Thesis Portfolio

Assessing Student Learning of Systems Thinking Concepts in an Online Education Module

(Technical Report)

An Analysis of the Relationship Between Common Core State Standards and Student Success

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree
Bachelor of Science, School of Engineering

Kayla Wallet
Spring, 2020

Department of Systems and Information Engineering

Table of Contents

Sociotechnical Synthesis

Just ten years ago, American students were taught using many of the same methods and tools as were used decades prior. Modern technological advances, however, have drawn students and educators out of their individual classrooms and into less personalized forms of education. Both my technical project and STS project aim to explore how technological and structural innovations in education currently function within the education system and to determine what improvements or changes can be made to optimize positive outcomes. The technical project explores the effectiveness of online modules in teaching college students about the use of "systems thinking" in everyday life. The STS project assesses how social perceptions of the Common Core State Standards (CCSS) introduce barriers to success within elementary education. While the projects explore different innovations within two types of education systems, both pieces of work contribute to a larger understanding of the way innovation is accepted and incorporated in modern education.

Institutions of higher education are vast interconnected networks of departments, programs, majors, and courses, whose complexity is further increased by the rapid growth and availability of technology-based learning in recent years. In today's data-driven world, it is critical for college students, whether studying engineering or not, to understand the basic concepts of "systems thinking" and how systems thinking strategies can be applied to nearly any problem they will encounter in their careers. While making this information available to students online is an easy way to disseminate the content within the complex network of higher education, the decision to do so may be at the expense of students' understanding of the material. Therefore, my technical project aims to assess the effectiveness of an online module in introducing the concept of systems thinking to both engineers and non-engineers. To conduct the study, a gap

analysis was first performed among existing online education platforms to select Thinkific as the most effective massive open online course (MOOC), a platform that has open access and allows for interactive participation through the Internet, through which to disseminate our module content. A short online module was developed and iterated upon in Thinkific using human design principles and user testing. Upon completion of the module design, groups of students in the College of Arts and Sciences (CLAS) and in the School of Engineering and Applied Science (SEAS) at the University of Virginia were asked to complete a pre-test, the online module, and a post-test. The qualitative and quantitative data provided by the pre- and post-tests was analyzed to determine the effectiveness of the module and how understanding varies by intended major. The results of this study hope to inform educators about the degree of emphasis that should be placed on continued development and scalability of online learning programs. More broadly, this study contributes to the growing body of literature which seeks to understand the impact of technology on the spread of information not only within the field of higher education, but within other large systems such as construction and healthcare as well.

My STS research paper aims to determine how the perspectives of key social groups in elementary education affect the success of global education initiatives. One such initiative, known as the Common Core Standards, has most recently been introduced to provide learning goals that all students in a certain grade should meet. However, evidence suggests that a discrepancy exists between the goals of the Standards and the actual progress that students have made under this set of initiatives (Hamlin & Peterson, 2018). A comprehensive literature review on papers published in the past decade defines four relevant social groups involved in elementary education: teachers, the general public, parents, and policymakers. Analysis of empirical studies about the sentiments of these groups using Wicked Problem framing and the co-production

framework provides novel insights about the degree and type of impact different perceptions of the Common Core Standards have on the overarching success of the initiative. In the field of STS, the results of this research contribute an analysis of a widespread, large-scale system to the existing body of literature about co-production. In the field of education, this work encourages policymakers and educators to disseminate complete and correct information about the Standards in order to transform sentiment about the initiative, thus providing a smooth transition to new curricula for teachers and easy acceptance of new material by students.

My technical project assesses the effectiveness of online learning in higher education, while my STS project analyzes how social perceptions affect the effectiveness of standardized learning initiatives in elementary education. By conducting these two projects simultaneously, I have gained insights about each topic that I would not have realized otherwise. My technical project provided me with the opportunity to produce and implement learning modules within an education system, just as elementary school teachers do every day. This experience, though in higher education rather than elementary education, highlighted the many challenges and barriers instructors face when attempting to introduce new ways of learning into an existing system. This firsthand account helped me better relate to and understand many of the empirical sources used in my STS project, allowing for a more robust analysis of the effect social perceptions has on the adoption of the CCSS. My STS project helped me examines the impact that professors, students, and UVA at large might have on the development and delivery of my technical project's online module. More comprehensively, it has helped me to become a more conscientious engineer who is aware of the social influences that must be considered when introducing new technology into a system. Thus, conducting these research projects in tandem has facilitated a greater understanding than either project could have independently.

Works Cited

Hamlin, D., & Peterson, P. E. (2018). Have States Maintained High Expectations for Student

Performance? An analysis of 2017 state proficiency standards. *Education Next*, *18*(4),

42–49.