

UC Santa Barbara

Center Reports

Title

Symposium on a Curriculum for Spatial Thinking: Executive Summary

Permalink

<https://escholarship.org/uc/item/0jc64617>

Authors

Spatial Curriculum and Research, University of Redlands
Center for Spatial Studies, UCSB

Publication Date

2009-03-01

Symposium on a Curriculum for Spatial Thinking

Executive Summary

June 3–5, 2008
University of Redlands
Redlands, California

Participants:

Kate Beard, University of Maine; Marcia Castro, Harvard University; Jeremy Crampton, Georgia State University; Phil Gersmehl, CUNY Hunter; Mike Goodchild, UC Santa Barbara; Don Janelle, UC Santa Barbara; John Kantner, School for Advanced Research; Steve Marshak, University of Illinois Urbana-Champaign; Jo Beth Mertens, Hobart & William Smith Colleges; Diana Sinton, University of Redlands (Director and Host for the Symposium).

Overview:

In June 2008 ten educators gathered for three days to consider the feasibility of a college-level course in spatial thinking. Interest in this topic emerges from many different perspectives, but within our group the objective was primarily academic. We recognize the growing value and pervasiveness of spatial thinking and are acutely aware that spatial intelligence has not yet been systematically addressed within K-16 education. Students today are constantly exposed to spatial “tools” (Google Earth, etc.), but typically lack the foundational sense of geographical inquiry to use the tools for more than Earth-browsing. Moreover, we believe that the domain of spatial thinking can inform the design of GIS and GIScience curricula, and serve student intellectual development from across the academy, including the sciences, social sciences, humanities, and engineering.

The National Research Council’s 2006 report on Learning to Think Spatially (http://www.nap.edu/catalog.php?record_id=11019) promotes the value of spatial thinking by identifying the role it plays in different and wide-ranging disciplines, such as the geosciences, demography, astronomy, and economics, among others. The authors described the spatial thinking we do in our personal and intellectual spaces and geographies, affirming that “spatial thinking” can be taught, yet questioning whether it could be done outside of a domain context. Our group, however, did imagine it would be possible to focus a single course, or portions of a course, on spatial thinking explicitly. At the same time, a course from any discipline could be revised and modified so that its content was substantially accessed through spatial ways of thinking.

The creation of a course in spatial thinking requires compiling and organizing relevant instructional resources—an effort that has never been publicly or fully accomplished. Having these resources readily available supports faculty who may want to incorporate notions of spatial thinking into existing courses, as well as those who might want to focus wholly on the topic. Individual instructors can choose content that is most germane to their backgrounds and to the needs of their students. Cognitive scientists,

geographers, geoscientists, economists, and anthropologists would each design something slightly different, as would faculty from a School of Education. There could be experts in “spatial literacy” emerging from any of those disciplines, or others. We discussed co-teaching or team-teaching models. The domain of spatial thinking is so vast that having guest lectures—by neuroscientists, cognitive scientists, or other professionals that practice applied spatial thinking, for example—would complement what any one instructor might accomplish.

Although the promotion of spatial literacy is a goal of our initiative, we recognize that this will be reflected differently in the objectives of specific courses based on the background and interests of instructors. While we limited our focus to the undergraduate university environment, we recognized the critical value of developing spatial thinking “skills” and “habits of mind” among K–12 students and in-service teachers, and discussed the complexities of linking a technology-influenced curriculum to educational “standards” in that environment.

Generating a single, all-encompassing and universal definition of spatial thinking is necessarily challenging. We discussed this in light of how the NRC report segments spatial thinking into (1) concepts of space, (2) tools of representation, and (3) processes of reasoning. “Literacy” is an appealing idea within higher education and spatial literacy can be linked to “quantitative” or “information” literacies; but these too are challenging to define and assess.

For spatial literacy skills, we include the ability to:

- Establish geographic or spatial context for situations and conditions
- Change perspective
- Visualize
- Pose questions based on what one sees
- Generate representations of what is not readily apparent through direct observations
- Interpolate between and extrapolate beyond observations
- Sense the evolution of events (physical, economic, social, etc.) based on what can be seen
- Recognize and use spatial language (vocabulary)
- Transfer spatial understanding from one situation to another
- Analyze spatial patterns and processes
- Draw on spatial analogy to enhance understanding
- Recognize what a spatial problem is
- Recognize patterns and spatial organization

Also, spatial literacy includes awareness of:

- The tools available to collect and manipulate spatial data
- The uncertainty inherent in spatial data
- What processes generate or relate to patterns
- Knowledge and use of the appropriate terminology with regard to all items above

As underlying principles, we place value on a course that:

- Generously incorporates visualizations
- Involves multi-model, direct, and/or tactile experiences (as appropriate)
- Uses current and controversial examples to engage students
- Refers to issues of uncertainty and data quality throughout

The vocabulary referent to spatial thinking may be complicated (with variants such as spatial aptitude, spatial skills, spatial literacy, etc.) and, although the creation of standards may be useful, perhaps they may be neither feasible nor necessary. However, faculty without formal training in this area require that the key concepts and issues relevant to spatial analysis have clear and consistent definitions. We reviewed various published enumerations of spatial concepts and recognized the need to reconcile discrepancies while avoiding reductionist tendencies and respecting the intellectual history that informed the concepts in their time. We concluded that consensus is possible in identifying a limited number of spatial “truths” that can be articulated clearly and broadly as foundational elements of a curriculum. Examples include the need to understand the modifiable areal unit problem (MAUP), spatial autocorrelation, and spatial dependency. Since some non-geography faculty may be familiar with such concepts but not with the discipline-specific jargon, it is important to be semantically clear about the concepts, ideas, and truths that we suggest as central to spatial thinking.

Discussion of assessment for this type of course was brief and inconclusive, recognizing that ideas would reflect the domain expertise of individual instructors. Nonetheless, we conclude that a “high degree of spatial literacy makes a difference for a society” and that both qualitative and quantitative course formats can contribute to the expectation that students will gain the ability to:

- Analyze representations of spatial information (text and graphics)
- Critically evaluate spatial relationships in current events
- Use spatial vocabulary consistently and correctly for a given situation

More and more universities are establishing stand-alone GIS Centers that offer training in software. These are popular with graduate and undergraduate students and faculty alike and serve to increase the visibility to GIS applications. Yet these activities are typically pursued in the absence of foundational understanding of spatial concepts and tenets of spatial analysis, resulting in missed opportunities and potentially creating flawed conclusions.

If spatial thinking is as important to society as we believe it is, then a place within general education requirements is appropriate. We discussed the trade-offs of various models for general education inclusion at different types of institutions (e.g., comprehensive research universities and liberal arts colleges), reviewed the types of institutional impediments that such a course might face (including already over-crowded curricula and the lack of a “home” department), and anticipated the skepticism of those who would question both the value and teachability of spatial thinking overall. In light of these considerations, we make a set of recommendations for moving forward.

Recommendations and Next Steps:

We believe there is an immediate window of opportunity to develop resources aimed at teaching spatial thinking; establishing a plan and curricular ideas for its teaching is both a logical and paramount next step.

1. Identify resources and alliances to promote spatial literacy

Numerous disciplines have been investigating the nature of spatial thinking from different perspectives and with different motivations and goals. To create a climate that is conducive to expanding the role for spatial thinking in undergraduate education, both on our respective campuses and nationally, we need to identify individuals and groups from these disciplines to help create more inclusive knowledge alliances in support of curriculum changes that enhance spatial literacy skills.

2. Develop collaborative website to enable dissemination

We must build an online space to gather resources as we develop the body of knowledge centered on the concepts of spatial thinking. This website should be designed in wiki format to maximize the opportunities for collaborative and inclusive discussion, especially during this formative time of concept accumulation and knowledge organization. Providing instructional resources in a modular format will enhance flexibility to serve any number of instructors from different disciplines and will increase the utility of the site. The wiki should be a vehicle to help scholars and practitioners formulate research questions regarding the nature of spatial thinking in different knowledge domains and formulate appropriate pedagogic strategies. We propose a concerted effort by ourselves and colleagues to codify this knowledge into a textbook that is suitable for use in a core curriculum course on spatial thinking.

3. Further development and application to research

Through improved organization of spatial knowledge, we will build a foundation of clearly articulated intentions for research that will be critical to successfully procure external funding. One research area that has already emerged involves spatial thinking and the curricula for and instruction of GIS and GIScience, such as investigating whether the understanding of a learning sequence of spatial concepts could lead to better software design for GIS and spatial analysis.

Conclusion:

With this report and with a website as springboards for action, we will seek to position this initiative for broad dissemination through follow-up meetings and conferences, a white paper for use on individual campuses, and journal articles.