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Preview of Award 1560862 - Annual Project Report

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Federal Agency and Organization Element to Which Report is Submitted:	4900
Federal Grant or Other Identifying Number Assigned by Agency:	1560862
Project Title:	RCN: Transformative Research in Geography Education
PD/PI Name:	Michael N Solem, Principal Investigator Richard G Boehm, Co-Principal Investigator
Recipient Organization:	Association of American Geographers
Project/Grant Period:	06/01/2016 - 05/31/2021
Reporting Period:	06/01/2019 - 05/31/2020
Submitting Official (if other than PD\PI):	Michael N Solem Principal Investigator
Submission Date:	05/27/2020
Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)	Michael N Solem

Accomplishments

* What are the major goals of the project?

This RCN project has six major goals:

1. Catalyze research planning with strong potential to result in transformative research projects in geography education.
2. Facilitate collaborative research among geographers and STEM education researchers.
3. Attract more diverse cohorts of graduate students to Ph.D. programs in Geography Education.
4. Increase research productivity and the knowledge base in geography education.
5. Secure the long-term growth and stability of the RCN.
6. Promote the use of research to improve practice in geography education.

The primary mechanism for pursuing the goals under this project is a grant program administered by the National Center for Research in Geography Education (NCRGE). This grant program is designed to catalyze the formation of research groups working in different thematic areas of geography education research. Their research planning activities are intended to position them for long-term work connected to the Road Map Project's agenda for transformative research. See appended group reports for details.

* What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?

Major Activities:

In the fourth year of the project, NCRGE organized research networks in the areas of 1) Geography Education and Libraries, 2) Powerful Geography and the NAEP Assessment, and 3) Geocomputation. Their activities and accomplishments to date in relation to the six major project goals are summarized below and in the appended group reports.

Geography Education & Libraries

One research group, under the direction of Emma Slayton and Jessica Benner (Carnegie Mellon University Libraries), is focusing on developing a community to explore the role of libraries and informal education spaces in supporting geography and GIS education. A network of libraries, data centers, and educators will work to develop a research agenda that focuses on assessing how the non-traditional teaching activities that occur in libraries can feed into and support existing methods of teaching about GIS and geography. The group will initially focus on the following research questions:

1. What practices/techniques are used to teach spatial concepts in libraries and other informal learning settings?
2. What spatial knowledge, skills, and perspectives are most commonly taught in libraries and other informal learning settings?
3. What are the relationships between informal learning practices in libraries and more formal learning practices in higher education?

Libraries are uniquely situated to act as a springboard for teaching spatial literacy and critical engagement with geographic concepts; however, there currently is no consensus about how librarians should teach geography and GIS. A multi-level approach to networking will include libraries on a national level, across the state of Pennsylvania, and locally in Pittsburgh to determine the broad state of the field for GIS and geography education in libraries. Outcomes of the network's activities will include a refined research agenda, an open access workbook and repository of pedagogical materials, and a series of face-to-face meetings to discuss the current practices and roles of libraries in geography and GIS education.

Powerful Geography & NAEP

NCRGE is also coordinating a research network supporting further development of the Powerful Geography curriculum project.

Powerful Geography is an effort to align the geography curriculum with the diverse aspirations and job prospects of students. The research draws on recent work in GeoCapabilities and science education that suggests conveying applications of science is a key factor influencing students' attitudes and aspirations toward science and science careers. Through this approach, the project aims to produce a curriculum model and strategy to achieve broader diversity in the discipline and workforce.

The Powerful Geography group based in Texas is currently gathering information about students' aspirations toward different careers and their interests in various social and environmental topics. Teams of researchers will then work to identify applications of geography that align with various aspirations and interests. As teachers in participating schools convey geography applications in their classrooms, a variety of methodologies, including questionnaires, interviews, and classroom observations, will explore and measure potential gains in key student attitudes (i.e., students' interest in geography, perceived utility of geography, and confidence to do geography).

The practical value of Powerful Geography will be in the form of enriched state standards and curriculum guides that provide teachers with evidence of geographic topics and applications that associate positively with students' aspirations and attitudes. Work is currently underway with schools, undergraduate students, and professional geographers in Texas, with additional states and collaborators set to join in future phases.

An important empirical perspective on student learning will come from a statistical analysis of the National Assessment of Educational Progress (NAEP), which is a periodic, nationally-representative assessment study of student achievement in various school curriculum subjects including geography. To date there have been five NAEP Geography Assessments: 1994, 2001, 2010, 2014, and 2018. Over that period, NAEP has repeatedly reported low levels of student proficiency in geography, especially among minorities. For example, Hispanic 8th-graders as a whole have barely scored above the "Basic" proficiency level (partial mastery of subject matter), whereas African American students as a whole have never even reached the "Basic" proficiency level.

NCRGE has received a license to access raw, restricted NAEP data from the Institute of Education Sciences (a research entity within the U.S. Department of Education). The restricted data include highly detailed background data on students, teachers, and schools participating in the assessment. Educational researchers in fields such as history, math, and visual arts have in the past acquired restricted NAEP datasets to conduct exploratory statistical analyses aimed at identifying student-, household-, and school-level factors that associate with varying levels of student achievement.

NCRGE is currently conducting a comprehensive multilevel statistical analysis of restricted-use NAEP Geography datasets. This exploratory analysis is scheduled to be completed in summer 2020. Meanwhile, NCRGE is organizing interested individuals to join a NAEP Geography Research Network to plan future research that builds on the exploratory analysis.

Geocomputation

This group has expanded its network and continues its assessment of the current capacity for and barriers to an inclusive geocomputational curriculum in U.S. higher

education. A second goal involves planning a research strategy to design geocomputational curriculum that is inclusive, supports teacher learning, and can be measured for effectiveness. This investment will set the stage for a longer-term research agenda around these broader objectives and will identify experts beyond universities to expand the network to all levels of geography education. Building such a research agenda will ensure future generations of geographers and geospatial industry professionals are prepared to contribute to the national innovative ecosystem.

Specific Objectives:

Significant Results:

Key outcomes or Other achievements:

* What opportunities for training and professional development has the project provided?

Refer to attached individual reports from the three research groups funded by the 2018 Transformative Research in Geography Education program.

* How have the results been disseminated to communities of interest?

For the 2020 AAG Virtual Annual Meeting in Washington, DC, the National Center for Research in Geography Education organized session proposals for a special track of sessions on Transformative Research in Geography Education. This was the fourth in a planned series of activities at the AAG Annual Meeting to raise the visibility of research in geography education, grow the research network, and provide productive spaces for discussion about geography education research and the notion of what makes research in the field potentially transformative. Additional dissemination is reported in the attached individual reports from the four research groups that launched and continued in the fourth year of this RCN project.

* What do you plan to do during the next reporting period to accomplish the goals?

NCRGE will continue supporting the work of the active research networks reported here.

Supporting Files

Filename	Description	Uploaded By	Uploaded On
Benner Slayton 2020.pdf	RCN group reports.	Michael Solem	05/27/2020
NSF RCN Annual Report - May 2020.pdf	RCN group reports.	Michael Solem	05/27/2020
Powerful Geography RCN report.pdf	RCN group reports.	Michael Solem	05/27/2020

Products

Books

Book Chapters

Inventions

Journals or Juried Conference Papers

Michael Solem (2020). Special Issue: Papers from the National Center for Research in Geography Education's Research Coordination Network. *Research in Geographic Education*. 20 (2), . Status = AWAITING_PUBLICATION; Acknowledgment of Federal Support = Yes

Licenses

Other Conference Presentations / Papers

Other Products

Other Publications

Patents

Technologies or Techniques

Thesis/Dissertations

Websites
National Center for Research in Geography Education
http://www.ncrge.org

Offical website of the National Center for Research in Geography Education.

Participants/Organizations

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Solem, Michael	PD/PI	1
Boehm, Richard	Co PD/PI	1
Zadrozny, Joanna	Graduate Student (research assistant)	1

Full details of individuals who have worked on the project:

Michael N Solem
Email: msolem@txstate.edu
Most Senior Project Role: PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: PI

Funding Support: N/A

International Collaboration: No
International Travel: No

Richard G Boehm
Email: rb03@txstate.edu
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: Co-PI

Funding Support: N/A

International Collaboration: No
International Travel: No

Joanna Zadrozny
Email: J_z37@txstate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Provided research assistance to the project directors.

Funding Support: Grosvenor Center for Geographic Education, Texas State University.

International Collaboration: No
International Travel: No

What other organizations have been involved as partners?
Nothing to report.

What other collaborators or contacts have been involved?
Nothing to report

Impacts

What is the impact on the development of the principal discipline(s) of the project?

Each of the research groups supported in the fourth year are pursuing activities that have significant potential to have transformative impacts on geography education, including new theories of geography learning and approaches to curriculum development, teacher education, and assessment practices.

What is the impact on other disciplines?

This RCN is forging research collaborations between geographers and STEM educational researchers, thereby opening opportunities for interdisciplinary insights on critical educational research questions and challenges.

What is the impact on the development of human resources?

RCN projects engage students and practitioners in research training activities. NCRGE will extend the work of the RCN by sponsoring additional research workshops and conferences for early career scholars and graduate students.

What is the impact on physical resources that form infrastructure?
Nothing to report.

What is the impact on institutional resources that form infrastructure?
Nothing to report.

What is the impact on information resources that form infrastructure?
Nothing to report.

What is the impact on technology transfer?
Nothing to report.

What is the impact on society beyond science and technology?
Nothing to report.

Changes/Problems

Changes in approach and reason for change
Nothing to report.

Actual or Anticipated problems or delays and actions or plans to resolve them
Nothing to report.

Changes that have a significant impact on expenditures
Nothing to report.

Significant changes in use or care of human subjects
Nothing to report.

Significant changes in use or care of vertebrate animals
Nothing to report.

Significant changes in use or care of biohazards
Nothing to report.

Each year NCRGE needs to file an annual report to NSF for our RCN project. NSF will be evaluating our success relative to the six major project goals stated below. **Due May 15th.**

~~**1. Catalyze research planning with strong potential to result in transformative research projects in geography education.**~~
~~• We will prepare summaries of each RCN project funded in 2016. No additional information from you is (needed.~~

2. Facilitate collaborative research among geographers and STEM education researchers.
• Please send us a list of individuals who are participating in your project: Name, Title, Affiliation, Location, Area of Research Expertise.

Jessica Benner, PhD.
Library Liaison, Computer Science & GIS
Carnegie Mellon University Libraries, Pittsburgh, PA
Collaborative mapping and accessibility,

Emma Slayton, PhD.
Data Curation, Visualization, and GIS Specialist
Carnegie Mellon University Libraries, Pittsburgh, PA
Archaeology and GIS Modeling

First Name	Last Name	Title	Affiliation	Location	Area of Expertise
Madeleine	O'Donnell	Director of Library and Information Services	Winchester Thurston School	Pittsburgh PA	School libraries
Michael	Balkenhol	Health Programming Coordinator	National Network of Libraries of Medicine	Pittsburgh PA	Health information
Melinda	Angeles	Systems Engineer, GIS	Allegheny County, PA	Pittsburgh PA	Information Visualization, Geospatial Analysis, Municipal data
Joshua	Sadvari	Geospatial Information Librarian	Ohio State University	Columbus, OH	GIS, Spatial methods
Nathan	Piekielek	Kalin Librarian for Technological Innovations and Geospatial Services Librarian	Penn State University	State College, PA	geographic information science and remote sensing, historical cartography, landscape ecology and conservation, human geography and mapping, and academic librarianship

Boris	Michev		University of Pittsburgh	Pittsburgh PA	GIS, Social Sciences
Christy	Wauzzinski	Principal	Pittsburgh Urban School	Pittsburgh PA	Public Education
Hannah	Gunderman	Research Data Management Consultant	Carnegie Mellon University	Pittsburgh PA	Data management, Speculative geography
Tess	Wilson	Community Engagement Coordinator	National Network of Libraries of Medicine	Pittsburgh PA	Community engagement, public libraries
Bob	Gradeck		Western PA Regional Data Center	Pittsburgh PA	Civic data
Rafael	de Miguel	Professor of geography, Associate Dean	EUROGEO European Association of Geographers; University of Zaragoza.	Zaragoza, Spain	GIS, geography and urban planning, geography education
Phil	White	Earth Sciences Librarian	University of Colorado Boulder	Boulder, CO	intersection of data science and library collection development, data literacy education
Maria	Jankowska	Social Sciences Librarian	University of California, Los Angeles	Los Angeles, CA	Geography, Economics, Maps and Cartographic Resources, Government Information (US Federal)
David	Cowen	Distinguished Professor Emeritus, Chair of the National Geospatial Advisory Committee, NRC Board on Earth Sciences and Resources	University of South Carolina	Columbia, SC	GIS applications, education, research, government service
Sarah	Battersby	Tableau	Tableau	Seattle, Wa	Spatial Visualization, Map Projections, Perception and Cognition
Christy	Thiry	Map and GIS Librarian	Colorado School of Mines	Golden, CO	Map and GIS resources, map cataloging, and mining history
Meagan	Duever	GIS Librarian	University of Georgia	Athens, GA	Map and government information

Caroline Maria	Kayko	Map and Geospatial Data Librarian	University of Michigan	Ann Arbor, MI	GIS, remote sensing, and computer science, physical and human geography
Jennie	Murack	GIS and Data Librarian	Massachusetts Institute of Technology	Cambridge, MA	Geographic Information Systems (GIS), urban maps
Chrissy	Klenke	Earth Sciences, GIS and Maps Librarian	University of Nevada, Reno	Reno, NV	physical or digital maps, GIS software, Geography
Tom	Tews	Geography Librarian	University of Wisconsin Madison	Madison, WI	Climate and environmental studies
Eric	Glass	GIS / Metadata Librarian	Columbia University	New York NY	Earth and Environmental Sciences, GIS
Becky	Seifried	GIS Librarian	University of Massachusetts Amherst	Amherst, MA	Mediterranean cultures, Archeolandscapes
Kathy	Stroud	David and Nancy Petrone Cartographic and Spatial Data Librarian	University of Oregon	Eugene, OR	Environmental mapping, Ecology, Maps
Tara	Anthony	GIS Specialist	Penn State University	State College, PA	GIS, Online mapping, Open source GIS, spatial literacy
Matthew	Parsons	Geospatial Data and Maps Librarian	University of Washington	Seattle, WA	Geospatial data, maps
Susan	Brazer	Science Librarian and Liaison	Salisbury University	Salisbury, MD	Academic libraries
Janet	Reyes	Geospatial Information Librarian	University of California Riverside	Riverside, CA	Natural resources, GIS
Susan	Powell	Map and GIS Librarian	University of California Berkeley	Berkeley, CA	Data accessibility, GIS
Carol	Cady	GIS Specialist	St. Lawrence University	Canton, NY	zoology, spatial analysis, GIS

3. Attract more diverse cohorts of graduate students to Ph.D. programs in Geography Education.
• Please send us a list of any undergraduate and graduate students who participated in your project, and include gender, race/ethnicity if known.

We have had several students attend our AAG session and Zoom conversations but we do not know their names or any demographic details at this time.

4. Increase research productivity and the knowledge base in geography education.
• Please send us a list of the following outcomes of your projects, including any pending material:

       o Publications
       o Conference presentations
       o Proposals submitted, awarded, declined

1) AAG 2020 Conference Sessions, Role of Libraries in Geography and GIS Education #1 and #2.
       Presenters: Emma Slayton and Jessica Benner, Rafael Miguel González, Phil White, Josh Sadvari, Maria Jankowska, David Cowen, Sarah Battersby, Chris Thiry

2) AAG 2020 Conference Presentation, Spatial Education in Libraries, Emma Slayton and Jessica Benner

3) UCGIS 2020 Presentation, Locating Libraries in the Geospatial Education Community, Joshua Sadvari and Emma Slayton

4) Carnegie Mellon Libraries 2020, Conversations on the Role of Libraries in Geography and GIS Education.
5) WAML 2019, Lightning Talk, Jessica Benner

5. Long-term growth and stability of the RCN.
• We have most of the data we need to address this goal. However, we would like to know what external organizations (e.g., professional societies, teacher organizations, etc.) you may have worked with under your project, or plan to work with in the future.

- MAPS-L (a listserv serving the map/gis librarian community, over 160 subscribers)
- WAML (Western Association of Map Libraries)
- MAGIRT (Map and Geographic Information Roundtable of American Library Association)
- WPRDC (Western Pennsylvania Regional Data Center)

Future:
- UCGIS (University Consortium for Geographic Information Science)
  - planned to attend symposium but postponed due to Covid-19
- PLA (Pennsylvania Library Association) maybe WV, OH or NY??

- PAMAGIC (Pennsylvania Mapping and Geographic Information Consortium)

6. Promote the use of research to improve practice in geography education.
• Provide a brief statement of how you see the longer-term implications of your work in terms of broader impacts on geography standards, teacher training programs, curriculum development, assessment development, etc.

- Community across university libraries, and other institutions, that now have had face contact outside of regional groups
- Clear focus on how we look at the role of libraries more broadly in the education space, in terms of sharing resources and materials
    - Create a repository or online collaborative space for people to deposit and find materials
- Bring people together to discuss assessment guidelines for teaching spatial literacy in libraries
- Encourage discussions about access to resource and contingency planning for those at different sized institutions, those with and without geography departments or traditional map librarians
- Come up with a list core learning principles of spatial literacy for many stages of learning, from k-12 into higher and postgraduate education.

Powerful Geography RCN report

1. Facilitate collaborative research among geographers and STEM education researchers.

1. Jo Ostrowski, high school teacher, San Antonio ISD, TX, geography education
2. Matthew Lyons, Technology Integration Specialist, Social Studies K-12, Fort Bend ISD, TX, technology and geography
3. Mary Curtis, professor, University of Texas – Arlington, Arlington TX, curriculum and instruction
4. Kivett Gresham, high school teacher, Glen Rose High School, Glen Rose TX, geography education
5. Charlie Perryman, social studies curriculum coordinator, Eagle Mountain Saginaw ISD, curriculum and social studies
6. Robin Manning, K-12 retired teacher, Round Rock ISD, TX, geography education
7. Robin Sabo, Social Studies coordinator, Clear Creek ISD, TX, curriculum and social studies
8. Benjamin Lewis, middle school teacher, Brenham Middle School, Brenham ISD TX, geography education
9. Kim Stucker, K-12 retired teacher, Houston TX, geography education
10. Whitney Crews, high school teacher, Lindale ISD, TX, geography education
11. Josh Williams, high school teacher, Round Rock ISD, TX, geography education and technology
12. Jana Poth, high school teacher, Floresville ISD, TX, geography education
13. Sabrina Blankenship, Education Service Center social studies coordinator, Lubbock TX, social studies curriculum
14. Amanda Killough, high school teacher, Lewisville ISD, TX, geography education
15. Myra Rains, Education Service Center social studies coordinator, Abilene TX, social studies curriculum
16. Sherri Driscoll, TAGE project manager, Texas State University, San Marcos TX, geography education

2. Attract more diverse cohorts of graduate students to Ph.D. programs in Geography Education.

1. Christopher Hinojosa, PhD graduate assistant, male, Caucasian
2. Kaleigh Shuler, Masters graduate assistant, female, Caucasian
3. Benjamin Wang, Masters graduate assistant, male, Chinese
4. Daria Andrievskikh, PhD graduate assistant, female, Russian

3. Increase research productivity and the knowledge base in geography education.
• Please send me a list of the following outcomes of this project, including any pending material:

Conference Presentation: Powerful Geography: Spreading the Word – 2019 NCSS/NCGE/TCSS Annual Conference, Austin TX, November 22, 2019

Conference Presentation Proposal Submitted/Pending: Powerful Geography – 2020 NCSS/NCGE Annual Conference, Washington DC, December 3, 2020

Publication Pending: Powerful Geography and K-12 Geography Education

4. Long-term growth and stability of the RCN.
• External organizations (e.g., professional societies, teacher organizations, etc.) we have worked with under this project, or plan to work with in the future.

- Texas Council for the Social Studies
- National Council for the Social Studies
- National Council for Geographic Education
- Texas Education Service Centers

5. Promote the use of research to improve practice in geography education.

NAEP data have sent out the message that 25 years of top-down national curriculum standards have failed to increase the interest or efficacy of geography teaching and learning. It is time for a sea change in thinking. Focused research is needed to identify student aspirations and how geography can respond with pathways to meaningful jobs and careers as well as high levels of civic responsibility. This RCN on Powerful Geography is designed to encourage research into a bottom-up, state-based approach to geography learning. Once this new curriculum model, modeled after Wesley Null's "liberating curriculum" (2017), is in place, teacher training (certification), teaching methodologies, and assessments strategies will adjust. A new type of vertical integration will appear and geography education will begin to grow in value for its social and economic acceptance.

Project Participants

Coline Dony	Senior Geography Researcher	American Association of Geographers	Washington, DC	Health Geography and GIScience
Sergio Rey	Professor	University of California, Riverside	Riverside, CA	GIScience
Laura Tateosian	Research Associate Professor	North Carolina State University	Raleigh, NC	Geovisualization and GIScience
Atsushi Nara	Assistant Professor	San Diego State University	San Diego, CA	Spatiotemporal data analytics and geocomputation
Eric Delmelle	Associate Professor	University of North Carolina at Charlotte	Charlotte, NC	Health Geography
Giuseppe Amatulli	Research Scientist	Yale University	New Haven, CT	Geocomputation
Diana Sinton	Executive Director	University Consortium for Geographic Information Science	Ithaca, NY	GIScience
Forrest Bowlick	Lecturer	University of Massachusetts - Amherst	Amherst, MA	GIS and Geography Education

List of any undergraduate and graduate students who participated in your project, and include gender, race/ethnicity if known
- Lauren Musshorn, Alanna Grady, Julia Fox, Cameryn Cox (UMass, undergrad, female); Nicholas Drummy, Brendan Clark (UMass, undergrad, male).

Publications
- Dony C.C., Nara, A., Amatulli, G., Delmelle, E., Tateosian, L., Rey, S., Sinton, D.S., (2019) Computational Thinking in U.S. College Geography: An Initial Education Research Agenda. Journal of Research in Geographic Education, 20 (2): 39-54.

Conference Presentations

- Dony C., Fekete E. (2018) Encoding Geography. In "Teaching Geography" Paper Session. Annual Meeting of the West Lakes Division of the American Association of Geographers, La Crosse, WI, November 3, 2018.
- Dony C. (2018) Engaging Undergraduate Students in Research Activities. Sponsored by the SEDAAG Education Committee. Annual Meeting of the Southeastern Division of the American Association of Geographers, Johnson City, TN, November 18-19, 2018.
- Solem M., Theobald R., Dony C., Chang C-H. (2019) Transformative Research in Geography Education Panel. Annual Meeting of the American Association of Geographers. Washington, DC, April 3-7, 2019.
- Solem, M., Zadrozny, J., Larsen, T., Dony, C., Bowlick, F., Benner, J., Slayton, E., Forbes, C. (2020) Transformative Research in Geography Education Panel. Annual Meeting of the American Association of Geographers. Virtual, April 6-10, 2012.

Promote the use of research to improve practice in geography education

The long-term implications of an EG-RCN would be most significant in terms of broadening participation and curriculum development. First, a known strategy to increase students' interest and retention in courses that involve computational thinking, is to provide hands-on exercises and examples of interest to a wider range of undergraduate geography majors. However, most courses lack this breadth because of a faculty's expertise in one area of geography. Developing hands-on exercises and curriculum from other subfields of geography is time consuming and requires that particular expertise. Consequently, an EG-RCN would be well-positioned to motivate faculty to share their use-cases, data, and curriculum content with the purpose of broadening and retaining participation in these courses. Second, an important discussion so far has been around developing a more gradual learning path in geocomputation. Most geography programs either don't have the capacity for teaching any computational curriculum, or have one course in which students are expected to learn advanced topics and concepts in GIScience, and to learn a computer programming language (often for the first time). "Micro-insertions" of computational curriculum in other courses of their program may expose *all* geography students and also lay a foundation for a gradual learning pathway. The EG-RCN could compile a number of such micro-insertions adoptable by any geography program. In the next year, the EG-RCN will explore the nature of geocomputation education through syllabus and content review allowing for an evidence-based understanding of how such courses are structured and the progression of expected knowledge, skills, and practices in these courses. By building this knowledge, we can begin to better integrate geocomputation into other course curriculum and scope degree sequences and learning plans.