Homework 5: User Study

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Data Description

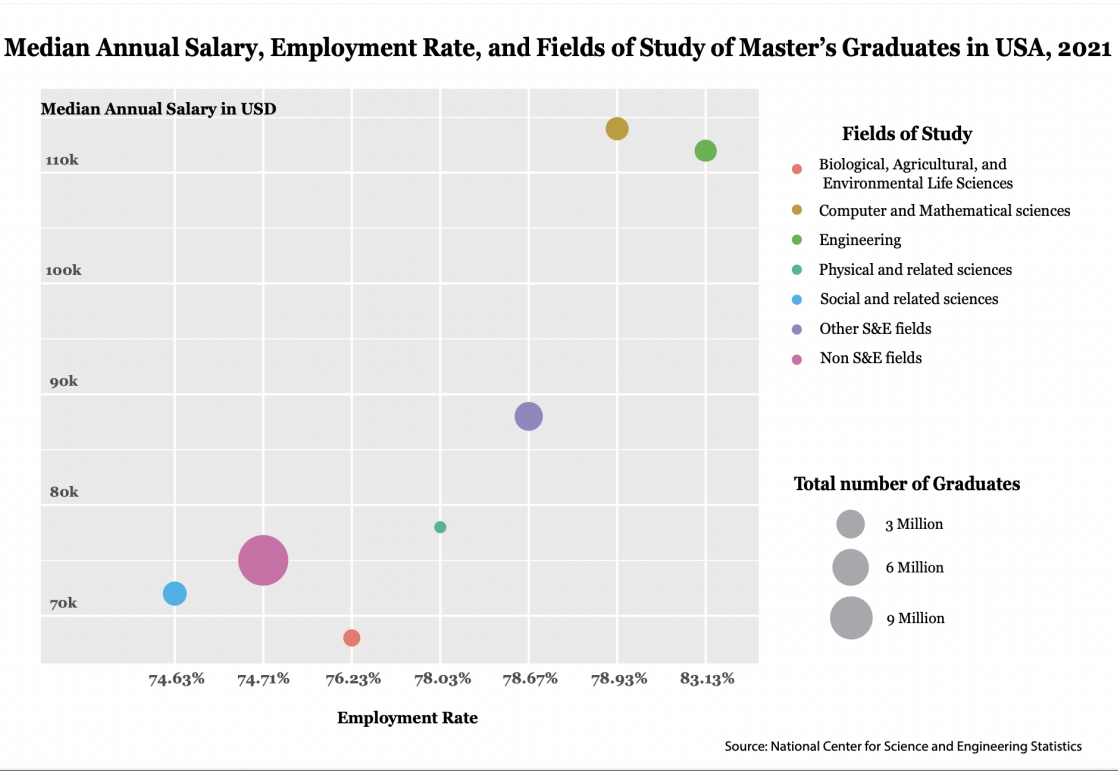
The dataset is about US college students' employment, education, and demographic details in 2021. It is collected by the National Science Foundation (NSF), an independent agency of the United States government that supports research and education, and they collect data every two years in the form of a survey. This data is a unique and credible source of determining the relationship between occupation, and salary with other characteristics of college students like degree field, highest degree, nationality, disability, familial background, work activities & other demographic features. (URL: https://ncses.nsf.gov/pubs/nsf23306)

The data was sourced from 2 data tables within the 2021 National Survey of College Graduates: "Fields of study of college graduates" & "Median salaries of full-time employed college graduates", focusing more on graduates coming from Science and Engineering related majors. The data were combined and used to produce visualization in R and Adobe Illustrator.

Audience

Undergrad students who are planning to pursue master's degrees. This group of audience members has plans to further their education in their current majors or plans to switch tracks to a different STEM-related field of study in graduate school. They have the ability to read graphs and pull information from visualizations. They have expectations of the outcomes of earning master's degrees, but not all of them are determined yet.

Visualization



User Testing

Participant Descriptions

Participant #	Age	Gender	Level	Major	Similarities to Audience	Differences to Audience
Participant 1	22	F	Undergrad Senior	Linguistic, Speech & Hearing Science	She is currently applying to further her education in Speech & Hearing Science.	She has already started her process of applying for graduate schools.
Participant 2	22	M	Undergrad Junior	Communications	Undergraduate	Wasn't certain about grad school
Participant 3	21	F	Undergrad Junior	Communications & Marketing	Undergraduate junior who is certain of pursuing a master's degree.	She has already narrowed down several of the master's programs and is looking for information particular to them.

Figure (A):
Participant # : Number identifying the participant. (Name not used to protect the identity of participants).
Age: Age of participant.
Gender: Self-described gender of participant
Level: Undergraduate year
As indicated by the above table, our testers were undergraduate students and had some similarities in major and level of study. However, they differed in their intention and stage in the process of considering graduate school.

Test Description

Users were asked to review the visualization, think aloud to provide comments on what they observed, and complete a few questions/tasks to see if they comprehended the visualization. The questions listed in *Figure (B)*, were asked to users. A few questions were asked before they were shown the visualization and several after. The criteria to determine if a user successfully completed a task/question was indicated in the table too.

During the review of the visualization, evaluators took notes on the responses users provided and general observations as well. Three (3) user tests were conducted on three (3) respondents by three (3) different evaluators. At the completion of the testing results were reviewed to determine if users were able to identify insights and how accurately they completed the tasks. Insights were evaluated through participants' responses on the purpose of the visualization and their ability to use the visualization to help them make a decision about graduate school or confirm/change their minds.

The evaluation questions were designed to include tasks to provide a more objective way of measuring user comprehension. Open-ended questions were included to elicit insights and intentionally ordered first to mitigate the effects of the tasks influencing insights. As research indicates that tasks can "... force users into a line of thought that they might not otherwise take" and even introduce bias (North 7). The questions were ordered with open-ended questions

presented first followed by a series of tasks. This ordering allowed the users to make their own insights before potentially being influenced or distracted by the tasks.

Some design flaws were identified in our testing method and in future user tests open-ended questions would continue to be used and insights elicited first, but higher complexity tasks and their inclusion would be considered further. A shorter (duration of) user test would also be implemented.

User Tasks

Tasks were assigned to elicit insights and demonstrate ability to use and comprehend the chart. On numerical questions we didn't expect the exact value, but a number we accessed as close to the expected value.

Figure (B)

Question/Task	Success Criteria/Reason measured
BEFORE SHOWING: Will a visualization influence your decision to go to grad school/switch major?	Background information.
BEFORE SHOWING: What are the factors that influence your selection of master's subject?	Gauge if the factors they mentioned are covered in the visualization. Factors that are aligned might be influential.
What do you think this visualization is about? (What do you see in this visualization?)	A chart of Median Salaries, Employment Rates, and the number of graduates for Various Master's Level programs in the US for 2021. (Determines if the title is clear and has a high level of understanding).
Can you tell me about the Turquoise Bubble?	See if the participants understand/can tell you the salary, employment rate, and the total number of graduates for the Turquoise bubble. ANSWER: Turquoise Physical and related sciences. Salary =$78,000;Rate=78.03%; Tot Num=223,000 Million . (Determines if they can distinguish colors, and understand how to read the chart. Also determines the level of detail they observe).

Can you easily find your current major in this visualization?	Users are able to determine what category their major is and where it lies on the chart. (Demonstrates they understand categories).
What program has the highest Median salary?	ANSWER: Computer and Math Sciences (Dark yellow bubble).
What is the salary?	(from the previous question) ANSWER: $114,000. (Demonstrates the user knows how to read the chart and if labels/ticks are clear).
What do you think the Employment Rate tells you?	% of Graduates in a particular field that is currently working. (Determines if users understand the terminology)
How many Graduates studied in Non-S&E fields?	ANSWER: Non-S&E fields Total number 11,950,000 (Helps determine if the size is understandable.
AFTER SHOWING: did this visualization influence your decision to go to grad school/switch majors?	If they decided to switch majors based on the visualization. Even if it did not influence their decision, they were able to read the chart and make insights that were judged as effective.

Assessment of Visualization

Insights and Error were used to measure the effectiveness of our user's ability to understand the visualization. The visualization was assessed using survey observations and user responses. Results of the insights provided by users and their ability to complete a set of tasks with limited error were the tested methods. The user's ability to complete the tasks provided a way to determine if they understood all the dimensions of the chart. Insights were evaluated if participants were able to draw conclusions on the open-ended, non-task-based questions.

To also determine if the visualization was effective participants were asked if it helped them, or if they changed their minds about attending graduate school. While out-of-scope for this assignment, rather than just asking users if it helped them make a decision about graduate school, following up with them to see if they pursued graduate school might be a better indicator. Sometimes user thoughts and behaviors are not always aligned - they might tell evaluators it helped or that they plan to go to graduate school, but might not actually go, or study in a similar/different area of study.

Test Results

Task	Participant #1	Participant #2	Participant #3

BEFORE SHOWING: Will a visualization influence your decision to go to grad school/switch majors?	Pieces of textual information will influence more than visualization	Possibly	I am not sure how much it will influence my decision
BEFORE SHOWING: What are the factors that influence your selections of master's subject?	Personal interest, employment rate	Go on to higher education. No time. Money.	I am interested in employment prospects and research opportunities but not in salary
What do you think this visualization is about? (What do you see in this visualization?)	Employment rate and median salary of people coming from different majors	# of graduates, mean salary and employment correlations	Employment rate, & median salary of graduate students from different majors
Can you tell me about the Turquoise Bubble?	People who study this major have lower employment rate and lower salary compared to other ones	Physical studies, under 3 million 78% and 80K salary.	Both median salary and employment rat is in mid range for this group
Can you easily find your current major in this visualization?	Yes, social & related science	Yes, Social and related, 70K salary 74.63% employment rate.	Yes, non S&E fields
What program has the highest Median salary?	Computer science	Computer and math	Computer and mathematical science
What is the salary?	114000	Initially answered 110k then revised it and said just about 115K	Just about 115K
What do you think the Employment Rate tells you ?	CS and engineering majors will have higher chances to get employed	How the percentage of graduated in fields have jobs	How the changes of getting a job is highest for CS and other engineering fields
How many Graduates studied in Non S&E fields?	10 million	9 million	9 million
AFTER SHOWING: did this visualization influence your	No. because i'm really clear about what i want to do for now and i'm okay with the	Helpful, but not convincing	The visualization is good. its providing important information but I am confused

decision to go to grad school/switch major?	employment rate and salary of my major. But the visualization is good for those who are still looking for future opportunities.		among streams of a specific domain. And no such information is provided.
General Observations not otherwise indicated	Participant felt that the questions about finding the major with highest median salary are a bit unnecessary. She points out that since she is already determined about what she wants to study in the future, this visualization will be considered more valuable to her parents (who care a lot about her future career).	Seemed had slight difficulty finding the turquoise bubble. Time was not measured, but it took longer for him to find the bubble then answer other questions. He also repeated the color out loud when trying to find it. He seemed to understand the dimensions of the chart and was able to identify approximate values without prompting. On the Non-S&E question, it seemed like the survey might be too long based on a change in facial expression but he completed the survey.	The interviewee could not grasp what the size of the bubble represented. She took some time to understand the purpose of providing batch size information and felt that could have been better presented. She thought the most essential measure, employment rate, was easy to read, but other information took more user attention.

Test Outcomes

POSITIVES

+ The participants were able to tell what the visualization is about based on the titles, labels, legends, and axis.
+ The visualization is clean and straightforward with no overlapped texts or circles.
+ The participants can quickly identify the bubbles' positions and point out the employment rate and median salary of the major.
+ Users understood the employment rate. So no further explanation is needed on the chart.
+ Participants were able to find the associated levels of employment rates.
+ Users were able to make connections on their own majors and salaries.

NEGATIVES

- The color indicating physical and related science (Turquoise) is slightly harder to identify due to the size of the circle in visualization and the little contrast to the green color.
- Users were able to tell rough differences between fields of study but were not able to tell us the exact numbers.

- Our sample was small, but the visualization didn't convince or change anyone of their graduate school decision.
    - Participants were determined about what they wanted to study further and they do not think the employment rate/salary would influence their decision.
- The survey might be too long (in duration) based on the observations of 2 participants.
- One participant points out that this visualization would be more helpful for those who are determined to go to graduate school but are not sure about what to study yet.
- One participant suggested that we can include some examples of physical and social-related sciences and other S&E majors.

Revision Plan

The chart provides an approximate comparison between majors. Users were able to approximate the salary as indicated on the y-axis but had difficulty judging the total number of graduates as indicated by the size of the bubble. Since the size is a visual encoding element that humans do not usually work the best with, altering the visualization to remove the number of graduates, using a different chart type utilizing length (like a bar chart), or maybe even pulling out the numbers and including them as statistics above the chart could be revisions. This change in chart type might better utilize one's innate ability to judge length vs size.

Since there are a lot of science and engineering-related majors and some areas of study, sometimes it is hard to identify which category a certain major will fall into. In the legend section for fields of study, we can add some descriptions and examples of physical and social-related sciences and also other S&E studies.

Another consideration is color. Our legend has multiple colors and it was difficult for users to discern the difference between the green and the turquoise bubble. It also requires additional cognitive effort to look back and forth between the chart and the legend. The chart could be revised by eliminating the categorical use of color and instead including the categories as text under each bubble.

Works Cited

North, C. “Toward Measuring Visualization Insight.” IEEE Computer Graphics and Applications, vol. 26, no. 3, 2006, pp. 6–9, https://doi.org/10.1109/MCG.2006.70.