RPP for Geocomputation: Partnering on Curriculum in Geography and Computer Science

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***Abstract*— The growth of the geospatial services industry is increasing the demand for graduates with training in both geography and computational thinking (geocomputational thinking). The limited availability of learning pathways towards geocomputationally intensive jobs requires employers across the public and private sectors to choose between hiring a geographer or a computer science graduate. This collaboration of authors will initiate the formation of a researcher-practitioner partnership (RPP) in Southern California, as a new strategy to addresses the lack of geocomputational learning pathways.**

***Keywords*— geography, computational thinking, learning pathways, researcher-practitioner partnership**

I. Introduction

In recent years, the geospatial services industry created approximately 4 million direct jobs, and generated 400 billion U.S. dollars globally in revenue per year [2]. The growth of this industry is increasing the demand for graduates with training in both geography and computational thinking (geocomputational thinking), but they are hard to find. The limited availability of learning pathways towards geocomputationally intensive jobs requires employers across the public and private sectors to choose between hiring a geographer with limited or no computational skills, or a computer science graduate with limited or no expertise in geography and geographic information technology. In this short paper, we motivate the importance of building capacity for geocomputational learning pathways for *all*, and provide a broad overview of associated educational challenges. We then introduce our collaborative effort, in the San Diego area, intended to initiate the formation of a researcher-practitioner partnership (RPP) as a new, exploratory, and evidence-based approach to address the lack of such learning pathways.

II. Growth of Geospatial Data

Continued innovations in geospatial hardware and software (e.g. GPS, GIS) are driving a growth in the collection of geospatial data. These data are now used beyond the field of geography. In fact, geospatial data are central to the current success of established tech companies such as Google, Uber, and Amazon and to that of many smaller tech startups. These companies generate a significant amount of geospatial data, and the customers and users of their platforms are generating geospatial data too; often on a daily or hourly basis.

A. Innovations beyond mobile GPS techologies

Geospatial hardware is becoming cheaper and smaller, making it possible to manufacture cheap satellites the size of a shoebox. This democratization of manufacturing geospatial hardware together with lower-cost unmanned rocket launches, is the business model of about a dozen start-up companies who offer their service to customers who want to capture their own geospatial data from space [3]. Clearly, this is a sign that this industry is continuing to innovate beyond mobile GPS technologies. Consequently, this industry will generate enormous volumes of geospatial data at even higher velocity and greater variety than we are already facing. The value of these spatial data, however, hinges on a workforce that inclusive and diverse, geographically knowledgeable, and equipped with the skills to properly analyze spatial data (e.g. spatial thinking, geospatial tools, GIS) and efficiently handle sizeable data (e.g. data mining, parallel computing).

B. Importance of spatial thinking skills

Geographers' expertise in geographic information and training in spatial thinking remain critical to the geospatial services industry. Most notably, non-geography experts lack conceptual geographic knowledge and understanding of spatial data quality standards, which often results in misused or mishandled spatial information, misinterpretation of spatial analyses, and misinformed decision-making [5]. The growing use of "crowdsourced spatial data" in research such as volunteered geographic information collected through citizen science projects creates new challenges in terms of standards, quality, reliability, and credibility of these data [7,11].

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III. Inclusive Geocomputational Learning Pathways

The unique characteristics and challenges associated with geospatial data are taught in undergraduate geography (or related) programs and are not part of the core curriculum of other programs such as computer science or engineering. On the other hand, computational thinking skills have not been a core component of geography programs in the United States [4,13]. At the K-12 levels, we are still facing long-standing challenges with geography education. In 2015, the Government Accountability Office raised concerns that "throughout the country, K-12 students may not be acquiring adequate skills in and exposure to geography, which are needed to meet workforce needs in geospatial and other geography-related industries" [6]. At the college level, geography departments are starting to offer courses that involve computational thinking [4], but only a handful have built capacity for certificates or a specialty in geocomputation.

Another challenge that is important to point out, is the limited understanding we have about the diversity of students and the motivations they have to enroll in courses offered by geography programs that involve computational thinking (e.g. computer programming for GIS, agent-based modeling for complex adaptive systems, geo-visualizations, spatial data science, and spatial network analysis). We are aware, however, of an overall underrepresentation of women and minorities in geography programs [1]. Studies have shown the far-reaching consequences of the underrepresentation of these groups among geographers and especially in the more technical GIS discipline [10,12].

IV. Partnering on Geocomputational Curriculum

In response to these challenges, a new collaboration between the American Association of Geographers, Texas State University, San Diego State University, UC Riverside, the California Geographic Alliance, and Sweetwater Union High School District, intends to inform, and guide the articulation of preK-14 pathways toward a more modern and inclusive geography curriculum that expand opportunities for all students towards computationally-intensive jobs and college majors.

A. Collective Impact framework

Broadening and sustaining participation in STEM is challenging, and requires effective collaboration. To this end, our collaboration will be guided by the Collective Impact framework [9], and begin with the formulation of a “Common Agenda”. The first phase of this project will be to identify a handful of geography and/or computer science teachers of the Sweetwater Union High School District to collaborate with us on a “Common Agenda”. The underlying goal of this agenda will be the use of RPPs to teach geography concepts along with GIS and CS technologies to conceive, design, and implement inquiry and analysis. We are arguing that computational thinking informed by geographic knowledge will better prepare students for career pathways that include, but are not limited to careers in the geospatial technology industry.

B. Pilot RPP for Geocomputation

The use of RPPs to make education research more useful and usable in promoting evidence-based changes in educational practices is not new [8], however—to the authors’ knowledge, they have not been used to address the lack of geocomputational learning pathways. The goal of the formation of a pilot RPP, is to support cross-collaborations between teachers and researchers in geography or social studies, and in computer science or engineering.

The pilot RPP will be composed of geographers, computer science educators, and geospatial technology specialists experienced in serving underrepresented minority students and communities. This RPP will provide the foundational knowledge upon which future strategy for scaling-up RPPs can be designed, developed, and implemented in other states and regions. Scaling-up approaches in other states will use a common set of core activities informed by a Collective Impact framework that will be developed in this initial pilot effort.

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