WSU Geoliteracy Study Summary Report

Prepared for WSU Tri-Cities College of Education Advisory Board Meeting

March 9, 2018

Study Background

Geographic literacy, or geoliteracy, is defined by National Geographic as *"the ability to use geographical knowledge and reasoning to make far reaching decisions in the 21st century."*[1] This is an essential skill in an increasingly interconnected world because our interactions – with one another, with animals and with our planet – have existential implications for the Earth and all of all its inhabitants.

Many students (and adults) need to become more geoliterate. For example, these are the 8th grade geography scores from the 2014 National Assessment of Educational Progress[2] (NAEP):

Basic	- partial mastery of prerequisite knowledge and fundamental skills	48%
Proficient	- fundamental geographic vocabulary and conceptual understanding	24%
Advanced	- command of extensive geographic knowledge, concepts and vocabulary	3%

In spite of the rapid growth in information technology, these numbers have remained virtually unchanged for the past 20 years. There is also a significant gap between students of different ethnicities. The most recent scores show disparate Proficiency levels for Asian (38%), White (34%), Hispanic (11%) and Black (6%) students.[3] Most concerning is the fact that a quarter of all students do not have even Basic geoliteracy skills!

Basic skills are not an acceptable goal, either. They are only the first step towards geoliterate decision-making. Just a few of the many Proficiency-level skills for 8th grade students[4] include the ability to:

- Solve locational questions requiring integration of information from two or more sources
- Identify a wide variety of physical and cultural features and describe regional patterns
- Respond accurately to interpretive questions using geography's visual and technological tools and translate that information into patterns
- Use information from maps to describe the role that regions play in influencing trade and migration patterns and cultural and political interaction

Solving the Puzzle

PuzzleMap is a learning tool that can help students master these skills. It turns an online web map into an interactive jigsaw puzzle. It therefore honors the legacy of John Spilsbury who invented the first jigsaw puzzle in 1766 *specifically for teaching geography*.[5] This modern version includes many innovative features but it still employs the power of visual-spatial manipulation to build conceptual understanding and increase knowledge retention.

PuzzleMap is a new product from SpherAware, a GIS solutions company committed to promoting geoliteracy. It is compatible with all modern browsers and may be used on touchscreens and mobile devices.

(Please see the WSU Geoliteracy Study Puzzle Content Documentation for a complete overview of the PuzzleMap we designed for the WSU Geoliteracy Study.)

WSU Geoliteracy Study Overview

In order to investigate the value of PuzzleMap in developing geoliteracy, we conducted a six-week study from October to December of 2017 in three different 5th grade classrooms in the Tri-Cities area. Our research questions were:

1. *Does solving interactive geographic puzzles that involve shape recognition and piece manipulation improve the comprehension and retention of related material?*
2. *How does working with interactive maps help students develop deductive spatial reasoning skills and improve their geoliteracy?*

We used a quasi-experimental design in which two classrooms served as different learning "conditions" while a third classroom served as the control group. The 20 students in Class One used PuzzleMap twice each week in conjunction with their regular Social Studies curriculum. Another 24 students in Class Two used PuzzleMap once a week in their Technology Class as a stand-alone resource. The 9 students in Class Three, the control group, took the pre- and post-assessment test but did not use PuzzleMap.

Pre- and Post-Assessment

A multiple-choice assessment was used to measure geographic knowledge of the US States at the beginning and end of the study period. We aligned test questions with material in Unit I of *The United States: Making A New Nation* (Harcourt, 2012), the Social Studies textbook used in Richland schools.

The exam included 36 questions related to the climate, landscape, economy, and people of America. The questions also reflected three learning categories: *conceptual* (state-specific attributes), *topological* (states' location and relationships to each other) and *spatial* (visual recognition of state shapes). The questions ranged in difficulty from "Which U.S. state is the smallest in area?" (which most students already knew) to "In which two states does the Mississippi River begin and end?" which involves assimilating knowledge in all three categories.

The assessment also encouraged deductive reasoning. For example, "A Southwestern tribe called The Hopi live in which of the following states?" would be easy to answer if a student realized that only one of the available options was in the southwestern part of the country. The exam was meant to be challenging so that it would produce a wide range of scores. Students were told that no one was expected to answer every question correctly.

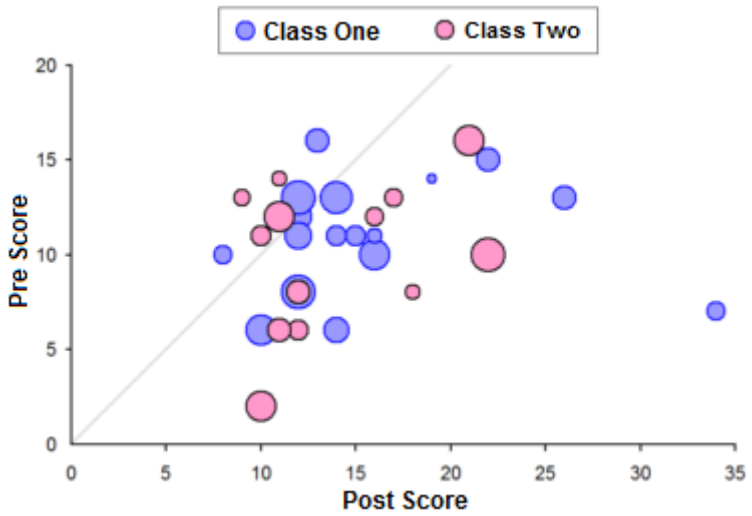
Results

The average for all participants in the study showed that 5th grade students were able to answer slightly less than 1/3 of the questions correctly prior to studying the US States in school. The control group made very little improvement afterwards, but the two groups that used PuzzleMap performed measurably better:

	Total (36 questions)	**Conceptual** (18 questions)	**Topological** (12 questions)	**Spatial** (6 questions)
Class One	12.1%	13.9%	7.1%	16.7%
Class Two	8.4%	4.7%	1.7%	2.0%
Class Three	0.3%	8.0%	0.0%	-22.2%

Class One, which used PuzzleMap the most (twice each week, with some students opting to use it at home and during free-time) had a post-assessment average close to 50% correct with the highest overall score being an impressive 34 right out of 36. Class Two also made significant gains. Class Three's average, however, only went up by only 0.3% and their spatial scores decreased dramatically! This may reflect the conventional approach to geography which emphasizes textual and verbal information while making only sporadic references to static maps.

A Paired T-test also showed a statistically significant correlation between PuzzleMap *completion* and gains on the post-assessment. Every 1% increase in the "puzzle completion ratio" equated to a score increase of 0.574 points. This means that the more often a student worked a puzzle through to completion, the better they did on the post-assessment. The bubble size in this chart represents the puzzle completion ratio:



We also noticed a performance difference between students who tried to solve PuzzleMaps quickly and those who worked with them more deliberately. The cluster of large bubbles showing little or no improvement in the chart above tend to be students with the fastest completion times.

Next Steps

PuzzleMap offers a self-paced, multimodal alternative to books and static maps. It may be customized for any geographic content at any scale. PuzzleMaps can be used to learn about oceans, geology, watersheds, wildlife, language, history, religion, sports or any other topic that has a geospatial dimension.

We would like to continue researching the benefits of PuzzleMap as a learning tool. To do so on a larger scale, we need to broaden the topic areas studied, the age range of participating students and increase the number of classrooms involved.

How can we bring PuzzleMap to your school or district? We are now seeking feedback and assistance from teachers and administrators in making PuzzleMap a viable product. If you are interested in evaluating PuzzleMap, collaborating on future research or making current or customized PuzzleMaps available in your school now, please let us know. Demonstration visits can be arranged and instructional support is available.

Media Attention

Our Geoliteracy Study has received some recent media attention. These links all provide more information about the study and its use of PuzzleMap in the classroom:

- KNDU Right Now News Program, February 26, 2018:
  - http://www.nbcrightnow.com/clip/14155239/wsu-tri-cities-education-program-part-1
  - http://www.nbcrightnow.com/clip/14155302/wsu-tri-cities-education-program-part-2
  - http://www.nbcrightnow.com/clip/14155380/wsu-tri-cities-education-program-part-3
  - http://www.nbcrightnow.com/clip/14155425/wsu-tri-cities-education-program-part-4
- WSU Tri-Cities News, February 20, 2018:
  - https://tricities.wsu.edu/wsu-tri-cities-professor-partners-with-father-to-develop-geography-classroom-technology/
- EdSurge Newsletter, February 15, 2018:
  - https://www.edsurge.com/news/2018-02-14-can-an-online-puzzle-make-geography-fun-and-relevant

Contact Information

For additional information about the WSU Geoliteracy Study or to inquire about getting your school involved, please contact Dr. Sarah Newcomer at sarah.newcomer@wsu.edu.

PuzzleMap

- Demo of the WSU Study U.S. puzzle: https://www.spheraware.com/demo/wsu-usa.html
- Other PuzzleMap examples to try: https://www.spheraware.com/puzzlemap
- More information about SpherAware products and services: https://www.spheraware.com

References

[1] https://www.nationalgeographic.org/media/what-is-geo-literacy/

[2] https://www.nationsreportcard.gov/hgc_2014/#geography/achievement#overall

[3] https://www.nationsreportcard.gov/hgc_2014/#geography/achievement

[4] https://www.nationsreportcard.gov/hgc_2014/#geography/questions

[5] https://en.wikipedia.org/wiki/John_Spilsbury_(cartographer)