Educational Leadership’s Literacy Needs for Informatics and Cybernetics Agenda

Abstract
At the heart of many forms of societal change is leadership that is aware of the necessary change that may best suit emerging technological paradigms. However, the informatics and cybernetics agenda is one that may be unknown in policy on the federal and many state levels towards educational K-12 value. Specifically, Executive Order 12906, a federal mandate known as the Coordinating Geographical Data Acquisition and Access: The National Spatial Data Infrastructure, by the federal government in 1994 has interested educators in exploring their possible roles in spatial thinking, broadly defined as the use of space to define, formulate and solve problems (Branch, 2009). As such, literacy towards informatics and cybernetics may be needed to stimulate such pipeline considerations by next generation educational leadership (NGEL).

Keywords: informatics, cybernetics literacy

Introduction
This work may serve as a brick in the new educational foundations of NGEL. Such proclaims that leadership must have pragmatic solutions and refrain from political rhetoric. NGEL should address, represent and bridge pragmatic solutions to long standing educational issues left behind due to a lack of effective interaction between communities, school leadership, such policy makers and the scientific community. Lastly, this work may imply that informal and formal community informatics and citizen science programs may be the plausible venues to address Science, Technology, Engineering and Math (STEM) outcomes. In addition, this paper focuses on Earth Science and space informatics as K-12 literacy need because it linked as outcome of the STEM outcome as defined by the United States Department of Education. Thus, the terms informatics and cybernetics are assumed to be linked to Earth Science and space concepts.

For example, as the [1] National Academy of Sciences (2006) defined spatial thinking as an likely medium of scientific communication for all levels of education, the stakeholders in control may develop a new age literacy and involvement towards [2] Executive Order 12906, state mandates, the societal needs of climate change and a green economy. At the root of such effectiveness is what infrastructure and what type of investment in such infrastructures will cost effectively benefit society. As school districts are hit with budget crises, informatics and cybernetics have to re-
define themselves into cost effective and pragmatic community based frameworks that support an interdisciplinary ontology of communication across disciplines as referenced in [3] knowledge representation in the semantic web for Earth and environmental terminology (SWEET). Such may be a defining collaborative skill development towards a global citizen mindset. Such a definition should be considered a NGEL literacy for the global citizen of tomorrow which is illustrated in this conceptual framework in Figure 1.

In the [3] SWEET implementation, math may be the root of relating the value of informatics or cybernetics across disciplines. Hence, data processes along with Earth Science investigations may need a synergistic value and intentional support by NGEL to sustain K-12 implementation and assessment.

The foresight of education leadership should have the ability to always define or anticipate the next generation of pedagogical need of its impending data and infrastructure requirements. For example, if grid or cloud computing becomes an cost effective norm in society, then perhaps education should consider a bee hive approach to societal needs where the entire society must input a more equitable role in the brainpower of its citizens to address future climate change and green economy needs. Simply, if informatics and cybernetics are critical to climate change response, then data driven practices along with computational Earth Science training must be a common occurrence.

Hence, educational networks must transfer more knowledge in future generations. For example, National Aeronautical and Space Administration’s (NASA) Cryosphere and Dynamic Earth public outreach materials suggest a 3-foot sea level rise by 2100 A. D. that may affect millions of persons in the world. If the potency of effective educational leadership does not have spatial thinking, informatics and cybernetics development on its radar, then how can it steer future generation towards a state of self determination in the face of a complex world where Earth Science data computation is a valuable commodity?

Therefore, society may be challenged with a spatial thinking literacy as well as an informatics and cybernetic literacy. Clearly, “the spatial thinking experience of data collection, data verification, and data analysis is not on the radar of educational leadership” [4] (Branch, 2009). As such, informatics literacy and cybernetics literacy may too be non-evolved within the educational K-12 community.

K-12 literacy needs
This paper suggests that applicable policy exists for spatial literacy to be embraced and supported from [2] 1994 Executive Order 12906. Such is the basis for literacy towards informatics and cybernetics to take root in the K-12 experience after projected based spatial thinking or Earth Science base experienced reach the K-12 standard course of study. This work argues that after school experiences are not enough to prepare the next generation of global citizens to deal with the green economy or climate change implications. The [5] 2009 White House “Educate to Innovate” campaign by the Obama administration should address the K-12 standard course of study on the state level and supported by the US Department of Education because of [2] Executive Order 12906. Furthermore, since past Presidential Initiatives such as Bush administration’s 2005
support of geospatial technology in the K-12 and college community should not be ignored. The states and the federal government laws applicable to [2] Executive Order 12906 should provide rationale for educational leadership and NGEL to ensure spatial literacy applied to the K-16 standard course of study. Literacy towards informatics and cybernetics by educational leadership may be a secondary response to [2] Executive Order 12906.

NGEL should utilize the practice of community informatics, a collection of community remote sensing, community geographical information systems and environmental study, where cost effective Earth Science could be implemented by partnership between educators and the community. Here, a literacy of climate change is justified in the terms and practices of informal to formal Earth Science data collection, analysis and presentation with cost effective Earth Science tools of GIS, remote sensing or Earth Science investigation.

Successful implementations may even become applicable solution to economically stricken school districts. Moreover, a possible benefit to government agencies could be stimulation in STEM disciplines outcome in a cost effective manner if collaboration between academic institutions, the community and scientific agencies desire such synergy.

Moreover, implications to Earth Science and Space informatics pipeline, climate change, interdisciplinary research and collaboration; accreditation change, and grant funding issues should be well versed by educational leadership to address the data driven needs and skills of next generation considerations of global citizens. NGEL has a morale obligation to create the next global competitive citizens with literacy in spatial tools, Earth Science data processes, climate change debate and logistics of a global economy.

**Keywords:** Spatial literacy, community informatics, next generation educational leadership, climate change literacy

---

**Spatial thinking for social scientists**

Other researchers, including [6] Allen (1999), have referenced a continuation of Dewey’s (1916) notion that time and space are key influences on educational experience, suggesting that education in general has not formally optimized the importance of space in terms of its educational potential. [6] Allen (1999) and others have argued that the concept of space is a vital consideration for social scientists stated “that space is an irreducible, essential quality of humanness and social being” [7] (Lefebvre,1991), [8] (Foucault and Miskowiec, 1986); [9] (Soja, 1989, 1996). Widespread use of spatial thinking models, such as those described by [10] Legates (2005), might not occur due to barriers in a spatial thinking culture in education, such as a lack of spatial literacy. Hence, similar literacy issues may stall Earth Science informatics and cybernetics development unless championed by NGEL.

**Spatial Literacy**

The social contract between educational leadership and the public may arguably center on helping students to prepare to be productive citizens. Such a commitment resonates in efforts to incorporate 21st century skills within the student experience. Central to the argument of this work is that before the student experience can credibly reflect 21st learning, the leaders of the educational system must themselves possess sufficient knowledge and awareness to direct, evaluate and access instruction in spatial thinking related paradigms.

**Literacy-informatics and cybernetics**

[11] "Leadership is the single most important factor affecting the successful integration of technology. This is true at the state level and at the school level. Schools which have made the most progress are those with energetic and committed leaders." Hence, NGEL frameworks should build constantly among leadership to incite change towards spatial thinking, informatics and cybernetics literacy.

Informatics and cybernetics defined respectively as information science and “use
models of organizations, feedback, goals, and conversation to understand the capacity and limits of any system” [12] (Pangaro, 2007).

More importantly [13] No Child Left Behind (NCLB) stated that funds can be used to “(1) acquire and use advanced technology, incorporated into the curricula of the school, to develop and enhance the information literacy, information retrieval, and critical thinking skills of students”. Such implies that NCLB funds may be applicable to addressing spatial thinking, informatics and cybernetic literacy in education.

Thus, such communication issues may involve the management of data and its presentation to stakeholders. “While increased accountability is just one part of NCLB, all schools must gather data and overcome barriers to analyzing and using the data” [14] (Bernhardt, 2004). Thus, spatial thinking should be a normal part of overcoming barriers or adjusting to changing metrics and methods of data collection and analysis. Likewise, with an interdisciplinary effort borrowed from Earth Science, NGEL may utilize informatics and cybernetics to overcome data barriers of implementation, assessment or operation.

[15] Dewey (1916) clearly acknowledged that student experience was dependent on factors such as time and space. Dewey (1916) stated, “As a societies[sic] become more complex in structure and resources, the need of formal or intentional teaching and learning increases”. [6] Allen (1999) stated that “Dewey believed that all schools, whether traditional or progressive, are essentially about experiences that lead to growth”. “We need to invest in a systematic educational program to enhance levels of spatial thinking in K–12 students” [1] (National Academy of Sciences, 2006).

**Conclusions**

Education professionals should not ignore this bold call for educational change by a major policy maker like the [1] National Academy of Sciences (2006), whose research reputation is second only to Nobel Prize researchers. The [1] National Academy of Sciences (2006) advocated, “Our goal must be to foster a generation of students (1) who have the habit of mind of thinking spatially, (2) who can practice spatial thinking in an informed way, and (3) who adopt a critical stance to spatial thinking”.

Such may not be fully sustainable without data skills involving informatics and cybernetics because of the inter-relationships of math, computing and science. As the National Academy of Sciences Academy (2006) advocated spatial literacy for student learning, NGEL must have such skills as well as any informatics or cybernetics literacy. This paper argues that educational professionals should be spatially literate and have a formal set of standards before they attempt to use or teach this in the classroom. Thus, educational professionals are not able to promote spatial literacy effectively to students if they themselves are not spatially literate.

Certainly, a growing spatial culture in education exists, which seeks acceptance, reform, and policy consideration for greater spatial literacy and implementation in education. [11] Legates (2005) stated, “A small number of faculty in each of the social science disciplines and public policy fields have sufficiently mastered GIS concepts and operations to use GIS effectively in their own research and are able to incorporate GIS into their teaching. Literacy towards informatics and cybernetics by educational leadership may have the similar low numbers across disciplines.


The U.S. Labor Secretary's Commission on Achieving Necessary Skills (SCANS) stated that the most effective way to teach skills is in the context of an established subject matter (U.S. Department of Labor 1991).
The SCANS competencies include identifying and using resources, working with others, acquiring and using information, and understanding complex interrelationships (Hill 1995a and 1995b). Interdisciplinary education, rather than teaching each subject in isolation from the others, may be a more effective means to help students solve problems (Jacobs 1989). Implementing GIS into the curriculum may encourage students to examine data from a variety of fields (Furner and Ramirez 1999; Sarnoff 2000).

Hence, spatial thinking, informatics, and cybernetics literacy may appear logical in interdisciplinary learning which may be an effective Earth Science modality as demonstrated in [3] SWEET 2.0 implementation.

A [4] Branch (2009) study participant echoed NGEL sentiment. “People have to be introduced to the concept of spatial order. They seem to be more spatially aware to understand to actually extract information; location, where you’re at and what’s available; that’s important” (study participant 6, personal communication, September 14, 2007).

As policy for spatial literacy exists on manner levels, further literacy interests towards informatics and cybernetics have to pushed by educational leadership dedicated towards the increase in STEM outcomes. However, without spatial think framework as recommended by the national Academy of Sciences (2006), the momentum of educational change led its stakeholders may linger longer than 14 years after the [2] 1994 federal Executive Order 12906.

Thus NGEL is set aside to lead when risk to the society can not ensure the self determination described as inalienable rights of the United States Constitution. All nations can not be held hostage to a robust and healthy pipeline of scientific and Earth Science thinkers intertwined in the mindset of educational leadership.

Thus, as spatial literacy reaches a foothold in education, literacy towards informatics and cybernetics should follow especially if spatial literacy can achieve a K-12 standard course of study implementation. Then, the likelihood of spatial data processes and the awareness of cost effective and efficient informatics and cybernetics development should be formally considered in STEM outcome numbers, furthering the diverse needs of the geosciences pipeline.

Here, the experience of a 21st century or NGEL skill may later transfer to the classroom for student experience. Spatial thinking, informatics and cybernetics require awareness and literacy with beneficial linkages to Earth Science pipeline issues where funding may be a present concern. Present federal policy such as importantly [12] NCLB states that funds can be used to “(1) acquire and use advanced technology, incorporated into the curricula of the school, to develop and enhance the information literacy, information retrieval, and critical thinking skills of students”.

References