Advancing STEM Education, GIS, and Spatial Thinking

THOMAS R. BAKER
Education Manager, Industry Solutions, ESRI Inc.
Adjunct Researcher, Center for Science Education, University of Kansas
Email: tbaker@esri.com

The call for this specialist meeting asserts that spatial abilities are related to both success and participation in STEM. More generally, it implies that spatiality is the unifier of [most] academic disciplines. These assertions beg many questions, perhaps beginning with, what is our goal? What should the educational community and industry partners do to clarify the need for and advance spatial abilities across the collegiate and K-12 curricula in the near term, from research and practice to curriculum development and promotion?

Uttal and Cohen’s (2012) meta-analysis lends clarity to the many critical dependencies STEM education holds for spatial abilities and training. The longitudinal work of Wai, Lubinski, and Camilla (2009) demonstrate the propensity of most STEM learners to score well on measures of spatial skills. Learning to Think Spatially (NRC, 2006) articulated the value of Geographic Information Systems (GIS) in serving a need to develop spatial skills in learners. It’s my contention that at multiple levels and use cases, GIS could be of great value in providing spatial skill development through well-defined STEM curriculum and instructional practices. GIS could also be of substantial benefit in assessing spatial skills development. While learning to use GIS provides learners with 21st century career skills, STEM teachers also use GIS in inquiry-oriented instruction to teach content, using real-world problems. To advance the development of spatial skills throughout K-12 STEM, collegiate STEM, and beyond (e.g., http://esriurl.com/spatialuniversity), Esri Education works in at least three interwoven spaces: educational research, open educational resource development, and educational advocacy.

At ESRI Education, we commit time and energies to supporting STEM and spatial thinking, especially in K-12 and informal education. High quality STEM learning supports national priorities in STEM-based career development and collectively, a workforce that is more globally competitive. STEM learning requires effective curriculum standards, high-quality teacher preparation, and supporting national policies and frameworks (NSB, 1997). The significance for targeting K12 (including university teacher education programs) cannot be overstated. “Nearly four in five STEM college students said they decided to study STEM in high school or earlier (78 percent). One in five (21 percent) decided in middle school or earlier” (Harris Interactive, 2011).

Supporting and contributing to GIS educational research efforts are capstones in my work to advance spatial skills, student outcomes, and teacher professional development across all disciplines, including STEM. Over the last six years, we have hosted researcher meetings at academic and industry conferences. The coming year holds plans for continuing that effort with intentions to support the development of a formal GIS education research agenda in collaboration with multiple partners from academia and industry. Such an agenda has been
called for by scholars, the GIS Education Working Group (http://edgis.org/research), and the ESRI academic advisory board. This agenda will undoubtedly include substantial recommendations that foster research on GIS as a tool for acquiring and assessing spatial abilities.

Open Educational Resources (OER) represent the intersection of spatial skills, STEM content, and GIS technology for the education team. Adopting a Creative Commons license (Attribution-Noncommercial-ShareAlike), Esri Education sponsors hundreds of activities in ArcLessons, the EdCommunity blog, and various video outlets. Our OER efforts include instructional resources, software, and data - all designed to foster spatial thinking. Resources are formed as single or multi-day lessons, modularized "plug-in" activities, units, and even whole courses. These instructional materials target both traditional content acquisition and skill building, including problem-solving, critical thinking, and spatial thinking. Summarily, our OER efforts are an attempt to democratize both spatial skill and GIS skill development across nearly all instructional boundaries.

ESRI Education is driven by advocate geographers and educators who are tasked with bringing spatial thinking and analysis by way of technology to the entire education space. With the aid of the Esri academic advisory board, we continually monitor and adjust our efforts to best align with community need. As a result, the team engages in a very wide range of activities, including designing promotional materials, creating a presence at key educational conferences, and developing literature and technology products that serve education. Each of these outlets includes and often frequently targets, spatial thinking and skill development in the context of GIS.

Within our ongoing efforts, lies the capacity to support the development of educational resources, research, and advocacy that extend spatial thinking across the K12 and collegiate curricula. What messages, materials, and technical developments should industry contribute to the promotion of spatial abilities across curricula? When is the appropriate time and what form should such efforts take?

References