

# Concept Mapping Project

“If it disagrees with experiment, it's wrong.  
In that simple statement is the key to science.”  
– Richard Feynman<sup>1</sup>

## Introduction

In my last assignment, I defined a concept map as "a graph representation of a subject's underlying ideas, where nodes are concepts at different hierarchical levels and edges are relationships between concepts."<sup>2</sup> In this assignment, I will go through the current research on the effectiveness of concept mapping in various subjects. Using that research foundation as justification, I will explain my project goals and my preliminary experimental design for my final research project on the effectiveness of concept mapping in computer science education.

## Current Research

The effectiveness of concept mapping has been explored in many research studies already. Novak and Cañas explored the impacts of concept mapping on learning in general, and they concluded that concept mapping is "powerful for the facilitation of meaningful learning."<sup>3</sup> A subsequent meta-analysis of 19 studies on concept mapping by Horton, et al., found that concept mapping "had generally medium positive effects on students' achievement, and large positive effects on student's attitudes."<sup>4</sup>

Furthermore, many studies examining specific subjects have found the use of concept mapping to be beneficial, as well. Salleh and Ismail found that concept mapping "is one of the promising methods that can be effectively used to teach history in secondary students"<sup>5</sup>; Aein and Aliakbari found concept mapping to be effective in boosting the critical thinking of nursing students<sup>6</sup>; Alsomaidan found that English as a Second Language learners comprehended an English conversation better when accompanied with a concept map<sup>7</sup>; and Martínez, et al., found concept maps to improve engineering students' physics test scores by 21.77%<sup>8</sup>.

## My Project Goals

Despite the copious amounts of research I easily found on all of the above subjects, I did not find any studies examining concept mapping on the field of computer science. In 2008, Keppens and Hay offer some suggestions on applying concept mapping to programming education, but admits that the quantitative data for computer science specifically is missing.<sup>9</sup> Still in 2017, Wei and Yue make the following observation on concept maps (which they refer to as “CMs”): “Although widely researched and utilized in many other disciplines, the uses of CMs in Computer Science (CS) education have been relatively scarce.”<sup>10</sup>

My OMSCS 6460 project will aim to fill in this blind spot of research on the effectiveness of concept mapping in computer science education. I believe this is a worthwhile endeavor because most of the education domains in which concept mapping has been applied are far less abstract than computer science, so making assumptions about concept mapping in computer science from research in these more concrete domains could be problematic.

## Experimental Design

I plan on conducting two separate experiments for this project. The first experiment will be administered in person over the course of the semester to a group of 8th graders who have applied to an after-school Introduction to Programming course. The second experiment will be an online test.

For the in person experiment, I plan to test 3 separate lessons (each on a different week). The first test will be a short post-test following a lesson to gauge how much the students learned and how they feel about their understanding of the material. The second test will ask them to create a concept map of the lesson’s ideas, and then complete a similar post-test. For the third test, I will provide them with my own concept map, and then ask them to complete the post-test. The post-test results will allow me to compare the effectiveness of each concept map strategy against not having one.

For the online experiment, I plan to first ask the participants if they know much about the programming topic in the test. If they do, then I will not include their scores in my analysis. Then, I will present them with a short lesson. After the lesson, the control group will write a short summary of the lesson, and the experimental group will draw a concept map. Both groups will have this reflection middle section, which will allow me to compare the concept map effectiveness more directly. All participants will then be given a post-test or a short programming challenge to gauge their mastery of the skill.

## References

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