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How Data Visualization Can Facilitate Active Learning and Undergraduate Research in an Online Class

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This assignment describes how a data visualization assignment can aid students in developing research skills in an online course.

Context

This assignment, created in partnership between a faculty member and an academic user experience (UX) designer, was designed for a senior seminar in International and Global Studies at a large, urban, public university with a large commuter student population. Many students elect to take courses online in order to save time and balance busy working lives. All the courses in which the students used this assignment were fully online, in course shells built in the D2L learning management system. A core value of the senior seminar in International and Global Studies class is that students acquire research and writing skills through the creation of a culminating major research paper. Unfortunately, the first time that the class was offered in 2016, students struggled with the research aspect of the project; in particular, students had difficulty identifying a research topic and hypothesis. The UX designer suggested replacing the midterm annotated bibliography with a data visualization project: a high-impact online teaching practice known to increase engagement in undergraduate research (Kuh 2008). In what follows, we explain the initial iteration of the data visualization assignment as well as the revised version that we created based on students' feedback.

Initial Assignment

We began by reviewing literature related to universal design for learning and high-impact teaching practices, which encourage dynamic presentations and assignments to increase student engagement (Baldwin and Ching 2016; Fink 2003; Kuh 2008). Our collective brainstorming around course outcomes, program outcomes and high-impact online teaching opportunities led us to select a data visualization assignment that would encourage students to think critically about their larger research project early in the quarter. A data visualization is the graphic depiction of numerical data in a manner that allows the viewer to better understand and interpret this information. The assignment would use software freely available to students, meet course objectives, and allow for individual personalization. Our original project asked students to first identify a data source, and then manipulate it in a basic manner to create a map, which they would later embed or share with the final research paper. The map was chosen not only to help students think with a global perspective (since this was an International Studies class), but also because maps can be easy to conceptualize. Students also would write a brief reflection to describe their research process and what they had learned.

Students had three weeks to complete the assignment. In week one, students were given a two-page assignment outline that included an overview of the assignment, a timeline, a grading rubric, and an example map. Sections with additional information included "Dynamic Learning Materials" with links to software and resources for the assignment; "Ask Questions, Get Help, and Help Others" with links on how to ask for help in a class discussion forum; "How-To Media" with a four-part video series that walked the viewer step by step through creating a map; and "Due Dates" with recommended progress dates outlined for each week.

The assignment was scaffolded on a weekly basis with the first three weeks being dedicated to researching data sets on the *UN World Drug Report* and finding a dataset (a collection of numerical information on a particular issue) that reflected the students' final research topic. In the first two weeks of the assignment students began working on their map. In the third week of the project students finished creating their map and shared their work with the class to foster a reflective conversation. The class then viewed each other's work, and discussed what they learned on the discussion board, based on the following prompts:

- Explain how difficult or easy this assignment was and why.
- Do you feel that this assignment helped you to prepare to research for your final paper?
- What advice would you have for someone doing this assignment in the future? Are there any changes that you would suggest to the assignment itself?

The result was a lively discussion about how the data visualization assignment project related to their final project. In addition, students also submitted a self-reflection on their paper, which was shared with the faculty member only.

Revised Assignment

Data were collected from the originally piloted 400-level undergraduate seminar class in International and Global Studies, and from six additional upper-division courses in the same program. The professor then used a similar assignment in other courses ("The US and the World" and "Global Drug Trade"). One key change to the project based on student feedback was the need for more choices in the format of the data visualization; in addition to the map, students requested a chart or timeline format. Students also wanted to explore their own statistical source for the project, as well as to see examples of other students' projects. With permission, the faculty member put examples of these projects into the course shell. The wording of the handouts and guidelines was adjusted to reflect student concerns.

Reflections on the Assignment

Through reflection, discussion, and public presentations of their visualizations, this assignment increased student engagement in their research. Additionally, some of the projects were visually stunning, which increased student enthusiasm for viewing each other's projects. Many students also chose to create data visualizations which were meaningful to them in some way, sometimes because of a family connection to the topic. For example, one student whose family came to the US from Iran chose to do a timeline that looked at the history of US–Iranian relations, while a student whose family came from Vietnam sought to better understand Vietnamese trade and migration. A number of students described how the assignment helped them to research their final paper and clarify goals for research, as well as facilitating new skills around technology. Over the course of redesigning the assignment, the professor saw that the students demonstrated higher levels of engagement with their research topics based on their reflections and discussion of the data visualization project. This assignment has become a standard research project in the faculty's upper division classes.

References

Baldwin, Sally, and Ching, Yu-Hui. 2017. "Interactive Storytelling: Opportunities for Online Course Design." *TechTrends* 61, no. 2: 179–86. https://doi.org/10.1007/s11528-016-0136-2 (https://doi.org/10.1007/s11528-016-0136-2).

Fink, L. Dee. 2003. "A self-directed guide to designing courses for significant learning." https://www.bu.edu/sph/files/2014/03/www.deefinkandassociates.com_GuidetoCourseDesignAug05.pdf (https://www.bu.edu/sph/files/2014/03/www.deefinkandassociates.com_GuidetoCourseDesignAug05.pdf).

Kuh, George. 2008. "High-Impact Educational Practices: What They Are, Who Has Access to Them, and Why They Matter." AACU Research Publication. https://www.aacu.org/node/4084 (https://www.aacu.org/node/4084).

Appendix: Materials

Assignment guidelines with video links included (all videos have transcripts) (https://jitp.commons.gc.cuny.edu/files/2022/01/Data-Visualization-Map-or-Timeline-Assignment.pdf)

Data Visualization Map or Timeline Assignment

U.S. and the World INTL 396 and the Global Drug Trade, INTL 407

About this Assignment:

For this project you will represent data visually by means of either a timeline or a map. The data will reflect either some aspect of the United States' relationship with the rest of the world, or some feature of the global drug trade. The goal of this assignment is to help you research your final topic, and to visualize information related to this issue. It allows you to develop your skills displaying information, which you can use later in other courses or your workplace. You will provide a link to this project in a Word document that you will upload to "assignments" in D2L at the end of week seven. This Word document will also have a two to three paragraph data reflection, which will ask you to analyze your project: what is the most important message or information that your project conveys? Why do you think that information is significant, and how does your project convey it? What other interesting information can be seen in your data visualization? You have all of week seven in the course to work on this project. You will also provide a link to this assignment in their final presentation. You must also cite the data source(s) that they used in APA format.

View an example in the course content for week four. *If you are viewing this material on a mobile device you may need to scroll horizontally as well as vertically to read all information.*

- Timeline: 3 Weeks.
- Create either: *a data visualization map* -or- *create a timeline* that includes a minimum of two charts showcasing data related to your research and write & submit a two - three paragraph reflection on your work.
- Watch a video reviewing the materials & resources for this assignment
- Review the grading rubric for this assignment
- Explore an example of a data visualization map including how the data is structured:

INTL 396 Data Visualization Map Example

Rubric for a map assignment (https://jitp.commons.gc.cuny.edu/files/2022/01/rubric-for-map-project.docx.pdf)

Rubric for the Map Project

	Excellent	Good	Incomplete
Impact	Conveys information in a clear and accurate manner. Alt text includes an accurate description of data. The clarity and color contrast make the visual easy to view. This map enhances and supports the student's research agenda in a visually plotted display.	Overall, a well done map, with one or two minor errors or issues. Alt text includes an accurate description of data. The map supports the student's final project.	May inaccurately display data, or be difficult for the viewer to interpret. There are formatting issues with labels or features. Does not include alternative text for the map. The information is presented in a confusing manner.
Data	The project correctly drew on a data source related to the research topic. The author correctly followed instructions related to the data set(s). The information is accurate. There are citations for the data used in this project.	Generally demonstrates a good understanding of the data and demonstrates their ability to use it. There may have been one or two gaps or issues with the data.	The data chosen was problematic, inaccurate or irrelevant. There was insufficient information to make a visually appealing map. The assignment may lack citations.
Written Reflection	Clearly written and well-edited for grammar and spelling, including complete sentences. Provides evidence of meaningful reflection and insights. Tightly organized.	Mostly well-written with a few errors in grammar or spelling. May not be as tightly organized as possible, or have particular insights.	Contains several errors that detract from the clarity and readability of the essay. The reflection lacks a clear organization, making the argument difficult to follow. Little evidence of thought or insight. There may be grammar or spelling mistakes.

Rubric for a timeline project (https://jitp.commons.gc.cuny.edu/files/2022/01/Rubric-for-the-Timeline-Project.pdf)

Rubric for the Timeline

	Excellent	Good	Incomplete
Impact	Conveys information in a clear and accurate manner. The timeline makes good use of images and is easy to view. This timeline enhances and supports the student's research agenda in a visually plotted display.	Overall, a well done timeline, with one or two minor errors or issues. The timeline at a couple points may be somewhat cluttered or difficult to view. The timeline supports the student's research.	May inaccurately display data, or be difficult for the viewer to interpret. The timeline may not contain sufficient information. There are formatting issues with labels or features. The information is presented in a confusing manner. Overall, the timeline may not further the student's research.
Data	The timeline drew on careful research to create a detailed timeline. The information is accurate. **For bonus points but not required:** Two charts from Statista (or another data source) are used as backgrounds for slides within the timeline. **The sources for the information are clearly cited.**	Generally demonstrates a good understanding of relevant information, and conveys events accurately and effectively. There may have been one or two gaps or issues with the data. The sources for information are poorly referenced. There were no charts from Statista for bonus points	The data chosen was problematic, inaccurate or irrelevant. There was insufficient information to make a visually appealing timeline. There may be no citations for where the data for this assignment was found.

Examples of student projects (https://jitp.commons.gc.cuny.edu/files/2022/01/Examples-of-Student-Data-Visualization-Projects.pdf)

Examples of Student Projects

All examples are used with the written permission of the students. This student work includes both their reflections, and the link to the data visualization. We wish to thank Anna-Liza Victory, Roger Navarro, Laura Arens, and Brandon Waterman for allowing us to publish their work.

Anna-Liza Victory

Data Visualization Reflection

Anna-Liza Victory final data visualization project

This Data Visualization Project consists of two graphics. First, it features a map showcasing the top countries for the number of kilograms of opium seized in 2016. Second, it provides a supplemental line chart plotting Tajikistan's annual seizures of kilograms of opium in the period between 1996 and 2007. In conjunction, these two charts convey significant information about trends in opium seizures in Tajikistan.

In comparing the two data sets, it becomes apparent that the most recent 2016 seizure statistic is abnormal. In the first data set, the map, we see that Tajikistan ranked 9th in terms of overall global opium seizures in 2016. However, its total for that year (612 kilograms) is exceptionally low compared to the number of kilograms it seized each year between 1996 and 2007, shown in the second data set. Compared to an average of 2,426 kilograms seized per year in that time period, 612 kilograms in 2016 is a miniscule amount. How can we account for this

Student quotes about the project (https://jitp.commons.gc.cuny.edu/files/2022/01/Student-quotes-on-a-Data-Visualization-assignment.pdf)

Student quotes on the Data Visualization Assignment

Section 1

Qualitative Evidence that students gained a Technical Skill Set
Quotes From Student Self-Reflections (shared with the permission of students)

The advice I would give to someone who is doing this assignment in the future is not to get too overly ambitious with the data you want to map. Make it simple. Too much data can overwhelm you which can lead to mistakes. Otherwise, understand that this assignment will not only help you with this course but you will achieve some life long skills.

After completing the assignment I feel I have gained a new set of skills that are useful within and outside an academic setting.

Up to this point I have been focusing on scholarly and news articles, but now I can see the importance of data sets to help support a thesis or research question. Being able to read a data set and connect it to a research question is a very valuable skill for research in any topic. I can now understand data sets more easily and comprehensibly.

The most technical part of the project for me was finding a good way to represent my data, since I had to alter the graph form from the example, and putting labels on the data once I had made the graph to my liking.

I found the knightlab timeline tool to be a little frustrating at first. Then I figured out that I need to erase the "era" figure, which necessitated that I have an end date to work. So knowing this, it's actually an easy tool to use.

Section 2
Qualitative Evidence of Active Learning to Support Research
Quotes From the Student Self-Reflections (shared with student permission)

There are a number of reasons I chose to research more about the immigration of Vietnam. First of all, I want to learn more about the pattern of migration of overseas Vietnamese after the Vietnam War. When I was younger, I didn't really understand why my uncles left Vietnam to come to the United States and Japan. I was never taught in school about the existence of South Vietnam (its history and government) and only educated on how the unification of the country was a good thing. I also didn't know about the large presence of Vietnamese people in the US (with the major influx coming after the Vietnam War to escape the communist regime) until I came here. By choosing this subject for my final slideshow, I hope not to just discover more about the real history during the Vietnam War era, but also to acquire a better knowledge of my community (Vietnamese American).

I think having done this assignment prior to writing a majority of my paper has actually given me more clarity in terms of the direction I want my paper to go in.

About the Authors

Kari Goin Kono is a usability designer with ten years of experience in online learning and designing digital environments within higher education. She has an extensive research agenda geared towards supporting faculty with inclusive teaching practices within online learning including student voice and co-construction as a practice in equitable curriculum design.

Shawn Smallman is a Professor of International and Global Studies at Portland State University. He has published extensively on Global Health and International Studies. He currently teaches entirely online, and uses both universal design and the negotiated syllabus in his courses.

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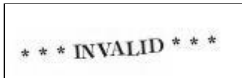Your email address will not be published.

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