CHAPTER 16

Diving Into Infographics:
Research Skills for Early Undergraduates in Global Environmental Science

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Introduction

The common experience for many early undergraduate students is to be taught the basics of their field via a survey course. Most often, their introduction to the library and librarians might be a one-hour instructional session on how to use the library catalog and find books and articles. Students' understanding of research and the library remains unchanged from their prior knowledge: subject information comes from teachers and textbooks, and libraries are places to study and check out books. This chapter describes a course that attempts to re-envision this relationship by giving students an initial experience that is a dive into the research process in a manageable format, with a semester-long introduction to their field, to research, and the role of the academic librarian as a research partner.

Background

This case study describes Global Environmental Sciences (GES) 100 at the University of Hawai'i at Mānoa (UHM), which serves as an introduction to undergraduate research for new GES majors as the degree has the co-curricular requirements of a faculty-mentored research experience, written thesis, and oral

presentation of results. Since 2016, this course has centered on a partnership between a GES faculty member and a librarian. Together, they have introduced students to research through the undertaking, presenting, and publishing of an infographic after discussing environmentally related research topics with faculty researchers. GES 100 effectively serves as a pre-undergraduate research experience (pre-URE) for the faculty-mentored URE and in this way is analogous to pre-course-based undergraduate research experiences.[1] The GES program has an inherently interdisciplinary, research-centered curriculum, and this course situates new undergraduates with an introductory overview of how to do, present, and publish research. More importantly, it grounds them immediately in a novel concept for most students: librarian as research partner for their projects, from the research infographic to the GES thesis.

The University of Hawai'i at Mānoa is a land-, sea-, and space-grant public university located in Honolulu, Hawai'i. UHM is the largest campus of the University of Hawai'i system, which includes three universities and seven community colleges across the Hawaiian islands, with a total undergraduate enrollment of 13,203 in 2020.[2] An R1 research institution, UHM has particular strengths in earth and environmental sciences, with a mission to educate students in research for both the worldwide community and for the local needs of Hawai'i.

The UHM Department of Oceanography was formed in 1964. The department offers MS and PhD degrees in oceanography and a BS in GES. The GES program started provisionally in 1997, graduated its first students in 2000, and was granted full status in 2002. A key element of the degree is the required faculty-mentored research experience, written thesis, and oral presentation of results to a live audience. There are currently 100 students from diverse backgrounds in the program.

The Hamilton Library Science and Technology Department is charged with providing instruction and liaison services to the various science-related departments at UHM, including the GES program. SciTech librarians are responsible for instruction and outreach to their academic departments, but are not given a standardized instructional model, and are free to develop their own partnerships with faculty to support the university's mission.

Partnerships

GES 100 - Global Environmental Science Seminar is a required one-credit course for GES majors that meets for fifty minutes once per week over the course of a sixteen-week semester. The purpose of the course is to serve as a pre-URE by (1) exposing students to some of the different environmentally related research conducted at UHM by visiting with UHM researchers to discuss their research, and (2) having students develop and give a presentation on an environmentally related research topic of interest. Up through 2015, the students used Power-

Point to give their presentations, and GES faculty were responsible for the entire instruction of GES 100. Beginning in 2016, the GES program began partnering with the UHM science librarian to improve the presentation component of GES 100, which led to the transition away from PowerPoint to infographics as the medium for the students to present their topics.

The role of the library in the GES 100 course began as a short point of contact to teach the students best practices in infographic design. Some of the motivation and techniques of this early phase of the course can be found in previous work focusing on the infographic method.[3] That is not the focus of this chapter, which is on the course as a whole. However, a brief explanation of how the infographic modality is appropriate to the undergraduate research endeavor is warranted, as it provided the mechanism for the librarian to join the course as a partner.

Infographics are visual representations of data or knowledge that convey information concisely and effectively. They are a feature of growing importance in scientific communication in their own right but also, for our purposes, serve as a microcosm of the research process.[4] To create an infographic, the designer must (1) identify a topic, (2) find background information, (3) refine the infographic's purpose, (4) develop a design, (5) gather or create visuals using design methods, and (6) present the results to an audience. As the librarian teaches GES 100, these steps mirror the research process: (1) define the research problem, (2) review the literature, (3) formulate hypotheses, (4) design the research methods, (5) gather and analyze data using research methods, and (6) present results in a publication.[5]

After rotating through research presentations from UHM faculty on a range of environmentally related topics, the librarian instructs the students on infographic best practices, information skills, and infographic design. Over the course of six weeks in the second half of the semester, through a series of lectures, demonstrations, guided worksheets, and in-class work time with personalized feedback, the librarian and co-instructors introduce students to the skills and process of creating a research infographic. Students are shown how to search for scientific literature and how to search for images, navigate copyright concerns and image resolutions, and develop legible color schemes and audience-focused narratives. The librarian discusses the translation of data into a visual format, the truthful representation of data, and how it can be misused. The librarian also mentors the student groups on these same topics as they craft their infographics.

This is an ideal introduction to research as it represents a microcosm of the entire research process and emphasizes the importance of communication. Furthermore, developing these skills serves students well in their future projects, which will certainly require the creation of charts and graphs. In contrast with traditional formats such as research papers, the students can immediately see how they must present their research to multiple audiences, both professional and public. Students learn to research a topic, make a persuasive

argument using valid statistics, and present their findings in a collaborative process—a true microencapsulation of the research process. At the end of the semester, students publish their infographics in UHM Hamilton Library's institutional repository, ScholarSpace (SS). A relatively recent addition to the course, publishing the infographics in SS has had a positive impact on the student research experience. Prior to this change, infographics were printed and hosted in a public space of the library, which while appreciated by the students did not attach the same cachet of "publishing" their work online. By making the infographics published scholarly items, with their names attached, the students are not only motivated to do their best work but also confronted directly with the thinking of their audience.

As the students move on to more advanced studies (beyond GES 100) culminating in completing a research thesis, they have already formed a connection with the library. This librarian-faculty collaboration on a research-oriented course is a foundational experience for the GES major here at UHM and provides undergraduates with research skills, experience, and library contacts they need to succeed in the research-intensive GES program.

In the fall of 2020, the librarians, UHM English Department, and graduate students established a new partnership to further improve the course. While the librarians involved with GES 100 were comfortable teaching the technical and stylistic aspects of infographics, there was a missing component to the lesson, an aspect of research presentation that is often overlooked: the crafting of narrative and story. To teach this, a faculty member from the UHM English Department and graduate students in the Composition and Rhetoric program were invited to contribute to the infographic project. This has been a beneficial, interdisciplinary addition to the course that has already resulted in improvements in the quality of the infographics. Prior to the partnership, most GES 100 infographics seemed to be targeted at the same audience (GES 100 students and faculty), while after the partnership the infographics have been aimed toward diverse audiences, including primary students.

Another recent addition is the integration of the GES 100 course into the larger GES student-centered research experience pathway.[6] The GES program has created a one-stop shop for the student's entire research experience using Laulima, UHM's course management system. The Laulima site hosts materials for both courses and co-curricular experiences that address the entire arc of the GES student's research experience. The GES 100 librarian works through this site to build an integrated research guide to the GES research experience, from GES 100 to the GES Symposium and the mentor-approved thesis. Laulima hosts materials for these experiences, bundled as "stages," and tracks students' progress from stage to stage as they travel on their research experience arc through the GES program; this expanded partnership allows the library to make contact with the students through all stages.

Reflection: COVID-19 Impacts

Due to the March 2020 emergency proclamation by Hawaiʻi's governor, UHM moved to online instruction. The GES 100 instructors chose to teach via a synchronous online mode using Zoom for the remainder of the semester. At this point of the semester, the first phase of the course had concluded (i.e., the face-to-face visits with UHM researchers) and the course was in the infographic phase. Infographic instruction continued in Zoom and students worked in groups via breakout rooms during class. The end-of-class infographic presentations were delivered online through Zoom with little disruption. In fall 2020 and spring 2021 semesters, the face-to-face visits with the researchers during the first phase of the class were switched to online presentations by the researchers. Some researchers gave live, guided tours of their labs, while others effectively gave short lectures on their research interests. This aspect of the course was less easily switched to online, with mixed results and feedback.

Assessment

The University of Hawaiʻi at Mānoa uses a standardized survey—the Course Evaluation System—that provides feedback to instructors on general metrics. This covers common questions such as whether instructors were available for consultations, prepared with the material, offered an appropriate level of rigor, etc. This level of assessment was not sufficient to determine if the class was addressing the research needs of undergraduate students. Therefore, an additional survey was added in 2019 and continues to date, asking students about their experience with research in a pre-post format in the first and last class sessions.

The survey asks about students' awareness of research areas and opportunities, their experience with presentations, and their plans to take research courses. To provide more anonymity and obtain honest responses but still allow the tracking of student answers across the semester, students use coded names to answer. While not strictly anonymous, this format provides a satisfactory balance between anonymity and ease of implementation. The results have shown that the course works very well at inspiring students to pursue further research in the program (82 percent positive responses) but work still needs to be done to improve students' awareness of GES research areas (39 percent increase pre-post). This may be a result of the pandemic reducing the impact of the faculty lab visits or may indicate an opportunity for the library to help improve the research survey component of the course. Expanding on the integrated library guide to allow students to more systematically explore GES faculty areas by aligning content with the GES 100 presentations is an additional possibility for the future.

Going forward, it would be ideal if assessment could also be aligned with research-related questions and results from other institutions. One possibility would

be to implement a student self-report survey based on the Undergraduate Research Student Self-Assessment (URSSA).[7] The URSSA is an undergraduate research assessment instrument used by students to self-assess research outcomes after the completion of a long-term research experience. Our self-report survey will be used to assess the impact of GES 100 on the student's entire research experience at the conclusion of the student's research experience (i.e., after the student has completed the required thesis and oral presentation of results).

Recommendations and Best Practices

Establishing Partnerships

While the embedded and semester-long partnership in GES 100 has been very successful, it should be reiterated that it began as a traditional, one-shot style instruction session itself. Libraries seeking to replicate this model should not hesitate to start short-form, research-oriented instructions and gradually build in more extensive contact with students and faculty. For example, after an infographic instruction session is established, offering to assist with a course-specific guide or hosting student work in the repository afterward can extend library involvement in the class. Often, faculty are unaware of the broad and diverse range of skill sets that librarians possess with regard to communication in general, and more specifically to infographics. Faculty are excited to have the opportunity to collaborate with other like-minded academics that can help improve their students' communication experiences.

Student Collaboration

In our experience, groups of two students are the optimum configuration to support a collaborative focus for the infographic project. Collaboration is emphasized as a part of the research experience. These pairings allow both students to contribute to the infographic project based on their strengths. In some cases, one student contributes more content expertise and the other contributes more design expertise. We have also observed the collaborative benefit of student pairs with distinctly different socio-cultural-economic backgrounds, resulting in very insightful and nuanced infographics.[8] The example infographic in the appendix demonstrates one result of blending these perspectives.

Continuity of Practice

Unfortunately, in the academic library, there are many cases of projects that start well and provide great benefits but come to an untimely end when the initiating

librarian leaves or retires, with no one to continue them. Projects should include plans for their continuation beyond a single founder, and although this project was not started with such a best practice in mind, we believe we have stumbled upon a useful mechanism for this. Since 2019, an assistant librarian has joined for the infographic portion, while the primary librarian remains responsible for instructing the entire course. This creates a "warm hand-off" or apprenticeship type of situation, where the assistant librarian builds ties with GES faculty and knowledge of the course and can take over if a transition is necessary. This comes with the cost of using additional librarian time, but in our experience, it is not time wasted; this portion of the class requires the most hands-on instruction time, and having an additional librarian is appreciated by the students and provides valuable experience for a junior librarian.

Minimalism in Tools

Over the course's lifespan, several implementations of the infographic project have been tested. Originally, students used Piktochart or Canva to teach students fully featured software for high-quality infographics. However, these tools are not ideal for collaborative work, nor are they immediately familiar to students. Ultimately, the course turned to Google Slides as the platform for infographic creation. While lacking in advanced design features, Google Slides is seamlessly collaborative, allowing students to work together and instructors to view and comment on the developing projects without any barriers. This became an essential feature during the transition to online instruction during the pandemic. Also, Google Slides needs no introduction to students, and that reduction in cognitive load allows students to focus on infographic design instead of learning new software. This concept of minimalism, focusing only on the core aspects of the research project is a recommended best practice.

Embedded Practice

Library instruction often takes place in a one-shot, "drop-in" format, where the librarian visits the class only briefly. When done well, this format aligns with course assignments and objectives and allows librarians to provide instruction to students across multiple classes. An alternative model is embedded librarianship, where the librarian becomes a long-term participant in the class. This allows the librarian to integrate into the didactic process and build stronger relationships with the students.[9]

The GES 100 infographic library instruction originated in one-shot format. As the librarian gained experience in how the infographic could be taught as a model of the research process, the class moved toward the embedded model. The librarian attends every class and is available to the students for assistance during the entire semester. This provides several critical benefits for the undergraduate

research experience. With the librarian in the role of a co-instructor rather than guest, the students take the infographic project more seriously. As the librarian attends the faculty introductions in the first half of the course, it allows the infographic instruction to be more targeted and relevant to the topics, and the librarian becomes seen as a research partner rather than an outsider to the class and the field.
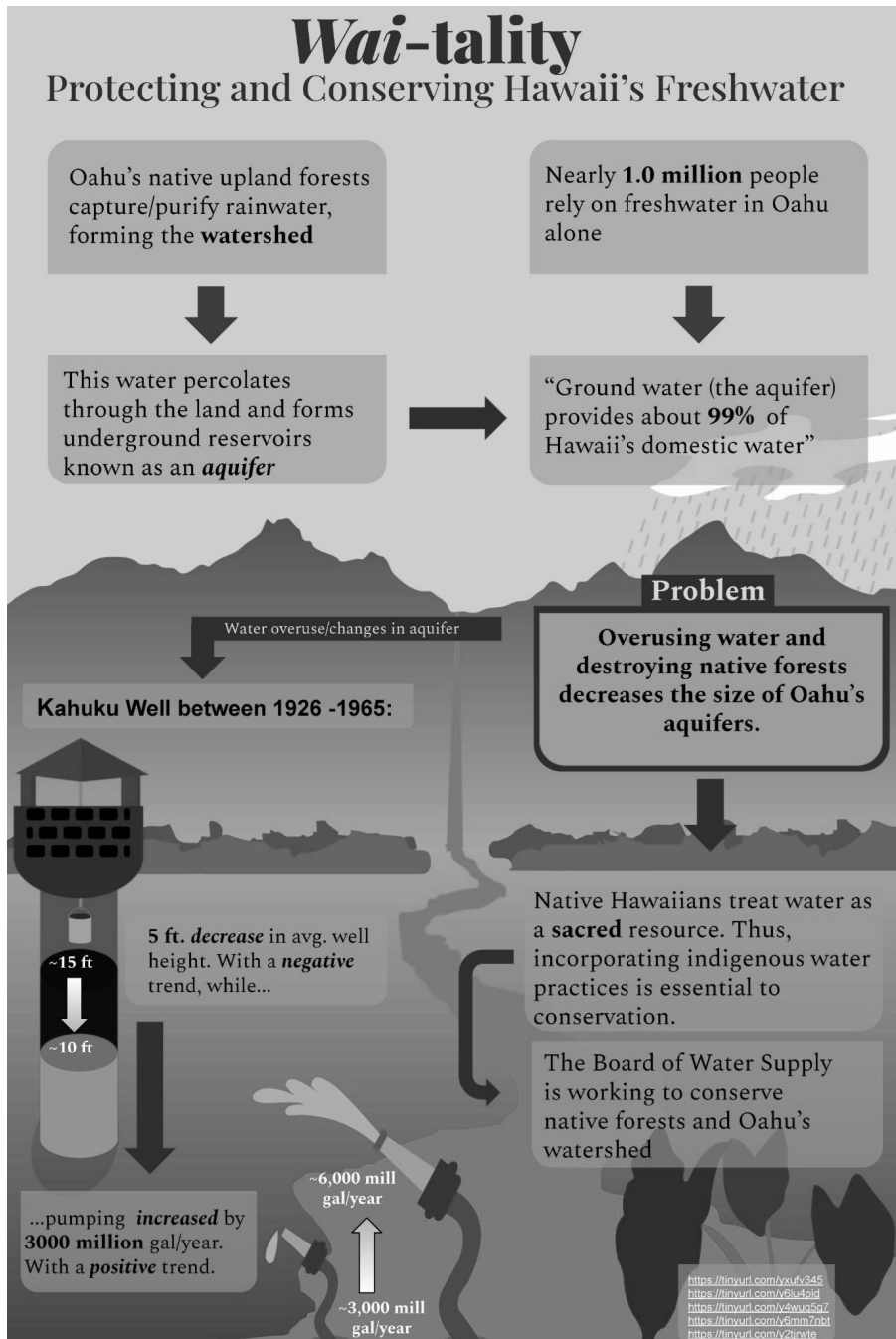
Iterative Design

New partnerships and tools for the course are tested every semester. New methods of communication, such as a GES Discord server and a permanent online library exhibit, are being piloted this year (2022). The aim of improving this formative research experience for students is always at the forefront. This willingness to be experimental and openness to build new partnerships outside of traditional departmental lines have been key reasons for the success of the course.

Conclusion

The GES 100 course at UHM has been a successful partnership between librarians and academic faculty, providing an introduction to research to undergraduates for several years. The course did not pioneer the use of infographics in instruction, nor the embedded librarianship model, but demonstrates how when combined, these concepts integrate into an even more impactful experience—first-semester undergraduates participating in the research process, including publication, and building lasting relationships with librarians as research partners that will serve them well to their undergraduate theses and beyond. The crucial components in our experience are a project that replicates the research process in miniature, infographics being an excellent choice, and an extended relationship with a librarian.

Appendix

Wai-tality
Protecting and Conserving Hawaii's Freshwater

Oahu's native upland forests capture/purify rainwater, forming the **watershed**

Nearly **1.0 million** people rely on freshwater in Oahu alone

This water percolates through the land and forms underground reservoirs known as an *aquifer*

"Ground water (the aquifer) provides about **99%** of Hawaii's domestic water"

Water overuse/changes in aquifer

Problem

Overusing water and destroying native forests decreases the size of Oahu's aquifers.

Kahuku Well between 1926 -1965:

~15 ft

~10 ft

5 ft. *decrease* in avg. well height. With a *negative* trend, while...

Native Hawaiians treat water as a **sacred** resource. Thus, incorporating indigenous water practices is essential to conservation.

The Board of Water Supply is working to conserve native forests and Oahu's watershed

...pumping *increased* by **3000 million** gal/year. With a *positive* trend.

~6,000 mill gal/year

~3,000 mill gal/year

Notes

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