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Expanding Library GIS Instruction to Web Mapping in the Age of Neogeography

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Abstract

The past two decades witnessed the flourishing of GeoWeb, a web infused with geospatial services and applications, which has given rise to a trend that non-experts are increasingly involved in creating digital maps, collecting spatial data, and developing mapping mashups or applications, known as neogeography. In light of that, the general public and researchers/students in higher education institutions are becoming increasingly interested in these technologies. However, a gap exists between the GIS educational programs offered by public/academic libraries in Canada and the fast developing web mapping technologies as well as the shifting needs of users. This paper describes two web mapping workshop initiatives at a public library and an academic library, arguing web mapping technologies provides new opportunities to adapt ACRL Information Literacy to GIS education, and advocating academic and public libraries' involvement in web mapping instruction in the age of neogeography.

Introduction

Revolutionary technologies in the past decade or so have drastically transformed the landscape of maps and mapping- digital maps have dramatically outpaced print maps, interactive web maps or apps have become a ubiquitous part of everyone's daily life. Higher education institutions, however, have only started to respond to this shift by offering web mapping programs and courses. While distance education programs in web mapping have notably jumped in to fill the gap, with the most prominent examples being the Pennsylvania State University and the University of Kentucky, the cartography and GIS programs in North America which offer courses in web mapping have not become the mainstream (Sack 2018). Similarly, responding to new technologies and university's changing needs is also the GIS and data services in academic libraries' mandate (Scaramozzino et al. 2014), yet the literature on library GIS instruction in web mapping is still limited in scope and quantity.

In 2018 spring, as an unemployed new graduate of library school, I approached Vancouver Public Library (VPL) and pitched an idea to teach a general web mapping workshop. After a few months' preparation, the workshop named Build Your Web Map- the first-ever of its kind at VPL - was delivered. The workshop attracted about 15 participants and received good feedback, so in the next year, I reached out to Evan Thornberry, the GIS librarian at the University of British Columbia, and we organized another web mapping workshop at VPL. Following that, I became a term GIS/Map librarian at an acadDodsworth, E., and L. Laliberte. 2016. Teaching spatial literacy: Location, distance, and scale. In *The new information literacy instruction*, ed. P. Ragains and M. S. Wood, 173–88. Lanham, MD: Rowman & Littlefield.

emic library and, having noticed the absence of instruction on this subject, launched a new Web Mapping workshop series in 2020 amidst the pandemic.

The purposes of this paper are to discuss both initiatives- the public library initiative consisted of a single workshop that evolved over time in response to lessons learned, and the academic initiative consisted of a series of 4 separate workshops, to argue that teaching web mapping provides new opportunities to adapt ACRL Information Literacy to GIS education, and to advocate academic and public libraries' involvement in web mapping in the age of neogeography, thus contributing to the practices and theoretical discussions of libraries adapting GIS education to cater to modern web technologies.

NeoGeography, GeoWeb, and Web GIS

What motivated the two initiatives- the first-ever GIS workshop at the public library and the first-ever Web Mapping workshop series at the academic library? The idea for the VPL workshops took form when I sensed a gap between the ubiquitous GIS-enabled technologies, the fast development of user-friendly web-based tools, and the absence of GIS education for the public. The gap becomes clear when contextualized in these interrelated terms: neogeography, GeoWeb, and Web GIS.

In the past two decades, what emerged from Web 2.0 – the new generation of web featured with interactivity and based on user-generated content- is a GeoWeb: a web infused with geospatial services and applications like Google Maps, Yahoo! Maps, Google Earth, OpenStreetMap, spatially-enabled crowdsourcing apps, and social media sites with geotagging functions, as well as developer-oriented application programming interfaces (APIs) and platforms like OpenLayers, Google Map API, Leaflet, and Mapbox. The presence of GeoWed, along with Global Position System (GPS) and smartphones, have a profound impact on the general public, who has grown accustomed to using digital maps for directions, travel, and exploration on computers and devices (Han 2019). The impact is also manifested by the proliferation of numerous mapping mashups (integration of information and functions from multiple websites)- people from technology and engineering fields have been deeply involved in geospatial online and mobile development. In short, creating maps, collecting spatial data, and developing map-oriented apps are no longer restricted to privileged researchers and professionals. This trend is called neogeography, a term coined in 2006, which can be described as the "blurring of traditional distinctions between experts and non-experts due to the lowering of barriers such as cost and access" (Byrne and Pickard 2016, 1506). Alternatively, it can be explained using the familiar narrative of Web 2.0:"neoGeography leverages technological and social changes since the turn of the century to allow consumers to be subjects, producers, and communicators all at once" (Aber and Aber 2017, 8).

What has been pushing forward GeoWeb is the rapid development of Web GIS, which refers to the development of GIS functionality over the Internet, the Web, and on the cloud (Han 2019), a term often used interchangeably with web mapping. Web GIS has many advantages, and the main ones from an educational perspective can be outlined as following:

Lower barriers to learning

Admittedly, Web GIS applications have some challenges for education, for example, the requirement of access to reliable internet may present a significant barrier for some users. Also, they are still considered analytically less powerful than desktop GIS offers. However, Web GIS applications such as Carto Builder and ArcGIS Online with full-fledged functionalities for importing, visualizing, and analyzing geospatial data, as well as making and sharing web maps and apps, are generally intuitive by nature compared to traditional desktop GIS programs: users first see a basemap in a web map application instead of a blank

canvas in a desktop GIS software (Kerski and Baker 2019). More importantly, unlike what can be half-jokingly described as *buttonology* of desktop GIS, a Web GIS application's toolset is streamlined and therefore much more understandable. These features enable learners who don't necessarily identify themselves as GIS users to enter GIS.

Interconnectivity and flexibility

Web 2.0 has accelerated a shift for geospatial data "from individual proprietary data formats to open specification exchange of data" (Chow 2008), resulting in an ever increasing amount and accessibility of geospatial data. Another aspect of this shift is the advent of data as web services. Inspired by the commercial map services vendors like Google who provide access to base map, governments have increasingly supplied their geospatial data as web services(Li, Dragićević, and Veenendaal 2011); this approach is especially good for disseminating dynamic or rapidly changing data. For example, the province of British Columbia offers map services for their thousands of data layers (Province of British Columbia 2021).

Although these web services as data resources can be consumed by desktop GIS system, web mapping APIs provide more flexibility for tapping into web services for both geospatial data and mapping functions to create mashups(Chow 2011). The significance of web mapping APIs can be explained by why APIs in general are fundamental to Web 2.0: through APIs, websites' data and functionalities become reprogrammable, making one site connected to another not just by hyperlinks, but also by data and functionalities (Plantin 2014). For example, with Leaflet, one can easily use the map tiles of OpenStreetMap, add third-party data in format of web services, and configure symbology for a web map.

Participatory mapping

Echoing the "participatory" nature of citizen science is participatory mapping, which refers to "the creation of maps by members of the public – often with the involvement of supporting organizations including governments at various levels, non-governmental organizations (NGOs), universities, developers and other actors engaged in land-related issues" (Corbett and Legault 2019, 124). An example is Humanitarian OpenStreetmap Team (HOTOSM), which brings together thousands of volunteers online to create open map data, in order to "revolutionize disaster management, reduce risks, and contribute to achievement of the Sustainable Development Goals" (HOTOSM n.d.). In the context of higher education, incorporating participatory mapping into courses has the potential of encouraging civic involvement, eco-justice and rein habitation, and developing both technical and social skills (Corbett and Legault 2019).

ACRL Framework for Information Literacy for Higher Education

In 2016, the Association of College and Research Libraries (ACRL) Board officially adopted the ACRL Framework for Information Literacy for Higher Education (ACRL Framework hereafter), which replaced the ACRL Information Literacy Standards. The ACRL Framework comprises six threshold concepts: "Authority Is Constructed and Contextual", "Information Creation as a Process", "Information has Value", "Research as Inquiry", "Scholarship as Conversation", and "Searching as Strategic Exploration"(ACRL 2015a). The ACRL Framework is not intended to be prescriptive; in fact, it provides a large room of flexibility for accommodation into information literacy instructions in different disciplinary contexts.

Applying the ACRL Framework to Geospatial Information Literacy

Since the publication of the ACRL Framework, how to apply it to geospatial information literacy has been explored theoretically and practically by librarians and educators in higher education. On the theoretical side, two recent works attempted to bridge the ACRL Framework with disciplinary geospatial literacy standards. Sadvari(2019) systematically analyzes the ACRL Framework and the Geographic Information Science and Technology Body of Knowledge, discovering significant connections between the learning objectives in the Geographic Information Science and Technology Body of Knowledge and the ACRL Framework's conceptualization of information literacy. Appel(2019) breaks down a geospatial information literacy framework to a group of subset literacies, including geographic literacies (which can be further broken down to geography, primary source, map, and spatial literacies), data and digital literacies, and the emerging *cyberliteracy for GIScience*. Notably, the connection between this geospatial information literacy framework and the ACRL Framework is delineated: "the ACRL Framework and scholarship on GIS and Society serve to inform critical development of such a framework" (Appel 2019, 145).

In addition to theoretical exploration, a number of studies have been published in which librarians have sought to use the ACRL framework to inform the curriculum design of geospatial programs(Kong et al. 2017; Dodsworth and Laliberté 2016). For example, Kong et al. (2017) describes how the ACRL Framework guided the design of the syllabus for a National Endowment for the Humanities (NEH) summer institute for school teachers. However, there is no literature on applying the ACRL Framework to web mapping instructions, and this paper seeks to contribute to the void.

Teaching web mapping at VPL

In the first Build Your Own Web Maps workshop at VPL, due to the difficulty of predicting who the audience was, we chose to focus on the basics. Three elements were blended: a few key GIS concepts such as map scale, layers, coordinates, and attributes, searching a municipal Open Data Portal, and visualizing a dataset downloaded from the portal using Carto Builder. The idea was that merely opening governmental data is not sufficient to empower the general public to be engaged with the data, find trends, and participate in the civil activities in a data-related way; teaching how to analyze and visualize the data in a spatial way should also be put into the equation. This logic aligned well VPL's aspirations to develop digital literacy in the general public. The workshop attracted 12 participants coming from different background ranging from government staff to civil engineers, and received positive feedback that the workshop was helpful in pursuing their professional development goals.

The next iteration of the Build Your Own Web Maps workshop at VPL in the following year took a drastic turn in pedagogy. My teaching partner and I chose to make a bold move- teaching Leaflet, a popular JavaScript library for interactive maps, which requires working with HTML, CSS, and Javascript. This certainly would sound a little daunting to the participants with little to no programming knowledge but we thought that, while it would definitely be challenging to teach this to a mixed audience, working with Leaflet was like taking an "under-the-hood" view of Web Mapping and we were curious to see how it turned out. We taught this workshop twice during the 2019 summer with each attracting about 20 participants. It was interesting to notice the different atmosphere in the room with different audiences. The first workshop's audience represented a whole spectrum of technical skills- ranging from university students who were comfortable to code to someone who had never ventured to open a text editor before. The motives varied quite a bit too: from general curiosity about map making to wanting to make a website

with a map to show their family genealogical distribution. While most people were highly engaged, we felt this coding heavy approach might be not suitable for all. The second time we taught, the room was filled mostly with software engineers who were eager to expand their skills to web mapping, which was precisely because we reached out to a web developers' meet-up group to advertise this free workshop.

Some strategies were put in place to ease the pain of learning how Leaflet works: my teaching partner developed a HTML boilerplate[i] into which a large portion of codes was already incorporated, with only a few places where the participants were supposed to add lines of code in order to tweak the configuration of a web map, say setting map Zoom levels, adding a layer of data in the format of GeoJson, etc. They could also just copy and paste the code if they wished. We also spent a lot of time troubleshooting with everyone who struggled to get things right: a piece of code did not yield expected results, some did not understand the workflow demanding saving changes in a text editor before refreshing the map in a browser, and so on. The second time we ran the workshop, due to the fact that the audience was predominately people from the IT world, did not involve as much trouble shooting, but instead sparked in-depth discussions on the coding details and GIS technology.

Applying a paradigm to examine these two workshops can help understand how they differ pedagogically. Broadly speaking, the approaches to integrating Web GIS into education can be categorized as Web GIS-involved education and Web GIS education (Han 2019). Web GIS-involved education involves using Web GIS applications to foster spatial thinking, whereas Web GIS education focuses on Web GIS technologies, principles, and applications (Han 2019). According to this classification, our first web mapping workshop falls under the first category, Web GIS-involved education, since we simply used Carto Builder as an approachable mapping tool to teach importing open data, visualizing spatial data, and asking/answering questions spatially. By comparison, our second attempt at pulling off a web mapping workshop, through touching more directly on web mapping technologies, belongs to the second camp: Web GIS education. Both approaches seem to be appealing to the public, but there is no doubt that they are suitable for different audiences, learning objectives, and purposes.

Teaching Web Mapping at Simon Fraser University

The Research Commons at the Simon Fraser University (SFU) Library provides services for graduate students at all stages of the research process, hosting workshops, consultations, and events on a range of topics such as writing, thesis formatting, knowledge mobilization & scholarly communication, GIS, qualitative analysis, digital scholarship, and so on. As part of the Research Commons' programming, GIS workshops are open to all SFU community members encompassing a wide range of GIS concepts and tools. These GIS workshops have been an important learning resources for students and researchers because they provide a low-barrier learning opportunities for people from various disciplines who hold general interest in GIS or interest in a particular tool. At SFU, the Geography department provides a few GIS courses, but taking a semester-long course may present significant barriers to entering GIS, particularly for students from other departments in terms of time investment.

Despite a wide range of topics, concepts and tools taught in the Research Commons' GIS programming, web mapping had been a missing part, which, in light of the phenomenon of neogeography and the fast-developing Web GIS, highlighted a need for filling this gap. Teaching the web mapping workshops at VPL proved that a one-off workshop is nowhere near satisfying users with different expertise levels and purposes. Therefore it seemed a more logical option to develop a series of workshops devoted to web

mapping, though the complexity of web mapping technologies and the range of tools meant it required a great deal of contemplation on learning objectives and preparation to make sure the contents are useful to students and researchers.

We launched the Web Mapping workshop series in 2020, which was initially composed of two workshops: Intro to Web Mapping, and Web Mapping with R, and later two additional ones: Storytelling with StoryMaps and Field Data Collection with ArcGIS Collector, each being two hours long and all geared towards graduate students who are beginners, with no previous GIS or Web technologies knowledge required. Each workshop carefully scoped out its learning objectives and the tool of choice in order to address a range of learners' needs, balancing application-based and programming approaches and encompassing a handful of tools and skills for different purposes. While each workshop focuses on a specific tool and certain skills, there are common threads that make the series cohesive: for example, understanding how web services work, and how web feature service (or hosted feature layer as Esri names it) allows for the reuse of data in an unlimited number of web maps and apps and analysis as well as editing (even by a group of people) is key to the majority of the workshops. Each workshop in the series is independent, without requiring any other one as prerequisite.

Applying the ARCL Framework in this workshop series

In designing the learning objectives for the workshops, I drew upon two geospatial literacy guidelines: the first is the Geographic Information Science and Technology Body of Knowledge (hereafter the BoK), particularly the topic CV-15 Web Mapping (Sack 2017). The second is *cyberliteracy for GIScience*, defined by Shook et al. (2019), referring to "the ability to understand and use established and emerging technologies to transform all forms and magnitudes of geospatial data into information for interdisciplinary problem solving"(223). Both provide useful guidance to design the learning objectives, since teaching web mapping involves fostering the ability to understand and use established and emerging technologies (map tiles, web map services, web mapping API, just to name a few).

Furthermore, in seeking to bridge the ACRL Framework and the learning objectives informed by these two disciplinary geospatial literacy guiding documents, I find three frames of the ACRL Framework particularly useful in conceptualizing the workshops: "Authority Is Constructed and Contextual", "Information Creation as a Process", and "Scholarship as Conversation". The connections between the ACRL Framework and learning objectives are illustrated in Table 1, and explained in details in the section below.

Authority Is Constructed and Contextual

The frame recognizes that "authority is constructed in that various communities may recognize different types of authority"(ACRL 2015a, np). We share this example BikeMaps.org[ii] in the Intro to Web Mapping workshop, a crowd-sourcing project that collects people's cycling experience. The language on the website indicates that the public knowledge is valued: "Our goal is to map your cycling experience to make biking safer. You know your local cycling trouble spots and we want you to map them". In this context, the general public, or more likely cycling enthusiasts, assume the authority over the information, empowered by this web mapping platform. We use this example to encourage the workshop participants to think about who were privileged in geospatial data collection, creation, analysis, and dissemination before and after the Web 2.0 arose.

Information Creation as a Process

The frame acknowledges that "the iterative processes of researching, creating, revising, and disseminating information vary, and the resulting product reflects these differences" (ACRL 2015a, np). This emphasis on the underlying process of creation that lead to the resulting product speaks directly to the very different process and infrastructure of creating web maps than the conventional way of geospatial information creation. Librarian have explored applying this frame to the era of the plethora of digital media. For example, Gersch (2017) reflected on teaching a media studies and journalism courses, concluded that "today's digital containers of information mask the creation process, as librarians our task is to unveil these processes in order for learners to recognize how they affect the information product"(Gersch 2017). Similarly, in this workshop series, we endeavor to unveil the technological and social constructs of web mapping,

Static maps vs. interactive web maps

At the basic level, a series of basic concepts about web mapping can be introduced. In our Intro to Web Mapping workshop, we introduced web maps vs digital maps, map tiles, Zoom levels, and so on. I also attempted to address, by showing a few web map examples including Mapping Black California[iii] and the extremely detailed election map by New York Times[iv], the "why web maps" question that participants may wonder. The examples demonstrate the strengths of web maps: the ability to zoom in and out on a web map means it can store a massive amount of information which a single sheet of print map cannot do, it is interactive and engaging, and could be useful for communicating an engaging message.

Server-client architecture

Although the ease of use of ArcGIS Online or Carto Builder means they tend to obscure how a web map is put together behind the scene, it is still possible to teach some key technical fundamentals even with a code-free approach. For example, I found it useful, when demonstrating with ArcGIS online, to show the difference between publishing a hosted feature layer that can be used for creating a web map and creating a web map directly from the Map Viewer. The benefits of the former method include: 1) the feature layer can be reused 2) there is no limit to how many features that can be uploaded 3) it supports all analysis.

It is important to point out the differences between these two approaches not only to avoid not being able to upload a large dataset or run an analysis, but also to illustrate a critical concept: web services. Hosted feature layers are essentially what is called web services, which can be thought of as "a focused task that a specialized computer (the server) knows how to do and allows other computers to invoke." (Quinn and Dutton 2020). GIS Web services, as web services specialized for GIS, are "software components that host spatial data and GIS functionalities that can be accessed and integrated into customized GIS applications through the Internet" (Han 2019, 107).

Why is it important to teach the concept of GIS Web Services? This is because web services technology is at the core of today's Web GIS (Quinn and Dutton 2020). For example, when one can pan Google Map forever without feeling any lag is because Google Maps – same as many other web map providers- uses "pre-cooked" titled images and tiled map services. Explaining GIS web services can help learners shift from the mental image of paper-based maps to web-based GIS.

For a two-hour workshop geared towards beginners, it is probably unnecessary to go into details such as Simple Object Access Protocol (SOAP) to Representational State Transfer (REST), however, it could be useful to briefly talk about different types of web services such as Web Map Services (WMS) and Web Feature Services (WFS). This topic can be brought up in other web mapping related contents, for example, for a workshop on collecting field data using ArcGIS Collector, when understanding feature services would be key: it returns vector geometries and attributes allowing for spatial analysis and editing- the editing function can be controlled and open to a group of people allowing for everyone contributing data.

Web Mapping API

Web Mapping API (application programming interface) is a key concept for many learners, even beginners to web mapping. In the Intro to Web Mapping workshop where ArcGIS Online is employed as the tool for creating a web map, we explained to the learners the limitations to ArcGIS online, for example, lack of flexibility for customization and inability to store data locally, and meanwhile mention briefly that's where the Web Mapping APIs comes in. In the Web Mapping with R workshop, we explained in more detail why Mapping APIs are useful, borrowing the language from Penn State.

> Web Mapping APIs typically include classes for maps and layers so that you don't have to write all the low-level code for displaying an interactive map image and drawing a new layer on it. Instead, you can just create a new map object, create a new layer object, and call some method such as layer.addTo(map). The API abstracts the complexity of the task and makes it easy for you to focus on the mapping aspects of your application, rather than spending time on the low-level logistics. (Quinn and Dutton 2020)

Explaining JavaScript functions like layer.addTo(map) in plain language and then moving to Leaflet for R, will help learners compare the workflow between the R package and Leaflet: the R package simply provides a more convenient interface for R users to use Leaflet but fundamentally by executing a R command they are still calling the function in provided by this API.

Aside from the close-up examining of code, we attempted to provide a high-level view of web mapping APIs and their significance. First, they open up the access to tiled base maps, such as OpenStreetMap, to everyone. Second, they offer a way of utilizing mapping functionalities, blending data resources, and therefore creating new geospatial information: in many cases, there is no need to collect all data sources in one place before mapping them, like the way we are accustomed to with a desktop GIS software; a web mapping API allows third-party data to be tapped into every time a user views the web map. This recent phenomenon- maps joining in the "mashup" culture- has profoundly changed how/what geospatial information is created, echoing the "Information Creation as a Process" frame.

Computational thinking

The workshop Web Mapping with R adopts a programming-based approach. Leaflet for R, an R package, serves as an R wrapper to using Leaflet. As much as Leaflet is a wonderful resource to learn web mapping, it may present a barrier for a lot of people as it requires at least a basic level of knowledge of HTML, CSS, and Javascript. R, on the other hand, is a very popular computing language in academia including at [MY INSTITUTION]. Not only does teaching this R package enables students and researchers to integrate web mapping into their preexisting data manipulation and analysis pipeline with R, but also provides an

opportunity for participants to see that a programming-based way of producing web maps is different from traditional GIS- no button to click but code to write.

Scholarship as Conversation

The frame recognizes the discursive nature of scholarship, and in light of the rise of social media and other Web 2.0 tools that enable researchers to communicate with each other in unprecedented ways, acknowledges "new forms of scholarly and research conversations provide more avenues in which a wide variety of individuals may have a voice in the conversations" "(ACRL 2015a, np). Web mapping precisely presents us with new forms of communicating geospatial information and research; we incorporated these techniques of communication in two of the workshops.

R Markdown

In the Web Mapping with R workshop, we show participants that, since this package is compatible with R markdown, it is straightforward to create an R Markdown file compiling text, R code chunks, and web map visualizations all in one place. The R Markdown can then be published and shared through Github pages, which provides a quick and easy way of publishing web pages. This approach is particularly useful for researchers to communicate research with their peers, since the R Markdown file is reproducible and informative, providing narratives for a project, giving explanations to the code, and incorporating the web maps without losing any interactivity. It may not, however, be suitable for communicating with the general public; a website with the web map embedded in the format of HTML or a story map would be more appropriate. Discussions like this encourage participants to critically think about the target audience and the corresponding format for communication.

Storytelling and Knowledge Mobilization

Knowledge mobilization has been gaining momentum in academia; it refers to practices "focuses on spreading the results of research findings to multiple audiences and enhancing the usability of knowledge products"(Heron and Reason 1997, 481). Knowledge mobilization emphasizes making knowledge useful and accessible for a wide range of people, and the key is to get "the right information, to the right people, at the right time, in the right format, to influence their decision-making and to create new value" (481).

One of our workshops' subject, Storytelling with StoryMaps, could be used to communicate research in an accessible way. StoryMaps, an Esri's product, is an online storytelling tool that enables users to integrate interactive maps from ArcGIS with multimedia content and create an immersive storytelling experience. To draw a line between knowledge mobilization and StoryMaps, we showed this example, COVID-19 Risks in British Columbia's Neighbourhoods- Mapping Risk & Vulnerability across the Province[v]. This example demonstrated how StoryMaps was used to communicate this research that may be of use to a wide range of people- the general public, community activists, policymakers, health workers, and so on.

It is important to point out some storytelling techniques enabled by this application. Unlike a normal print or digital map with a big legend that presents complex and layers of information, what's special about StoryMaps is it can tell a story progressively- one layer of information at a time- which resembles, from a

viewer's point of view, the experience of someone standing beside the map telling the story personally (Nelson n.d.) . It was a point the participants found inspiring in the workshop.

Discussion

The key question is: why bother to apply the ACRL Framework to guide the development of the workshops? Given the nature of these workshops- open to all disciplines and any level of GIS experience- some came to the workshops with only a general curiosity about web mapping, uncertain about whether the tool/method introduced in the session would be useful for their research projects. Therefore, diving directly into technical details cannot prepare the participants cognitively. Instead, guiding them to see the larger technological and social context, as well as connecting what they already know or the rapidly changing world we all live in with the subjects of these workshops, helps the participants make the cognitive transition.

The ACRL Framework represents a drastic change from the ACRL Information Literacy Standard, with the focus shifting from skills to concepts, philosophy from positivist to social constructivist: "knowledge is constructed and reconstructed through social interactions" (Foasberg 2015, 702). This emphasis on the social nature of information, coupled with the driving factors for the establishment of the ACRL framework: "changes in technology, scholarly communication and the information life cycle", deeply echo the rise of neogeography- Web 2.0 technologies, GPS, and mapping APIs opening up new ways of collecting, sharing, and communicating spatial data, which has lead to the blurring of the lines between geospatial experts and amateurs, creators and consumers. The innate alignments can be illustrated by how Pantin (2014) describes neogeography: "neogeoraphy is not so much about replacing a professional geographic practice, but rather about enriching it. This can be done by adding people's subjectivity to the picture, which is often excluded from GIS" (34).

The ACRL Framework, particularly the three frames discussed in this paper, therefore serve as a useful lens through which I organize those geospatial information literacy competencies or learning objectives informed by the BoK and *cyberliteracy for GIScience*; this exercise helps to bring some hidden social aspects or easy-to-neglect context to light. For example, we explain how mapping APIs work but also remark that they represent a drastic change in how geographic information is created; it's a technological phenomenon but also a social phenomenon, as Han (2019) put it, "the web has become a data and thoughts sharing platform that features bottom-up information uploading with increasingly spontaneous spatial information" (106).

Furthermore, purposeful organizing geospatial competencies/concepts through the lens of the ACRL Frame helps us avoid a *cookbook* approach, characterized by step-by-step instructions without demanding a deeper understanding conceptually. This benefit validates Sadvari (2019)'s statement that connecting the ACRL Framework with the BOK would help instructors resists the tendency towards adopting a *buttonology* or *cookbook* method.

Conclusions and future work

Both initiatives at VPL and SFU discussed in this paper could be broadly described as attempts to draw a bigger circle of users for GIS, that is, empowering people to become not only consumers of spatial information but also creators of them. Pedagogically, the workshops discussed in this paper cover two

types of instruction: Web GIS-involved education (the first workshop in the public library) and Web GIS education (the rest of the workshops); each approach proves to be useful for addressing different learning objectives and technologies. The cloud-based web mapping applications like ArcGIS online and Carto Builder, for their easy-to-learn nature, can be used to teach spatial thinking (falling within the camp of Web GIS-involved education) or web mapping concepts and skills (falling within the camp of Web GIS education); mapping APIs allow programmers and people with basic coding skills to build web maps/apps with maximum flexibility and leverage the interconnectivity in terms of data and functionalities, and teaching mapping APIs touches the core of Web GIS education. In summary Web GIS empowers people who lack professional GIS trainings to venture into GIS or cartography work; as a result there has been a growing need for learning web mapping, and this is true regardless of the general public learners or university learners. In reality, however, university curricula in Canada are unable to keep pace with the development of Web mapping technologies (Han 2019) and hence "Web GIS in Canadian education still needs advocacy" (120). To help fill the gaps, academic libraries' GIS services, traditionally serving as a neutral place for promoting geospatial information literacy across disciplines, hold a unique place to update instructions to be responsive to the growing influence of neogeography, rapid development of Web GIS, and the shifting learners' needs.

For public and academic libraries alike, expanding their instructional program to web mapping is also consistent with library's long held-values such as democracy and privacy. Although neogeography has presented exciting opportunities for democratizing GIS, it can also lead to marginalization and barriers as well as concerns over data privacy and surveillance: "neogeography can result in the democratization of GIS and geospatial data limited to a mostly already technically literate demographic"(Byrne and Pickard 2016, 1518). Libraries are well positioned to bridge the digital divide against the backdrop of neogeography and promote awareness around these critical issues around locational data privacy and surveillance.

From the perspective of outreach, our endeavors at VPL felt a little like a shot in the dark- we did not know whom we were reaching out to. The uncertainty, however, did not stop us from materializing the idea of teaching web mapping to the general public. And the audiences' enthusiasm gave the testimony that the general public is keenly interested in these topics and skills, but the interests remain, dare I say, unmet needs through many public libraries' programs. A sustainable institution to institution partnership should be given more consideration. A public-academic library partnership can likely leverage the strengths of both sides: the public library offers accessible locations, established marketing channels, and public awareness of their educational programs; the academic library offers expertise gained through a commitment to GIS education and keeping current with GIS technologies.

In this paper, following Appel(2019)'s call for librarians to keep refining, strengthening, and adapting the ACRL Framework to geospatial information literacy instruction, I argue that the spirit of neogeography and the ACRL Framework are inherently in line. The ACRL Framework came to existence partly because of "the dynamic and often uncertain information ecosystem in which all of us work and live"(ACRL 2015a, np), which resonates deeply with the rise of neogeography. Organizing the learning objectives informed by the BoK and *cyberliteracy for GIScience* through the lens of the ACRL Framework helps to bring to light the hidden social aspect, as well as to contextualize the technical skills in a larger technological perspective to the changing geospatial information creation process. For geospatial librarians, this perspective aids us to move away from the *buttonology* or *cookbook* method; for learners, who, in the ACRL Framework's language, take "a greater role and responsibility in creating new knowledge"(ACRL 2015a, np), this

approach assists them to get a holistic view of the changing contour of geospatial information ecosystem. It is important to point out, however, that the web mapping workshop series discussed in this paper should be deemed as only the first step into expanding an academic library's GIS instruction to the realm of web GIS. Each workshop in the series is independent, without requiring another as prerequisite, which certainly lowers the bar to attending the workshops, but on the other hand, limits the extent to which the ACRL Framework can be applied, as the ACRL Framework is "intended to be developmentally and systematically integrated into the student's academic program at a variety of levels"(ACRL 2015b, np). Also, given the nature of these workshops, project-based learning and participatory mapping are hard to implement. These limitations to this experimental workshop series, in turn, highlight that there is a lot more potential for librarians to explore in adapting the ACRL Framework to teaching web mapping in different disciplines and learning environments.

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[i] https://github.com/ect123/intro-to-leaflet-workshop

[ii] https://bikemaps.org/

[iii] https://bvnews.maps.arcgis.com/apps/View/index.html?appid=6701b987e4fe4caea210f6b114a44fb0&extent=-119.6295,33.4961,-116.9255,34.8481

[iv] https://www.nytimes.com/interactive/2021/upshot/2020-election-map.html

[v] https://storymaps.arcgis.com/stories/b390728f6d6f43c8bfcddf0b9e4dbbc4