Examining the National Geography Standards for Presence of Spatial Concepts

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Abstract

The publication of *Geography for Life: National Geography Standards* (GESP, 1994) proved to be a milestone event in the recent history of geography education in the United States. While this document is certainly comprehensive in scope, early analyses of its effectiveness and implementation has revealed areas for improvement. Building on these concerns, a content analysis of *Geography for Life* was conducted using a comprehensive list of 22 geography concepts developed in a 2005 Ontario, Canada standards study by Sharpe and Huynh. The research was performed in two parts: Part 1 applied the expanded set of 22 Ontario concepts to *Geography for Life* with the aim of discovering the degree of emphasis in U.S. standards between basic "object and process" geography and concepts associated with higher levels of "spatial thinking." A secondary goal in Part 1 was to observe the extent to which differences might exist between Ontario and U.S. standards. Part 2 investigated a different set of 16 geospatial concepts — developed from the author's experience in teaching a college-level introductory human geography course, and by reviewing other related materials — to examine the extent to which these 16 concepts might also be found in various grade levels in the national standards. Part 2 questioned the assertion that simple concepts appear more often in early grade levels, while more complex ones appear later in the K-12 continuum. The content analysis of Part 1 revealed definite strengths in the U.S. geography standards in terms of its areas of emphasis on higher level spatial concepts, as well as, basic geography concepts. The Ontario standards differed with an emphasis on concepts related to "geomatics," (geographic information science) which did not appear in the U.S. standards. Findings from Part 2 were generally as expected, encouraging for instructors of higher education geography courses; however, findings from this research also indicate that more research is needed on the effectiveness of the national standards, not only for K-12 education, but for the geographic and spatial knowledge that students carry on to higher education.

Keywords: U.S. geography standards, national geography standards, Ontario geography standards, spatial concepts, content analysis, K-12 geography education

Introduction

Completion of *Geography for Life: National Geography Standards* in 1994 (hereafter, referred to as *Geography for Life*) proved a formidable effort by four influential geography organizations: the National Geographic Society (NGS), the Association of American Geographers (AAG), the National Council for Geographic Education (NCGE), and the American Geographical Society (AGS). Development and publication of the document came in response to the *Goals 2000: Educate America Act*, which was signed into law in 1994 and stated that students, by the year 2000, must demonstrate competency in challenging subject areas, including geography. According to Downs and Liben (1997), "the National Geography Standards are redolent with the language of space" (p. 21). Thus, this research examined the extent to which this was/is a true statement by conducting a comprehensive content analysis of *Geography for Life* using a comprehensive list of 22 concepts developed in an Ontario, Canada standards study. The research design and analysis was performed in two parts. Part 1 applied the expanded set of 22 Ontario concepts to *Geography for Life* with the aim of discovering where the emphasis occurs in U.S. standards, that is, "object and process" concepts versus those associated with "spatial analysis." Part 2 investigated a different set of 16 geospatial concepts developed from the author's teaching of a college-level introductory human geography course, and examined the extent to which these 16 concepts were found in various grade levels in *Geography for Life*. Part 2 questioned the assertion that simple concepts, appear more often in early grade levels, while more complex ones appear later in the

K-12 continuum. The overarching goal of this particular research question was not only to determine the presence of fundamental geospatial concepts in the geography standards, but also to provide insight as to what geography instructors in higher education might expect in terms of their students' exposure to fundamental spatial concepts.

Background

National Standards and State Standards

As stated in *Geography for Life*, the national standards serve as voluntary benchmarks of what students *should* learn, thus, schools or school districts may (or may not) use the national standards as a guideline for developing their own geography curriculum; however, the authors of the national standards strongly assert that the document specifies the "essential subject matter, skills, and perspectives that all students should have in order to attain high levels of competency" (GESP, 1994, p. 9).

The context for developing the national standards states that the objective is "to develop world-class levels of understanding of geography which will be useful in the context of workplace, voter's booth, and people's lives in the United States" (p. 26). The authors further describe "world-class" as meaning, "equivalent to and perhaps leading the world in a system of outcomes-based geography education" (p. 26).

The authors stress the voluntary nature of the national standards, and argue that, in and of themselves, the standards do not constitute a national curriculum, "Thus the set of essays of principles and purposes for the 18 national geography standards is neither syllabus nor curriculum nor textbook, but it is the *essential* starting point for all three of these ideas [emphasis mine]" (p. 26).

Analysis of the Standards: Fordham Foundation

Even though the national standards document provides a purported strong, even "world class," foundation for a geography curriculum, it is each state's responsibility to determine their own standards and develop their own curriculum. In response to the development and distribution of the national standards, and in an effort to determine if progress was being made in implementing geography into K-12 classrooms and increasing student competency, as mandated in the Goals 2000 act, the Fordham Foundation conducted the first ever appraisal of state geography standards (Munroe & Smith, 1998). In order to undertake this appraisal the Casados Group (Terry Smith and Susan Munroe), in conjunction with an advisory panel, developed a set of criteria by which to measure the effectiveness of 38 states' and the District of Columbia's geography standards (these were the jurisdictions from which they were able to obtain documents).

The assessment assigned grades to states based on their ability to meet six general criteria as well as seven characteristics specific to geography. Of the 39 state standards documents assessed, 3 states received As, 3 states received Bs, 9 states received Cs, 6 states received Ds, and 18 states received failing grades. The evaluators claimed that a significant part of a likely explanation for the large number of failing grades was that many states that developed geography standards had purposefully framed them in very general terms, leaving it up to local districts to add specificity. Unfortunately, as argued by the evaluators, this generality, essentially, turned state standards into merely vague guidelines that ultimately defeated the purpose of having standards in the first place.

Implicit within this criticism of the documents' evaluators was the notion that the national standards document should have contained sufficient detail for classroom implementation, not merely vague objectives. Thus, an important aim of undertaking a rigorous content analysis of the national standards is to determine how specific this document is in terms of its goals.

Analysis of the Standards: GENIP

In 2003, the Geography Education National Implementation Project (GENIP), a consortium of four geographical institutions (AAG, AGS, NCGE, and NGS) committed to improving the status and quality of geography education in the U.S., assessed *Geography for Life*. GENIP is a clearinghouse that coordinates the geography education initiatives of its member associations. Its mission centers on outreach on behalf of geography to educators and policy makers across the United States. GENIP is active in providing expertise and leadership in the development of policies related to geography education. Since the publication of *Geography for Life*, GENIP's primary focus has been the promotion of standards-based geography instruction as an integral part of every student's educational experience (see http://genip.tamu.edu/). Thus, GENIP is, currently, the organization that is actively working to help states implement standards-based geography into their curricula.

The assessment of the national standards by GENIP took the form of a survey sent or distributed to 612 teachers, administrators, professors, academic geographers, and education consultants. The survey experienced a 20% response rate (120 returned). Respondents were asked to answer nine questions related to the effectiveness of the standards (strengths/weaknesses, redundancies/omissions, areas for improvements, and who is using them and how). One of the nine questions asked survey respondents to comment on areas in the national standards that have received either too much or too little emphasis. Most respondents agreed that nothing was over-emphasized, but that technology (GIS, GPS), globalization issues, environmental issues, and gender issues needed to be included (currently, omitted in the document), and that physical systems, human systems, skill development, uses of technology and learning taxonomies needed greater emphasis (Marran, 2003).

Analyses of Students' Geographic Literacy

Since the development of the national standards in 1994, two organizations have conducted extensive surveys to determine: 1) students' geographic literacy, and 2) their improvement in geographical literacy. The National Geographic Society (NGS) conducted two significant Roper Polls to assess the former, while the National Assessment of Educational Progress (NAEP) assessed 4th, 8th, and 12th graders' geographic understanding in 1994, 2001, and 2010 to determine if improvement in tests of geographic literacy occurred since publication of the national standards.

The most recent Roper Poll conducted by the National Geographic Society occurred in 2006 and was designed to assess the geographic literacy of American students between the ages of 18 and 24. Their "literacy" was compared to that of their peers in eight different countries across the globe, Canada, France, Germany, Italy, Japan, Mexico, Sweden, and Great Britain. Overall, in comparison to their peers, American students consistently performed poorly, answering about half (54%) of the questions correctly. It should be noted that the assessment consisted of map identification tasks and multiple-choice questions, with the majority of the latter mostly addressing a variety of geography-related current events (e.g., identifying the location of the 2004 Indian Ocean Tsunami, explanations for the dramatic effects of 2005 Hurricane Katrina, discovering the most-spoken language across the globe, etc.). While it might certainly be argued that this poll did not necessarily gauge true geographic literacy, but rather students' ability to answer more geography-related current events questions, it might also be argued that the ability to answer most of these questions correctly would likely result from a rigorous geography curriculum; thus, findings from the Roper Poll do provide some insight into the state of geography education in the U.S. today.

The most recent published assessment, conducted by the National Assessment of Educational Progress (NAEP), occurred recently, in 2011 (the assessment was completed in 2010), with the major goal of determining progress in students' geographic literacy. The assessment looked at 4th, 8th, and 12th grade students and discovered an improvement among 4th graders only, while 8th and 12th grade students saw minor decreases in their scores. In terms of geographic content, the assessment asked questions related to space and place, environment and society, and spatial dynamics and connections. Upon investigation of the actual test questions, in comparison to the Roper Poll, NAEP's assessment involved questions more directly related to spatial thinking; for example, numerous questions contained either real or hypothetical maps and asked students to answer analysis questions based on the information depicted on the map (National Center for Education Statistics, 2011).

Rationale

While the national standards have undergone myriad analyses since their inception in 1994, and while a full reading certainly indicates a comprehensive exposure to all the various facets of geography, the motivation to perform a content analysis (essentially word counts) was two-part. First, as claimed in the Fordham Foundation Study, many states, which used *Geography for Life* as a guiding document in developing their geography curriculum materials, performed poorly in terms of incorporating spatial concepts into these materials. While an initial reading of the national standards, as mentioned, does seem to reveal a comprehensive picture of all the various facets of geography, the aim of this study's analysis of the national standards was to explore the extent to which fundamental concepts are found within *Geography for Life*. Second, similar to Sharpe and Huynh's 2005 study (discussed below), it was believed that a qualitative analysis of word counts and frequencies, in this case, those related to spatial concepts would provide a necessary first step for determining possible overlaps for spatial thinking inclusion in other disciplines. Therefore, a major outcome of this content analysis of the *Geography for Life* document was to discover what exactly is emphasized in the document.

Prior Research Pertinent to this Study

Sharpe and Huynh (2005), using content analysis, conducted an in-depth investigation of the presence of spatial concepts in Ontario, Canada's K-12 curriculum (Canadian Council for Geographic Education, 2001). In addition to identifying the presence of spatial concepts across the curriculum, the authors hoped to identify opportunities for the integration of spatial concepts into content areas of other disciplines. The methods included a content analysis of the Ontario geography curriculum and standards, which at the K-8 level is incorporated into the social studies standards, while in grades 9-12 geography is included in the "Canadian and World Studies" portion of the curriculum. In addition to looking explicitly at the geography (or "geomatics") curriculum, the authors also looked at the curriculum used in other content areas, such as Business Studies, Health and Physical Education, Mathematics, Media Studies, Science, Social Sciences, and Technological Education. Pertinent to this study, are the various content analysis tools and vigorous methods that Sharpe and Huynh used to determine a final set of 22 concepts that appear in geography. Using these concepts and employing a software package, NVivo, that aids researchers in analyzing qualitative data, the Ontario study discovered that within geography curriculum materials, essentially, two domains of geospatial knowledge emerged: 1) basic spatial concepts of geography, and 2) specialized "geomatics," the science and technology of gathering, analyzing, interpreting, distributing, and using geographic information. Some of the most frequently mentioned basic spatial concepts (in order) included: scale, coordinate, longitude, locate/place, direction, bearing, vector, cardinal direction, aspect, and angle. More specialized "geomatics" concepts included projection, wayfinding, and spatial proximity (among others), which appeared less in the curriculum materials, but did have a significant presence (Sharpe & Huynh, 2005).

Similar to Sharpe and Huynh's study, the purpose of this research was to analyze the frequency and context of certain concepts within the document, with the understanding that geography, as presented in *Geography for Life,* was not merely a list of terms and concepts. Through content analysis, a comprehensive investigation of the frequency of terms and concepts emphasized revealed information that was otherwise difficult to obtain. The findings from this research add to the insights that have already been gained through other forms of analyses of the national standards document.

Objectives and Hypotheses

As stated earlier, the major objective of this analysis was to provide insight into the spatial concepts that are emphasized in *Geography for Life.* This objective was achieved in two parts. Using methods similar to Sharpe and Huynh (2005) which involved a rigorous process for determining a set of 22 spatial concepts that appeared in curriculum materials found in the Ontario standards, the first part of this research involved determining the frequency that the 22 spatial concepts in Canada are also observed in *Geography for Life.* While comparison between a country (the United States) and a province (Ontario) is imperfect, the Ontario analysis is the only quantitative geography curriculum content analysis that exists (in English). Thus, despite some of the obvious problems with this comparison, it nevertheless provided interesting first-round, preliminary insights into the later comparison of documents between both entities.

The second part of this research examined the U.S. national standards in *Geography for Life* to determine the frequency with which another set of 16 fundamental spatial concepts developed from undergraduate teaching in an introductory human geography course taught by the author appeared within the standards document. Implicit within both of these investigations was also a goal of enumerating the frequency of terms outside of the 22 investigated in part 1, as well as, the 16 investigated in part 2. Thus, while the major priority was to determine the frequencies of concepts within these two sets of terms (Ontario and the U.S.), it was also of utmost interest to identify what the document emphasized outside of these two lists of terms.

Hypotheses for Parts 1 and 2

As a result of completing a thorough content analysis *Geography for Life* using two different types of software, it is expected that:

> ***Hypothesis 1 (Part 1):*** The national standards will emphasize geographic objects and processes over spatial concepts. Thus, if the standards emphasize conceptual and procedural information, then, possibly, the poor results on the NAEP test might be influenced by the deficit in spatial concepts *expected* to be found in *Geography for Life.* The *expected* emphases on geographical objects and processes within the document will be demonstrated by observing a higher frequency of objects (e.g., place names, specific geographic features) and other types of geo-

graphic terminology (e.g., models, methods, processes, etc.) instead of spatial concepts, which are defined as an abstract idea generalized from particular instances or observations (e.g., "network").

Hypothesis 2 (Part 1): In comparison to the Ontario curriculum, the U.S. national standards will show lower frequencies when compared to the Canadian 22 spatial concepts. Geography, particularly "geomatics," experiences a greater presence in Canadian K-12 classroom instruction compared to the U.S. Thus, I anticipate seeing evidence of these two different treatments in priority of spatial concepts through a higher frequency of all 22 terms in the Ontario curriculum when compared to the spatial concepts found in U.S. standards.

Hypothesis 3 (Part 2): The complexity of the 16 geospatial concepts investigated will increase as grade level increases. This will be demonstrated by a higher frequency of complex spatial concepts in the higher grade clusters compared to a higher frequency of more simple spatial concepts in the lower grade clusters. Golledge et al. (2008) developed and tested a geospatial conceptual hierarchy; simple concepts consist of the primitives (*location, identity, magnitude,* and *time*). First order derivative concepts are directly derived from the primitives. For example, with two locations comes understanding of distance. Conceptual difficulty increases as derivative level increases. I expect that the simple concepts, according to this hierarchy, will appear more often in early grade levels, while more complex concepts will appear later on in the K-12 continuum.

Methods

For Part 1, as in the Ontario study, the qualitative analysis software program, NVivo, was chosen as the primary method for comparing the content of the national standards document using the 22 geography concepts from the Ontario study. Digital versions of *Geography for Life* were obtained (Bednarz, personal communication, 2006), and pre-processed by removing all headers, section titles, repetitive information, glossaries, and any other verbiage that was not part of the explicit expectations stated within the curriculum, making the documents more concise and easier to read by the software.

Using the set of 22 concepts defined by the Ontario study, the first step involved a content analysis of *Geography for Life* to find the frequency and the context of each of these 22 terms. The analysis of U.S. standards subjected to the Ontario standards, however, could only be accomplished by using the two first sections of the U.S. national standards document as this material more closely conformed to the structure of the Ontario standards.

In addition to NVivo, another qualitative analysis tool, Text-to-Matrix Generation (TMG), was used to analyze the national standards using Ontario's 22 concepts. Unlike NVivo, TMG operates in a bottom-up-manner, by including all references to all individual words. The TMG software also uses "stemming," which allows it to present comprehensive results of all word stem appearances, beyond reporting just the frequencies of words (for example, "map," "mapping," "maps," all appear under the same term). The bottom-up approach of TMG allowed for expedient categorizing of large volumes of data without the individual effort required by NVivo, where the user must search the document for specific terms. This consequently broadened the scope of the project by providing data on the frequency of terms, outside of the 22, specifically, investigated using NVivo.

After obtaining the frequencies of the 22 concepts terms in NVivo, TMG was then used to confirm those totals and investigate the terms and type of terms appearing most frequently in the national standards document. The TMG tool, as stated, provided frequency counts for every term that appeared in the document. Once the frequencies were obtained for the document, the content was analyzed thematically to determine the emphases in *Geography for Life*. The categories for the thematic analysis included:

- Concept: an abstract idea generalized from particular instances (e.g., network)
- Model: an idealized representation of the real (e.g., The Gravity Model)
- Geographic Objects: as defined by Mark, Smith, and Tversky (1999), consist of geographic features (e.g., mountains, lakes, etc.) which can be further categorized into land-based features, water-based features, and features made by humans (e.g., kinds of human settlements such as towns, or counties)
- Method: a systematic procedure, technique, or mode of inquiry (i.e., unique to the geographic domain)
- Process: a continuing activity or function (e.g., deforestation)
- Representational Schema: items by which geographic information is represented (e.g., maps or globes)

For each category, the term must also be geographical. All the totals presented from both types of analysis — NVivo and TMG — only contained frequencies of terms present within the "knows and understands" and "is able to" sections of each of the 18 standards.

For Part 2, NVivo was used to investigate the set of 16 fundamental spatial concepts taught in an introductory human geography course. Both the NVivo and TMG output were structured such that they conformed to the organization of the standards document. As it stands today, *Geography for Life* is divided into 18 different geography-based standards; these are categorized into three grade clusters: K-4, 5-8, and 9-12, which are further divided into three types of knowledge. The types of knowledge for each standard for each grade cluster were divided among: 1) items students should know and understand, 2) items students should be able to do, and finally 3) examples ("exemplars") that illustrate students' levels of knowledge and skills. For the purposes of this analysis, the "exemplars" were removed as they merely described suggested activities that *could* demonstrate a student's grasp of a certain concept or skill; they were not an essential component of the standard.

Results

Comparison of the U.S. Geography Standards to Ontario Geography Standards, Using Ontario Standards

Once the content analysis had been performed on the national geography standards using NVivo, the frequencies of the 22 terms were compared and ranked (Table 1). The main difference between the two standards documents appeared in concepts that represented "geomatics." Seven concepts in the Ontario standards associated with geographic information systems did not appear at all in the U.S. standards and were: *coordinates, elevation, GPS, navigation, projection, remote sensing,* and *vector.* However, *spatial concepts* ranked highest of all for the U.S. standards using the Ontario criteria. This result cast a positive light on the question of level of emphasis for *spatial concepts* in the U.S. standards. In addition, using the 22 Ontario standards, the U.S. standards showed further emphasis on basic, solid geography concepts: *place, region, distribution, map, location,* and *scale.* Except for *map* and *scale,* these concepts were ranked much lower in the Ontario standards.

Table 1

List of 22 geography standards from the Ontario, Canada Study applied to the U.S. geography standards (Source: Sharpe & Huynh, 2005).

Concept	**U.S. National Geography Standards 1994**		**Ontario, Canada Geography Standards 2001**	
	Count	**Rank**	**Count**	**Rank**
Spatial	70	1	22	11
Place	63	2	38	4
Region	56	3	38	4
Distribution	30	4	31	9
Map	25	5	48	1
Location	19	6	32	8
Scale	14	7	16	13
Area	8	8	16	13
Classify	5	9	15	15
Movement	5	9	42	2
Symbol	4	11	3	18
Demographics	2	12	3	18
Direction	2	12	33	7
Geography	2	12	36	6
Position	1	15	9	16

Coordinates	0	16	2	21
Elevation	0	17	4	17
GPS	0	17	27	10
Navigation	0	17	39	3
Projection	0	17	3	18
Remote Sensing	0	17	18	12
Vector	0	17	1	22

Analysis that Supports NVivo: Text-to-Matrix Generation (TMG)

Next, the results from TMG were analyzed to determine if there was agreement with the NVivo analysis. For 82% of the terms, the frequencies determined from NVivo matched the frequencies determined from TMG, and provided support for the NVivo analysis. The main difference in concept frequency between the two (*distribution, map, location,* and *scale*), were likely due to the stemming operation available in TMG as it assigns higher frequencies (less than five counts higher) than the output from NVivo.

Second, the TMG output was used to investigate both the frequency of spatial terms within the document *not* included among the 22 investigated in the Ontario study, as well as, the frequency of terms that were not spatial concepts. The former revealed emphasis on important spatial concepts left out of the NVivo analysis while the latter revealed what the document actually emphasized when investigating frequencies of types of terms (e.g., geographic concepts vs. geographic objects vs. geographic processes, etc.). The TMG output, even with stemming and implementation of a "stop list," (which removes terms, such as "the," "and," "it," etc., that were not relevant to the investigation), counted 2,677 different terms within the document. It was decided, to try and maintain accuracy while gaining insight into additional spatial terms (left out of the Ontario analysis), as well as, non-spatial term frequency, to investigate the frequency of the top 40 terms (which included terms with frequencies above 10, see Table 2).

In addition to looking at the 40 most frequent terms, included, and not included, in the 22 Ontario standards, each geography term within the

Table 2

Frequencies including terms not covered in the 22 Ontario standards.

Term	Frequency
Physical	90
Human	73
Space/Spatial/Spatially	**70**
Place/Places	**63**
Explain	56
Region/Regional/Regions	**56**
Describe	52
Geography/Geographical	51
Environment/Environmental	48
Earth	46
Analyze	44
Pattern/Patterns	**41**
Identify/Identifying	38
Characteristics	37
Different	35
People	35
Processes	30
Map/Maps/Mapping	**27**
System	27
Distribution	**26**
Economic	26
Resources	25
Changes	20
Ecosystems	20
Evaluate	20
Activities	19
World	19
Affect	18
Change	18
Surface	**17**
Settlement	16
Cultural	15
Events	15
Features	15
Scale/Scales	**15**
Issues	13
Organization	13
Problems	13
Global	12
Local	12

document was manually placed into an appropriate category, using the category definitions provided earlier. Within each term category, a distinction was made in terms of how often that type of term appeared in different grade levels to ascertain what types of terms were emphasized at different points in the K-12 educational spectrum (Table 3).

Table 3

Frequencies, by grade cluster, of different types of terms.

TERM CATEGORIES	K-4	G5-8	G9-12
Concepts	74	30	43
Objects	33	15	6
Processes	21	20	33
Representational Schema	7	5	2
Models	2	4	2
Methods	9	16	13

Presence of Fundamental Spatial Concepts in College-level Introductory Human Geography

The final step in this study was to determine how frequently a set of 16 fundamental terms (not associated with the Ontario study) appeared in a higher education introductory human geography course taught by the author. This investigation was motivated by the desire to provide some insight into what introductory-level geography professors might expect in terms of students' possible levels of exposure to spatial concepts. The list of 16 terms resulted from the author's multiple and varied exposure to the introductory human geography course. In addition, other sources informed the development of 16 fundamental terms, and included: 1) talking to other instructors' from this university's geography department about their use of the 16 concepts in their lectures for the introductory course, 2) investigating the Advanced Placement Human Geography course, and 3) reviewing multiple introductory human geography textbooks. From these sources, the list of 16 fundamental human geography concepts was determined. Table 4 provides total frequencies for each term, but also provides how often each term appeared within the specified grade groupings.

Table 4

Presence of 16 fundamental spatial concepts by grade cluster.

Concept	k-4	5-8	9-12	Total
Location	15	3	1	19
Direction	2	0	0	2
Distance	2	1	1	4
Cluster	1	0	0	1
Network	1	1	0	2
Pattern	13	20	8	41
Density	0	0	0	0
Distance Decay	0	0	0	0
Time-Space Convergence	0	0	0	0
Region	14	17	25	56
Hierarchy	0	0	0	0
Accessibility	0	2	0	2
Connectivity	0	0	0	0
Scale	9	4	2	15
Generalization	0	0	1	1
Spatial Association	0	0	0	0

Discussion

Hypothesis 1 (Part 1): Objects and Processes, Compared to Higher Level Spatial Concepts

When looking at Table 3, which categorized terms according to their "type" and grade cluster they appeared in, it seems that *Hypothesis 1* did not prove true and that spatial concepts do, indeed, enjoy a greater presence in the national standards compared to other types of geographic terms. However, in order to be placed into the spatial concept category, a term had to be "an abstract idea generalized from a particular instance," a rather broad definition that allowed many terms to be placed into this category, for example, *parallels, meridians, seasonality, climate*, and so forth. While these were ALL very important spatial concepts, they were mostly specific to various sub-areas of geography. For example, it would not be expected that a student in an urban geography class be exposed to the concept of "faulting."

However, students should be exposed to a certain set of spatial concepts regardless of the type of geography being studied: fundamental spatial concepts that include terms such as, *location, distance, direction, area, region, scale, network*, and so forth—terms that *all* geographers (should) use to understand and describe space. When exclusively looking at fundamental spatial concepts (Table 4), there was definitely less of a presence within the national standards document compared to other types of geographic terms. Table 2 lists the top 40 most common terms, and revealed that only 8 of those 40 terms were fundamental spatial concepts. Consequently, the data from both software systems suggested that while the national standards do emphasize concepts as opposed to other types of spatial terms, within that emphasis very little focus was placed on fundamental concepts of geography.

Hypothesis 2 (Part 1): U.S. Geography Standards Compared with Ontario Standards

When comparing the U.S. national standards to Ontario's standards, the U.S. demonstrated higher frequencies for the concepts: *spatial, place, region, distribution, map, location,* and *scale.* Except for *map* and *scale,* these concepts were ranked much lower in the Ontario standards. Seven of the twenty-two Ontario terms did not appear in the U.S. standards at all: *coordinates, elevation, GPS, navigation, projection, remote sensing* and *vector* (at least within the two sections of the U.S. standards document that was investigated).

Consequently, the difference in concept frequencies between the standards documents from the two entities suggested that geo-education priorities differ substantially between the U.S. and Ontario. However, it should be noted that the 2001 Ontario standards analyzed in Sharpe and Huynh's (2005) study were published seven years after the publication of *Geography for Life* which may explain the emphasis on "geomatics" in the Ontario standards, given the explosion of information technology since 1994.

Caveat and Limitations

It should also be noted that the Ontario standards are structured somewhat differently from the U.S. standards. The U.S. set contains 18 different standards organized around, "The Six Essential Elements" (which include the world in spatial terms, places and regions, physical systems, human systems, environment and society, and the uses of geography). The Ontario standards, however, are divided first between Academic and Applied Geography, and within each, are further broken down into five main themes: space and systems, human/environment interactions, global connections, understanding and managing change, and methods of geographic inquiry and communication. At the high school level, each of the five themes is covered in one page for each of the two major divisions, comprising, approximately, 10 pages.

For grades K-8, geography is interwoven into the social studies curriculum, making it more difficult to determine the amount of the document explicitly addressing geography. It seems, though, based on preliminary investigations *Geography for Life* is a much longer document than the both K-8 and high school geography-related standards in Ontario put together, meaning greater opportunity to find these spatial concepts within the U.S. document (note: in Ontario, exemplars were provided in a document separate from the national standards).

Finally, it should also be noted within this discussion that only the 22 words obtained from Sharpe and Huynh's investigation were used for this comparison. Further research might apply a similar analysis as Sharpe and Huynh's to the U.S. standards and related spatial disciplines to similarly determine a core set of spatial concepts. Also, researchers might also investigate possible similarities and differences between concept lists, as well as, developing a more comprehensive list (that includes fundamental concepts determined from the U.S.-based analysis) that might limit the discrepancy between total appearances of these 22 terms between the 2 sets of documents (306 counts in the U.S. standards compared to 476 counts in the Ontario Standards).

Hypothesis 3 (Part 2): Presence and Placement of 16 Fundamental Geospatial Concepts

Of the 16 fundamental spatial concepts investigated, 2 demonstrated a frequency of over 20 (more than what was hypothesized). *Region* appeared 56 times and *pattern* appeared 41 times. Six of the concepts received no mention in the national standards: *density, distance decay, time-space convergence, hierarchy, connectivity,* and *spatial association.* The remaining eight concepts, with the exception of *scale*, which had a frequency of fifteen, experienced little mention in the national standards (Table 4).

Table 4 presents the concepts in order of complexity; for the simple concepts, as expected, the frequencies were higher in the lower grade levels than upper-grade levels. For the remaining concepts that actually appeared within the document, frequency did not seem to increase as complexity increased (as hypothesized); in fact sometimes the opposite relationship occurred where difficult concepts appeared more frequently at lower grade levels. For example, scale, a relatively complex concept appeared more often at younger grade levels compared to region, which appeared more often in *Geography for Life* at the upper grades than lower grades. Nonetheless, it was likely that the level of understanding for some of the more complex concepts, which appeared in lower grade levels, is not as advanced as would be required for the older students.

Inclusion of Exemplars in U.S. Standards Analysis

As the findings proved rather surprising, it was decided to add one additional investigation to this study that included concept frequencies within the national standards exemplars (it was originally decided to remove these from the analysis as: 1) they were not an essential component of each standard, and 2) they were not included in Sharpe and Huynh's Ontario analysis). The Ontario Standards provided exemplars as a separate document, thus, removing the U.S. exemplars for that comparison was logical and appropriate. However, inclusion of exemplars with U.S. based geography might reveal that certain fundamental concepts do actually appear or appear more frequently within this document than what was previously discovered.

For six of the sixteen concepts, inclusion of exemplars in the analysis did not change the frequency of the presence of those terms within *Geography for Life* (Table 5). Four, *distance decay, time-space convergence, connectivity,* and *spatial association*, still did not appear in the document,

Table 5

*Frequency of concepts by grade cluster.**

Concept	k-4	E	5-8	E	9-12	E	Total	Total + examples
Location	15	7	3	20	1	22	19	78
Direction	2	1	0	1	0	1	2	6
Distance	2	1	1	1	1	4	4	10
Cluster	1	0	0	0	0	0	1	1
Network	1	1	1	0	0	5	2	8
Pattern	13	6	20	39	8	19	41	105
Density	0	4	0	4	0	0	0	8
Distance Decay	0	0	0	0	0	0	0	0
Time-Space Convergence	0	0	0	0	0	0	0	0
Region	14	6	17	49	25	68	56	179
Hierarchy	0	0	0	0	0	2	0	2
Accessibility	0	0	2	3	0	0	2	5
Connectivity	0	0	0	0	0	0	0	0
Scale	9	3	4	4	2	4	15	26
Generalization	0	0	0	0	1	0	1	1
Spatial Association	0	0	0	0	0	0	0	0

*Including frequencies within exemplars indicated in columns labeled "E" (Source: GESP, 1994).

while *cluster* and *generalization* did appear in the previous analysis but not in the exemplars. *Density* and *hierarchy* only appeared in the exemplars, but with low frequencies while *direction, distance, network, accessibility,* and *scale* all did experience greater frequencies once exemplar frequencies were included, but total numbers still proved to be quite low. The concepts enjoying the greatest presence among the exemplars included *location, pattern,* and *region.* Outside of the exemplars, *location,* a simple concept, appeared more at lower grade levels than upper grade levels, a pattern which was reversed with inclusion of the exemplars. *Region* and *scale,* both more complex concepts, did appear more at upper grade levels with inclusion of the frequency counts within the exemplars.

While inclusion of the exemplars definitely boosted the frequencies of many of these fundamental concepts, it is likely that the frequency of object terms (such as place names) would increase much more dramatically than the concept terms, which would strengthen the observation predicted in hypothesis one. In fact, the emphasis on object terms within the exemplars was a major determining factor in eliminating this portion of the standards from the preliminary analysis.

Future Research Avenues

While the results of the content analyses presented in this paper certainly provide some interesting preliminary insight into the types of terms emphasized in *Geography for Life*, further research will certainly support and expand upon these findings. First, some disciplinary-wide agreement on the fundamental concepts of geography would certainly provide insight into what concepts should be emphasized within the standards document. Content analysis of major textbooks (of all sub-disciplines of geography) might reveal which overarching concepts receive the most attention and, thus, might receive greater implementation in a revised standards document.

Second, further and more extensive analysis might be conducted on the non-conceptual terms present within the document. Analysis from the previous suggestion might possibly reveal the most important processes, models, theories, and objects within the discipline, which might be considered for inclusion in the standards.

Third, overlap between what exists in the national standards, in terms of conceptual presence, and what is actually taught in K-12 classrooms may not be perfect. Students may actually receive greater instruction in fundamental concepts than what the standards would imply. Investigation of curriculum materials, perhaps in conjunction with the NAEP report (to determine which states excel/struggle in terms of geography understanding), might point to interesting outcomes in terms of what concepts are actually taught, and, if compared across states, might provide some preliminary explanations for why certain states excel in their ability to produce geographically literate students (as measured by the NAEP results).

Finally, greater investigation of standards/curriculum materials in other disciplines that employ spatial thinking is called for, and, as encouraged by Downs and Liben (1997), in conjunction with developmental research on when students are able to comprehend and apply certain concepts to their thinking processes. Through content analysis of related disciplines (e.g., math, science, art, etc.), a core set of spatial concepts might be determined, and then, be combined with developmental research to more appropriately apply these concepts across the curriculum. For example, is it logical to expect an early elementary school student to understand the concept of *generalization*? Data on when certain spatial concepts appear in other school subjects (e.g., geometry, science, art), combined with data on when students are able to understand specific spatial concepts will likely lead to a much more robust and useful set of national standards in geography.

References

Battersby, S., Golledge. R., & Marsh, M. J. (2006). Incidental learning of geospatial concepts across grade levels: Map overlay. *Journal of Geography, 105*, 139-146.

Canadian Council for Geographic Education (2001). Canadian national standards for geography: A standards based guide to K-12 geography. The Royal Canadian Geographical Society. Retrieved from http://www.ccge.org/programs/geoliteracy/docs/Canadian_Geography_Standards.pdf

Downs, R., & DeSouza, A. (Eds.). (2006). *Learning to think spatially: GIS as a support system in the K-12 curriculum.* Washington DC: National Academies Press.

Downs, R., & Liben, L. (1997). Geography and the development of spatial understanding. In R. Boehm & J. Petersen (Eds.), *The first assessment: Research in geographic education* (pp. 21-45). San Marcos, TX: The Gilbert M. Grosvenor Center for Geographic Education.

Geography Education Standards Project (GESP). (1994). *Geography for life: National geography standards.* Washington, DC: National Geographic Society.

Goals 2000: Educate America Act. (1994). Retrieved from *www.ed.gov/legislation/GOALS2000/TheAct/*

Golledge, R., Marsh, M., & Battersby, S.E. (2008). Some thoughts about a geospatial lexicon and task ontology for acquiring geospatial knowledge. *Annals of the Association of American Geographers, 98* (2), 285-308.

Mark, D. M., Smith, B., & Tversky, B. (1999). Ontology and geographic objects: An empirical study of cognitive categorization. In C. Freksa and D. M. Mark (Eds.), *Spatial information theory: A theoretical basis for GIS* (pp. 283-298). Berlin, Springer-Verlag.

Marsh, M., Golledge, R., & Battersby, S.E. (2007). Geospatial concept understanding and recognition in G6-college students: A preliminary argument for minimal GIS. *Annals of the Association of American Geographers, 97* (4), 696-712.

Miller, J. (2004). Geographic information literacy in British Columbia's K-12 education curriculum. (Unpublished master's thesis). Victoria, British Columbia, University of Victoria.

Munroe, S., & Smith, T. (1998). State geography standards: An appraisal of geography standards in 38 states and the District of Columbia. Washington, DC: Thomas B. Fordham Foundation.

National Center for Education Statistics. (2011). The Nation's report card: Geography 2010. Retrieved from http://nces.ed.gov/nationsreportcard/pubs/main2010/2011467.asp

National Geographic Society. (2006). 2006 Roper Report on Geographic Literacy. Retrieved from www.nationalgeographic.com/roper2006/pdf/RoperPoll2006.pdf

Sharpe, B., & Huynh, N. (2005). Geospatial knowledge areas and concepts in Ontario's K-12 geography curriculum part II. Technical report for the GeoSkills Program, GeoConnections: Natural Resources Canada.

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