Research Statement

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My research concerns the affordances of technologies in the teaching and learning of STEM. To this end, I conduct research that spans the areas of pre-service and in-service training of technology and STEM, and specifically how to be successful in bringing these discrete subjects together to extend and enhance students understanding.

In the past, I have taken the role of principal investigator in a two-year study to investigate a whole school one-to-one iPod Touch implementation. This exploratory study used Rogers [1] Theory of Diffusion of Innovation as a lens for providing in-depth qualitative data of how teachers and students are integrating these tools into their daily instructional practices and routines. The findings from this research [2, 3] were among the first published manuscripts to focus on whole school implementation of mobile technologies. Some of my quantitative studies include cyberlearning research [4, 5, 6, 7] for the National Science Foundation using text mining and topic analysis to understand how access to cyberlearning projects can improve scientific research and shape federal research policies in this field. I have also been fortunate to work with a research team to determine how students’ task definitions and plans affect their self-regulated learning while studying within a hypermedia learning environment [8]. This study met a critical need in the literature to examine phases in students’ self-regulatory processing and how those interactions influence academic performance.

I have balanced my research with a careful review of the literature. My published theoretical articles have included various aspects of technology and mathematics. I have argued for the use of technology in the teaching and learning of mathematics [9]. This paper highlights the affordances technology offers mathematics education and looks at some of the reasons behind the slow uptake, such as teacher beliefs and lack of appropriate training. Solutions are offered, such as the Technological, Pedagogical, Content Knowledge (TPACK) framework for teacher training. This was followed with further articles on TPACK [10] and Interactive Teaching Programs to support demonstration, modeling, and exploration of mathematics [11].

I have reviewed Web 2.0 tools and the way they have changed the way students learn [12]. This paper used Darwikinism and folksonomy as the underpinnings of this claim. Darwikinism is a portmanteau of Darwinism and Wikis, describing a similar system to Darwin’s theory of evolution in processing and ordering Wiki content. Folksonomy, again a portmanteau of folk and taxonomy that refers to the users of web 2.0 as the folk, has created a system for classifying content on the web. In addition, I have written about the history [13, 14] and theories of mobile learning [15], as well as how mobile learning theories can be put into practice [16, 17].

Dissertation Work: Context-Aware Ubiquitous Learning in Geometry

There are many unique challenges to understanding the concept of an angle and to visualize spatial relations, which include the development of misconceptions due to prototype diagrams that lead students to believe that orientation and length of the rays are salient angle attributes. Nomenclature can also cause misinterpretation as students can consider a right angle as an angle pointing towards the right. My dissertation addresses Clements’ call for angle
concepts to be taught in the elementary years so that young children are supported in making sense of these difficult mathematics concepts. The study used design-based research to employ methods to develop a local instruction theory and instructional materials. The framework utilized in this study provides the basis for two research questions:

1. How do students come to understand angle and angle measure through the use of real-world connections and technology enabled learning tasks?
2. What are effective means of support to facilitate students’ understanding of angle and angle measure?

A review of the literature uncovered two significant recurring trends, which are the use of real-world connections and the use of technology as supportive pedagogical components to promote students’ understanding of angle concepts. Context-aware ubiquitous learning is a sub category of mobile learning, which provides a means by which mobile devices can be used to study real-world phenomena while using the technologies to provide computer support. This study uses context-aware ubiquitous learning as students use a Dynamic Geometry Environment, a Sketchpad Explorer, on an iPad to photograph and use the tools within the program to explore angle.

In the study the local instruction theory was subject to a cyclical iterative process of anticipation, enactment, evaluation, and revision. Following the literature review, the lessons were constructed, taught, reviewed, and revised and the cycle continued as not only the lessons were studied, but also the way students learned the mathematical concepts.

The Beginning Years: Three Strands of Inquiry

My scholarly discourse will follow three strands over the next few years:

1. From my dissertation research I am extending this focus to other STEM concepts using context-aware ubiquitous learning, especially looking at supporting students visualize spatial relations.
2. I am looking at how mobile learning can support students seamlessly across formal and informal contexts.
3. I am studying the flipped classroom methodology with pre-service and in-service teachers to better understand how to meet their professional development needs.

In these early years I have followed this research path and published extensively on technology and STEM. These publications involve the exploitation of contemporary technologies in formal and informal settings to support students in the understanding difficult concepts. See my curriculum vita for an up-to-date list of those publications.

Future Research

As I look further into the future, I expect to continue to build on the literature on effective ways to use technology and to incorporate technology into STEM. I will dig deeper into pre-service and in-service teacher training to strengthen teacher education in STEM and technology.
References


