non-black Hispanic and Other. The age distribution among the study participants showed that 66 preservice teachers were between 18 and 24 years, and the remaining 26 participants were between 25 and 30+ years.

The only criterion used in selecting the sample for this study was their enrollment in a geography course (GEOG-1). GEOG-1 is structured to expose preservice elementary teachers to the requisite content they'll need for the social studies component of the

state administered teacher certification exam. GEOG-1 also aligned with the state's grade level content expectations for K-5 social studies (geography topics). The preservice teachers in this study were enrolled in GEOG-1 during the academic year 2011-2012. The study participants had the option of opting out of the study by not completing the survey. Of all the students who took GEOG-1 in 2011-2012, twenty-two individuals opted out while 6 individuals were removed from the study due to incomplete survey submissions. The 92 preservice teachers reported on in this study were elementary education majors, with an emphasis in a range of subjects including science, math, English and language arts, and social studies.

Given that GEOG-1 is a required course for all elementary education preservice teachers in the college despite their prior geographic knowledge and training, the participants were not given a pre-test to ascertain their geographic knowledge. Instead, the participants were given a 4-week 'crash-course' in basic geography. Some of the topics covered included (1) what is geography, why it is important, and how do we live geography every day? (2) The 5-themes of geography as a pedagogy tool; (3) Regions and regional geography; (4) Culture and cultural geography; (5) Human environment interactions and environmental awareness; (6) Map reading and the importance of geographical representations. This ensured that all the preservice teachers were exposed to some geographic knowledge prior to completing the survey.

Instrumentation and Procedures

Data for this study were collected using an online survey (Appendix I). The survey was administered at the four-week marker in the GEOG-1 course during Fall 2011, Winter 2012 and Spring/Summer 2012. Cohen, *et al*. (2000) noted that "the attraction of a survey lies in its appeal to generalizability or universality within given parameters" (p. 171). The outcomes of the survey allowed the claims of this study to be supported by data even if the study itself is not completely generalizable due to the small sample size (research location, and participants). Geographical learning involves learning about the nature of environments, climates, natural resources, and human, cultural, political, and spatial contexts of places (Thomas-Brown, 2011a). These geospatial parameters underscore the geographical skills that students in today's global society need if they are to function as effective global citizens. Therefore, as argued by Newcombe and Chiau-Ru (2007), geographical learning goes beyond encoding spatial layouts. As mentioned, the instrument used to survey the geographic literacy of the preservice teachers borrowed several of its questions from the National Geographic, geographic literacy surveys from 2002 and 2006.

This study surveyed and reported on four variables. The first was the importance and usefulness of geospatial tools, technologies and representations. The second variable focused on place-based and geographic knowledge related to key world regions and countries. The third variable evaluated access to and use of multiple sources of information to facilitate spatial awareness, thinking and reasoning, as well as cultural competency. The fourth variable was comfort with teaching geographic materials in the future. Arguably, many of the place-based knowledge and geopolitical factors evaluated

in the survey represent knowledge that should over time help both preservice teachers and their students as they navigate the world within which they live (Thomas-Brown, 2011a; Carano & Berson, 2007).

The survey (Appendix I) had 27 questions and was divided into 4 sections. The first section had 14 closed-ended questions that focused on the preservice teachers' place-based and geographic knowledge - did the respondents' place-based and geographic knowledge demonstrate any habits of mind of thinking spatially and were there any demonstrations of informed spatial thinking? The second section of the survey had five questions - did spatial thinking and geographic representations and reasoning factor into their responses? The third section of the survey had three questions, which focused on the demographic background of the participants. In the fourth section of the survey had three questions that were required. The questions in this section focused on the preservice teachers' comfort levels with teaching geographic materials in the future - did the respondents show a willingness critical stance to spatial thinking in the future? The questions were a combination of closed ended; open ended, and attitude scale questions. According to Silverman (2000), attitude-rating scales is the most widely used research approach within opinion surveys. The Likert scale for Klooster, *et al*. (2008) is well accepted because of its simplicity, reliability and its ability to be substituted for perception scales. All the open-ended questions in the survey were guided by the literature on Critical Literacy.

Data Analysis

There were three stages of data analysis. First, quantitative data collected from the survey were analyzed and frequencies and percentage distribution of responses used to identify patterns and trends. This phase was aimed at assessing the importance attached to geospatial tools, as well as geopolitical knowledge. Second, narrative analysis was used to examine responses to the open-ended questions. The narratives of the preservice teachers were then analyzed and discussed within the context of the geospatial literacy of preservice elementary teachers' and critical literacy. For Connelly & Clandinin (1990); Thomas-Brown (2011b); Denzin & Lincoln (1994) the educational importance of this line of work brings forth theoretical ideas about the nature of an individual's lived experiences within the context of their educational experiences. The narratives of the preservice teachers provided a useful framework for identifying the extent to which they were able to combine their place-based and geographic knowledge to foster spatial thinking and reasoning. This is tied to our assumption that the more geographically literate they were, the more comfortable they should be with teaching geography topics and materials. The narratives of the preservice teachers generated from the literacy survey were coded to identify emergent themes for analysis and interpretation and are represented in this piece as direct quotes. The trends and patterns that emerged from the quantitative data analysis were then cross-referenced with the narratives to validate and support each finding.

Results

Place-based and Geographic Knowledge

Place-based and geographic knowledge were examined through questions about: the importance attached to and use of multiple sources of information, travel experiences, prior exposure to geography content, ability to accurately identify the location of continents and countries on maps, the ability to make inferences about global population distributions, languages and religions. These questions were premised on Winship's (2004) proposition that there is a relationship between an individual's geographic and place-based knowledge, and global awareness. The questions were also asked with the assumption that an individual's travel within and outside of the U.S. and prior exposure to geography course/s should enhance place-based and geographic knowledge. Note that this assumption did not take into consideration the skills and competencies that are later assessed, but are essential for any individual as they transition from a simple possession, to the application of knowledge that fosters any demonstration geographic literacy.

During the twelve months that preceded the completion of the survey, 21% of the 92 preservice teachers did not travel outside of their home states. Fifty-nine percent (59%) of participants had traveled outside of their home states but within the country a total of 1-3 times, while 20% traveled outside of their home state four or more times. Forty percent (40%) of all the participants traveled outside the U.S. 1-3 times during the 12-months period prior to this study, while 18% traveled outside of the U.S. four or more times. The participants who traveled outside of the country consisted mainly of three categories of preservice teachers: (1) more mature participants (25-30+ years) who indicated that they had a family and took family vacations, including cruises; (2) participants who were either immigrants or first generation immigrants and who indicated that they still had family ties overseas and their visits were for the purpose of seeing family; (3) participants from all age ranges, and ethnicities who traveled to border countries (Canada and Mexico) for short vacations/visits. The question is, to what degree did these travel patterns correlate with place-based and geographic knowledge?

The preservice teachers were given a total of nine countries/places located on four continents excluding North America and asked to identify the continent on which each country/place is located. The majority (71%) of participating preservice teachers were able to correctly identify the continent. The corresponding open-ended question asked the respondents to select 2-3 of the countries and/or continents, and use evidence to make claims about these places. While correct identification of places was high among respondents, their place-based and geographic knowledge of a subset of these places, based on characteristics prominent in popular media, was wanting. For example, only 35% (N=32) and 33% (N=30) of respondents, respectively, accurately identified Indonesia as the country with the largest Muslim population and Mandarin Chinese as the language spoken by most people globally. Noteworthy, is the fact that 52% (N=48) of the respondents reported that English is the most spoken language globally. It is argued that the prominence of the Muslim culture and the emergence of China as a

major trading partner with the U.S. over the past two decades in popular media, along with the reported reliance on said sources for information, should translate into higher levels knowledge about these places and issues. One cannot avoid arguing that for future teachers this is critical knowledge, not only for classroom discussions but also for informed conversations and decisions.

As expected, there was a positive relationship between preservice teachers' travel outside of the U.S. and their place-based knowledge. Those who traveled multiple times outside of the country were more likely to accurately identify continents for given countries/places, the country with largest Muslim populations, as well as the most popular language spoken globally. Those individuals who never traveled at all during the period demonstrated less global place-based knowledge and were more likely to incorrectly answer survey questions that required them to locate places on a map or write evidence-based claims about places outside the U.S. This confirms the view that travel does positively impact one's place knowledge (Tucker, 2007; Fien, 1986). A majority of the preservice teachers demonstrated generally accurate information (perspectives represented in the main stream media) about the countries and/or continents that they selected to describe in the open-ended question. However, the 40% of preservice teachers who had traveled outside of the U.S. in the 12 months leading up to completing this survey tended to select the countries and continents they previously visited, and to present descriptions and perspectives that were not always represented in the U.S. mainstream media about these places. This is another clear demonstration that traveling does influence place-based knowledge. Given the evidence-based claims written by these preservice teachers it is also reasonable to conclude that some of this knowledge did translate into improved geographic literacy. The overall findings in this section were based on the assumption that possession of higher levels of geographic and place-based knowledge was more likely to lead to an individual's increased ability to think and reason spatially.

Access to Multiple Sources of Information

Sixty seven percent (67%) of participants indicated that they had previously taken geography courses either before and/or during college. This implies that the information and knowledge gained would increase their potential for higher levels of geographic literacy. Related questions pertain to the sources of information from which participants gained their place-based and geographic knowledge. When asked to identify these sources, 98% of the respondents reported using the Internet, 75% used network TV news, and 41% used cable TV news (Table 1). Other news sources identified included radio, newspapers and magazines. The preservice teachers' individual sources of information did not make them more or less informed geographically. They demonstrated more place-based and geographic knowledge when they frequently access several (more than 2 to 3) sources of information. Again an emergent trend was that preservice teachers who were immigrants and older minority students tended to access information and news sources outside of mainstream media. Some examples of these media sources mentioned included Black Radio, and international newspapers and news

websites. For this subset of the sample, their geographic knowledge tended to be more rounded as they offered differing perspectives.

Table 1.
Respondents' regular news sources

News sources (multiple options allowed)	No. of respondents	Percentage
Newspapers	24	26%
Magazines	21	23%
Radio	36	39%
Cable TV News (such as CNN, MSNBC)	38	41%
Network TV News (such as NBC, ABC, CBS, FOX)	69	75%
Internet/Web	90	98%
Don't know	3	3%

Importance of Geographic Technologies, Tools, and Representations

Table 2 shows the technological advances/devices as well as language skills the respondents deemed important within the context of global citizenship. Overtly geographical/geospatial components in the table included maps and global positioning systems (GPS), and Geographical Information System (GIS). The table shows that almost 67% of the respondents thought that map reading and GPS and GIS knowledge and use were absolutely necessary, while 97% thought that it was important but not an absolutely necessary. Another 35% indicated that knowledge of these geographic technologies and tools was not important. An open-ended question in this section asked the respondents to articulate what they knew about the usefulness of the various geographic technologies, tools and representations. They talked about why they attached the level of importance to these that they did, and how their knowledge, perceptions and use of these influenced their human-environment interactions. The results suggest the preservice teachers' responses reflected disconnects between the use of geo-based technologies, tools and representation and the potential for these to increase their knowledge and make meaningful spatial-related decisions (Tussyadiah & Zach, 2012; Edelson, 2009). This brings into question how the preservice teachers transition from geographic knowledge to actual spatial thinking, spatial reasoning, and eventual geographic literacy. Likewise, how do they transition from reflective observation (RO) to abstract conceptualization/forming generalizations (AC) within Kolb's experiential learning loop explained in the Research Context section of this piece? This finding actually contradicts the previous findings because it showed that among the respondents, knowledge and awareness of the importance of geographic tools and representations did not immediately translate into spatial thinking or reasoning, taking a critical stance on spatial thinking, or reflective observation. In general, most of the respondents did not unconsciously or habitually think about the world in physical terms, and there was no indication of environmental and cognitive mapping. Unless prompted by the researchers, spatial thinking and geographic representations and reasoning did not factor into their responses.

Table 2.
The importance of technological skills or abilities in today's world

How important do you think it is to have each of these skills? (N=92)	Absolutely Necessary	Important but not absolutely necessary	Not too important	Don't know
Use a computer	93%	7%	0%	0%
Use a GPS/GIS	17%	60%	22%	1%
Read a map	50%	37%	13%	0%
Use the Internet	80%	17%	1%	1%
Speak a foreign language	5%	75%	18%	0%
Know where countries in the news are located	40%	37%	7%	0%

Comfort with Teaching Geography Materials in the Future

The preservice teachers in the study were asked about their comfort levels related to their geographic knowledge and how prepared they felt about teaching geography in the future. The results showed that only 36% of the respondents were either very comfortable or comfortable: 5% indicated that they felt very comfortable, and 31% felt comfortable with their geographic knowledge. Almost 60% of preservice teachers said they were either unprepared or were unsure of how prepared they were to teach geography in the future. This finding corresponds with the previous one on geographic technologies, tools and representations. The finding showed that having place-based and geographic knowledge did not translate into geographic literacy when the ability to conceptualize the world on spatial terms and make evidence-based spatial claims was lacking. Given that the preservice teachers' knowledge had not transformed into cognitive application in the form of spatial thinking and reasoning, it was expected that they would have demonstrated high levels of discomfort with teaching geography content materials in the future. The unfortunate yet expected outcome was that, generally, the respondents in this study did not demonstrate the ability and willingness to adopt a critical stance to spatial thinking in the future. This finding was also based on the respondents' narratives about what they thought geography was and why they thought it was important.

The preservice teachers cited a myriad of reasons for their discomfort with future geography teaching. The more common reasons cited were inadequate knowledge and understanding of the discipline, difficulty memorizing geographic facts, access to materials, and in-service training. The participants also mentioned specific topics for which they wanted to improve their knowledge. These topics included classroom maps, landforms and regions, layers of the earth, plate tectonics, the seasons, and eastern and western hemisphere studies. Again, the focus of these preservice teachers was less on the competencies and application of this discipline, but more so on knowledge, this in itself is problematic.

Discussion

The Influences of Geographic Knowledge and Access to Multiple Sources of Information on Geographic Literacy

A well-defined set of spatial-temporal primitives can help provide a firmer theoretical function to the central theme of geography, because the realities of modern-day globalization make imperative an enlightened perspective and response to its spatial and temporal nuances and challenges. Many of these nuances and challenges include interdependence, cultural diversity, competition for scarce resources, global citizenship, as well as power disparities (Kaufman, 2004; Banks, 2002). Within this context, the preservice teachers' perspectives on what geography should teach offers us, their audience, a basis for assessing their geographic literacy, and in turn designing and implementing appropriate remediation. Among the participants in this study, there was a good grasp of the factual and place-based geographic knowledge. Ninety of the 92 teachers who defined geography used place-based terms such as 'location'. They also talked about how people interacted with the environment or the world around them. The participants included geographic representation terms such as 'map', 'GPS', 'knowing where we are', or terms such as 'resources', 'movement', 'interaction', and 'connections' in their definition of the term. Overall, their definitions of geography did reflect many of the topics covered in the first four weeks of GEOG-1. Here is an example of one individual's definition

> *"I think geography is everything that is around the world, everything that makes the world, and where everything is located around the world…to me it is a multilayered subject that ties in ideas of culture, history, economics, and even some sciences. It helps people understand their place in the world and, hopefully, helps them also realize that there are many places for them to visit and study outside of their bubble."*

While this quote supports the existence of place-based and geographic knowledge, the overall findings of this research suggest that for many of the preservice teachers in this study, this knowledge did not convert into demonstrated habits of mind of informed spatial thinking. Possession of the geographic knowledge in isolation of the requisite skills and know-how did not foster the kind of spatial thinking that allowed many of the participants "to come to grips with the static and dynamic spatial relations between and among self and other objects in the physical environment" (National Research Council, 2006, p, 29).

The comprehensive descriptions of geography as a discipline forwarded by the participants prompted questions about their access to multiple sources of information outside of academic settings. The participants' primary source was the Internet, as demonstrated in table 1. Norris (2000) suggested that technological advances have precipitated attrition from traditional news sources such as printed newspapers towards more easily accessible news sources such as the Internet. The group demonstrated access to varied sources of information including the radio, community- based newspapers, and network television. Hence, the participants' place-based and

geographic knowledge, though not the ideal, may be attributed to this, among other variables.

Hicks (2013), quoting the American Council of Education (2012), notes that CL plays an important role in the development of intercultural skills and competencies necessary to be successful in this globalized world. Therefore, the role of CL constitutes "functional competence, cultural and ideational, interpersonal and textual knowledge" (Breen & Candlin 1980, 91). These components of CL align with and compliment the approach this piece purports as geographic literacy. The outcomes of this study demonstrated that the participants were really not able to convert their knowledge into spatially ordered sequences as they answered the survey questions. This ultimately impeded how they articulated and applied spatially based concepts to the real world. The participants were not able to reason spatially, and this was more apparent when the "underlying data were not inherently spatial in the geographic sense" (p. 30). So, unfortunately, they lacked the geography of intellectual space (National Research Council, 2006).

The Importance of Geographical Technologies, Tools and Representation

The use of geo-based technologies enables people to be more knowledgeable about places and to make meaningful space-related decisions (Tussyadiah & Zach, 2012). The results of this research indicated that this was one aspect of geographic knowledge that was in need of remediation among the preservice teachers in this study. As the findings demonstrated many of the study participants attached relatively little importance to the need for certain geospatial tools. They were unlikely to incorporate them into their teaching because they assumed that they did not have the skills to use these tools, technologies and means of geographic representations. It was also logical to assume that if they had the wherewithal to use these, the level of importance attached to them would have been greater. This is a fundamental problem with how geography is perceived and taught in schools today. Current research documents scant implementation of GIS in K-12 classrooms (Milson & Alirandi, 2007; Baker, 2005; Kerski, 2003). As educators we need to design lessons that continually reference the real world, including students' personal sense of place, their sense of social and economic reality, as well as, other aspects of social studies.

For Elbow (1973) CL writing recreates meanings and understandings to a learner's viewpoint, and the same may be argued for geographic representations. This may be expanded to include the myriad of geographical tools used to represent the world. For the study participants, geospatial tools should have extended beyond the maps, GIS and GPS mentioned in the survey. It should have included their ability to operationalize spatial and temporal relationships without avoiding complex constructs, patterns, distributions, visualizations, and processes (Kaufman, 2004). In the broader context of geography, a teacher who is able to incorporate these geospatial-thinking skills into his/her classroom is more likely to facilitate geographic inquiry, as well as, spatial thinking and reasoning. Geographic inquiry, when done well, fosters learning that is democratic, transformative and critical (Wolk, 2003). "Spatial thinking uses

representations to help us remember, understand, reason, and communicate about the properties of and relations between objects in space, whether or not those objects themselves are inherently spatial" (National Research Council 2006, p. 27). Thus, if a group of teachers who will be tasked to teach these are actually lacking this suite of knowledge and skills, to what extent are they able to facilitate spatial thinking in their students?

Comfort with Teaching Geography in the Future

Thinking spatially means we contemplate life spaces, physical spaces, and intellectual spaces as interdependent. The grounding of CL in this piece has demonstrated that despite intuitive roots of spatial thinking in geography, its educational importance lies in the process of spatialization that creates intellectual spaces (National Research Council, 2006). One of the more significant findings of this study was the degree to which the preservice teachers' comfort levels showed their concerns regarding teaching geography materials in elementary social studies classes in the future. This piece has repeatedly argued that place-based and geographic knowledge does not automatically translate into geographic literacy. According to one preservice teacher,

> *"I only know the basic information of geography that I had learned back when I was in elementary through high school. I do not have a complete and clear understanding of all the details that go along with geography so I am not very comfortable teaching it in the future." Another preservice teacher noted, "This is my first geography class. The small amount of geography that I know is what I've learned in here. I could barely list the continents, because that was never a focus of mine growing up. I find it unfortunate, and I feel that I will be unprepared to teach it if I do not continue to receive instruction such as this."*

According to Kirman (2003) and Morgan (2011), elementary social studies curriculums should emphasize inquiry so that students will develop questions, acquire information, and make decision-literacies. They further argued that it is appropriate to emphasize geography, which encourages children to take responsibility for the impact their actions have in and on the environment (both locally and globally). To assume this responsibility requires pedagogical development around inquiry, and critical thinking. The outcome of such endeavors would bolster the component of geographic literacy that speaks to the extent to which individuals demonstrate the ability and willingness to adopt a critical stance to spatial thinking.

Conclusion and Suggestions

So, the big deal is, the power of geographic literacy resides in its capacity to provide an understanding of patterns, relationships, structures, and functions of a phenomenon. It is also the ability to deduce and articulate how and why a phenomenon works, how it is ordered and transformed. Therefore, spatial thinking, reasoning, and geographic literacy are processes; they are not static, nor are they compartmentalized. Rather, they are interconnected, reciprocal, and dynamic. While this research has demonstrated that, for the most part, the place-based and geographic knowledge of the preservice elementary

teachers was adequate, its existence, in isolation of the requisite skills and know-how that fosters spatial thinking and reasoning and by extension geographic literacy results in discomfort with teaching geography topics and materials in the future.

The research showed that conducting the survey in GEOG-1 at the 4-week marker; in order to evaluate the extent to which introductory geographic topics covered during the first four weeks of this course had activated the participants existing geographic knowledge was a good temporal strategy. This is because it gave the researchers time to generate the results of the survey and design and implement an appropriate remediation.

This project will continue to conduct research on the use of KELT to frame geospatial-thinking workshops for preservice teachers. These workshops, while foreshadowing a shift from traditional pedagogy, will facilitate holistic content understanding and application of real-life geospatial event, thus supporting Morgan's (2011) suggestions that there is no single geography, but multiple geographies. This means that continued exposure to geography topics and techniques will foster geospatial thinking and reasoning grounded in the learners' lived experiences. This, we posit has the potential to facilitate the kinds of geographic literacy desired. The workshops will also attempts to increase the participants' level of comfort with teaching geography materials in the future, though increase content knowledge and application.

Therefore, one imperative of elementary teacher training becomes the essentiality of imparting techniques that will allow future teachers to become geographically literate. This may be demonstrated through habits of mind of informed spatial thinking, thinking about the world in physical terms, and demonstrating the ability and willingness to adapt a critical stance to spatial thinking in the future. Most if not all Geographers would agree with us - this is a big deal!

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Appendix I.
Geographic Literacy Survey for Pre-service Teachers Taking GEOG-1

Introduction: Please Read!

I. If you are not sure of an answer please do not be reluctant to say so. Very few people will know the answers to all of these questions. I am not interested in EVALUATING YOUR KNOWLEDGE. I just want to get an idea of what students IN GENERAL know. Your responses, remember, are being kept strictly confidential, so let's just have some fun with this.
II. The gray box labeled code is not for your use.
III. The follow-up questions which have an asterisk***** before them are optional
IV. I certify that I did not do any research while answering these questions

Section 1: Geographic literacy questions

1. How important do you think it is to have each of these skills or abilities in today's world?

	Absolutely Necessary	**Important but not absolutely necessary**	**Not too important**	**Don't know**	**CODE**
a) Use a computer					
b) Use a GPS, or Global Positioning System, device					
c) Read a map					
d) Use the Internet					
e)Speak a foreign language					
f) Know where countries in the news are located					

*****Briefly explain your choice in question 1 above: _____

2. Compared to the average person, would you say you know more or know less about each of these subjects?

	Know more	Know less	Same	Don.t know	CODE
a) Foreign languages					
b) Math					
c) History					
d) Geography					
e) Science					
f) World religions					

3. Which of the ranges on this card contains the correct population of the United States today?

		CODE
A	10 million - 50 million	
B	B 150 million - 350 million	
C	500 million - 750 million	
D	1 billion - 2 billion	
E	Don't know	

4. In which of these countries did a catastrophic earthquake occur in October 2005, killing over 70,000 people?

		CODE
A	Sri Lanka	
B	Japan	
C	Pakistan	
D	Mexico	
E	Don't know	

5. In 2004, what percentage of population growth in the U.S. was due to immigration?

		CODE
A	5%	
B	22%	
C	33%	
D	54%	
E	Don't know	

*****Where do you think most of the immigrants to the U.S. come from and why do you think they come here? _____

6. Here are the names of all the continents (*Africa*, *Antarctica*, *Asia, Australia*, *Europe*, *North America*, *and South America*) in the table name the continent on which each of the following is located?

List of places	**Continent name**	CODE
Colombia		

Nigeria		
Pakistan		
Rwanda		
Sri Lanka		
Sudan		
The Amazon Rainforest		
The Alps		
The Sahara		

7. In which of these countries is a majority of the population Muslim?

		CODE
A	Indonesia	
B	South Africa	
C	Armenia	
D	India	
E	Don't know	

8. Which of the following was not a significant contributing factor in Hurricane Katrina's impact on the city of New Orleans?

		CODE
A	Much of the city was located below sea level	
B	The Mississippi River was at record high flow levels	
C	Flood protection walls failed	
D	Protective coastal marshes had disappeared	
E	Don't know	

9. Which of the following is the main/primary language spoken by most people globally?

		CODE
A	Russian	
B	Mandarin Chinese	
C	English	
D	Arabic	
E	Don't know	

***** Briefly explain your choice in question 9 above: _____

10. Which of the following countries is the world's largest exporter (dollar value) of goods and service?

		CODE
A	China	
B	United States	
C	Japan	
D	France	
E	Don't know	

***** Briefly explain your choice in question 10 above: _____

11. How does the size of the population of China compare to the population of the United States?

		CODE
A	China's population is less than half the size of the population of the United States.	
B	China's population is about the same size as the population of the United States.	
C	China's population is about double the size of population of the United States.	
D	China's population is more than four times the size of the population of the United States.	
E	Don't know	

12. A person is able to wear lightweight clothing all year round if he/she probably lives near the:

		CODE
A	Arctic Circle	

B	British Isles	
C	South Pole	
D	Equator	
E	Don't know	

13. Which of the following countries is the world's largest consumer of oil?

		CODE
A	United States	
B	China	
C	Russia	
D	India	
E	Don't know	

*****Briefly explain your choice in question 13 above: _____

Use a map of the world to answer question 14 A & 14B:

14A. A ship carrying cars directly from Japan to Australia travels in which direction?

		CODE
A	North	
B	South	
C	East	
D	West	

*****On the map draw in the most likely route the ship would take on this trip:

14B. On the map provided locate, shade and label the places listed in the table below:

Place name	CODE	**Place name**	CODE
Australia		Iraq	
Brazil		Israel	
Canada		Mexico	
Egypt		Pacific Ocean	

Gulf of Mexico		Saudi Arabia	
Indonesia		United Kingdom	
Iran		United States of America	

Insert Blank World Map Here…

Section 2: Background questions

15. In the past twelve months, approximately how many times have you traveled: (A) Within the United States, but outside the state where you live most of the year? (B) Outside the United States? (*Select the box that best applies*)

A: Within The U.S.				**B: Outside the U.S.**			
	None		CODE		None		CODE
	One				One		
	Two				Two		
	Three				Three		
	Four				Four		
	Five or more				Five or more		
	Don.t know				Don't know		

16. How do you think your travels impact your knowledge of and the ways you interact with different places? _____

17. How important do you think it is to have knowledge about other countries and why: _____

18. Which of the following sources (print and electronic), if any, do you use regularly to keep up with current events at home and around the world? (You may select as many as apply to your situation)

Print and electronic sources	**Frequency** **Daily. Weekly. Monthly etc.**	**Reasons**	**CODE**
Newspapers			
Magazines			
Radio			
Cable TV News (such as CNN, MSNBC)			
Network TV News (such as NBC, ABC, CBS, FOX)			
Internet/Web			

News magazines (e.g., Time, Newsweek)			
Entertainment magazines (e.g., People, Entertainment Weekly)			
National Geographic			
Sports Illustrated			
Other: Name_____			
Don't know			

19. How often do you use forms of geographic representations (Maps, GPS etc.), briefly talk about how important these are to you and how you using them impacts the ways you interact with different places: _____

Section 3: Demographic Questions

20. What is your age?

Age categories		CODE
18- 20		
21- 23		
24- 26		
27- 29		
30 or older		

21. What is your gender?

Gender categories		CODE
Male		
Female		
Other (S*pecify*)		

22. Which of the following best describes your race or ethnicity?

Race/ethnicity		CODE
White		

African-American/Black		
Asian/Pacific Islander		
American Indian or Native American		
Other (*Specify*)		

Section 4: Questions about teaching geography in the future

23. When you were in grades 6-12, did you ever take a course devoted entirely to geography? (*Select the box that best applies*)

Yes		**CODE**
No		
Don't know		

24. What do you think geography is, and why do you think it is important? _____

25. As a future elementary school teacher, how comfortable do you feel about your geography knowledge? (*Select the box that best applies*)

Very comfortable	**Comfortable**	**Kind of comfortable**	**Uncomfortable**

*****Briefly explain your answer in question 25 above: _____

26. To what extent do you think your knowledge and experiences will influence the how you make geographic learning meaningful to your students' lives:

27. To what extent do you think you will incorporate real life geographic events and processes into your teaching of social studies in the future and what impacts do you anticipate this will have on your students? _____