

Recap

I am studying the effect of Concept Maps on Computer Science education. For more info on Concept Maps, see my [Project Proposal](#).

I am doing two experiments, one for a class of middle schoolers who are in an after school program to learn the basics of programming. At the end of 5 of their lessons, I will provide them with lesson review either in the form of a Concept Map or a non-hierarchical bulleted list and a post-test. I will compare the post-test scores to test the following hypothesis.

Null Hypothesis: Providing students with a Concept Map review for introductory computer science lessons will have no difference over non-hierarchical, non-graphical review materials on students' (a) test scores, (b) personal assessment of lesson understanding, or (c) enjoyment of lesson.

Since my sample size with the middle school students is very small, I've also decided to run an online experiment to get more participants. However, the challenge here is that I no longer am dealing with a group of participants with the same experience level and with enough time to learn computing concepts. Therefore, I selected a task for this experiment that anyone could do: finding a solution for an instance of the Traveling Salesman Problem. I will have the participants do two rounds of the TSP, and in between I will provide them with some tips and strategies for thinking about the problem. The control group will receive a bulleted list and the experimental group will receive a Concept Map. I will compare each group's improvement to see which format of the strategies was more effective. Here is my hypothesis for this experiment.

Null Hypothesis: Providing participants with a Concept Map overview of Traveling Salesman Problem (TSP) strategies will have no difference over a non-hierarchical, non-graphical overview on participants' ability to approximate an optimal solution to an instance of the TSP manually.

Experiment Design

My experiment design will be such that the independent variable will be whether a participant was shown a concept map or a bulleted list for their review section. The dependent variable will be the amount which they improved from Round 1 to Round 2. I will capture this independent variable with the following formula:

$$\frac{TSP_tour_length_1 \div TSP_optimal_tour_length_1}{TSP_tour_length_2 \div TSP_optimal_tour_length_2}$$

Conceptually, this formula will be 1 if a participant reached the optimal solution in both rounds. If a participant's solution in Round 1 is twice the optimal solution, and they reach an optimal solution in Round 2, their score will be 2. If they get worse in Round 2, their score will be less than 1.

To analyze these results and determine whether the null hypothesis is disproved, I will use a z-test to compare the difference in scores from my control group and experimental group. I'm opting for a z-test over a t-test because I already have 36 responses to my experiment, and I expect that number to keep growing, and as the sample size grows over 30, the z-test and t-test become very close.

Progress

For the middle school experiment, I have received 3 out of 5 weeks' worth of responses. There is no class this week, but in the two following weeks I will collect the remaining data. Then, I will analyze the data to see if there is any statistically significant evidence to negate my first null hypothesis.

For the online experiment, I was originally planning to use a online interactive version of the TSP. However, it made my experiment difficult for participants because they had to navigate that tool, entering a game code, and it was too much friction for some early testers I had. Also, one tester wasn't able to get the tool working at all, getting a German error message, which is not good.

Therefore, I decided to write my own simple TSP interactive website. It doesn't have as many features as the original tool, but it's streamlined and has enough functionality to get data from my participants. There is a 10 point problem and a 30 point problem:

10 Point TSP: <http://www.datajourneyman.com/edtech-experiment/tsp>

30 Point TSP: <http://www.datajourneyman.com/edtech-experiment/tsp?idx=1>

I have two surveys on Survey Monkey. The only difference between them is which material is shown in between the two rounds of TSP.

Bulleted List: https://raw.githubusercontent.com/donovanfm/omscs6460-edtech/master/TSP_Bulleted_List.png

Concept Map: https://raw.githubusercontent.com/donovanfm/omscs6460-edtech/master/TSP_Concept_Map.png

Here are the two survey links (again, they will look identical, except that the link in Step 6 “Strategy Review” will point to a different resource for the control and experimental group).

Control Survey: <https://www.surveymonkey.com/r/N55XW7N>

Experimental Survey: <https://www.surveymonkey.com/r/D3M8KGL>

Finally, I have created a landing page that will direct participants to one survey or the other with a 50% probability: datajourneyman.com/edtech-experiment/.

Future Plans

There are three main things that need to be done in order to do my final paper:

1. Finish collecting the middle school data.
2. Publish my online experiment and get the word out about it.
3. Analyze all of my data and test my hypotheses.

Step 1 will happen over the next two weeks. The work to accomplish this is known, since I’ve already gotten through 3 weeks of this.

Step 2 is trickier because I want to get as many participants as possible. I plan on advertising my experiment on Twitter and Facebook to get it in front of as many people as possible. The remaining challenge is to get people to complete the experiment. For that, I plan on offering a drawing for a \$25 Amazon gift card for anyone who completes the survey and provides their email address.

Step 3 will take time, but since my research methods are already well defined, the work here is also known, and I don't expect any difficulty in completing these analyses.

Conclusion

I am excited to continue my research on Concept Maps, and I don't think anything is blocking me from completing my experiments at this point. I think that my research design is sound, and if I cannot disprove my null hypotheses, I think the most likely culprit will be lack of data. Of course, my full analysis will have more detail on any possible errors in my research design I discover in hindsight.