Chapter 40

Scaffolding Subject Matter Content With Pedagogy and Technologies in Problem–Based Learning With the Online TPACK Learning Trajectory

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ABSTRACT

This research-based application of an online inservice teacher education course highlights how scaffolding subject matter content, pedagogy, and technologies in a problem-based learning approach reframes teachers' TPACK for integrating digital image and video technologies with 21st century inquiry thinking skills: critical thinking, creative thinking, communicating and collaborating. The course design takes advantage of knowledge-building communities through the application of the online TPACK learning trajectory. The participants' products, interactions, and reflections demonstrate how the scaffolding engages them in high levels of thinking and learning in mathematics and science with digital image and video technologies. The result is an explanatory framework for how the scaffolding of the subject matter content, pedagogy, and technologies in problem-based learning with the online TPACK learning trajectory guides teachers in rethinking, relearning and reframing their TPACK knowledge for engaging students 21st century inquiry thinking with digital image and video technologies.

Teaching in the Internet age means we must teach tomorrow's skills today.

~Jennifer Fleming, 2015

INTRODUCTION

After more than 10 years into a new century, the 21st century education continues to look much like the 20th century education despite multiple calls for significant improvements in not only what students learn but also how they learn it. The Partnership for 21st Century Learning (2015) and the Thoughtful Learning Organization (2016) both call for attention to the 4C's as learning and innovation skills for successful citizenship in a global society, specifically identifying critical thinking, creative thinking, communicating and collaborating. They propose that these skills prepare students to engage in today's more complex social, cultural, educational environments saturated with dependence on multiple technological resources of the 21st century. And, as a result, according to Jennifer Fleming, (https://kzoinnovations.com/10-awesome-elearning-quotes) teachers must teach tomorrow's skills such as the 4C's today!

The new century is a time of significant technological and social change with the emergence of and easy access to multiple digital technologies (hereafter referred to as technologies) such as digital cameras and inexpensive, easy-to-use digital video cameras. Students have been quick to innovate with these technologies. They communicate with cell phones, take pictures to send to friends through various social media. They gather live action videos, sharing the results through social media sites like YouTube. They combine still images with their own narrations for developing digital stories that they share through email and social media sites. Thus, their teachers are challenged to integrate these widely accessible image and video technologies in ways that engage students in 21st century skills such as the 4C's as they are learning for tomorrow.

Consider an example created by Sharp, Thompson, and Garofalo (2005). What is the impact of the slope on the construction of rooftops? In response to this question, a collaborative group engages in a knowledge-building community to examine the idea of slope and how slope influences the design of rooftops in various geographic locations. The students collect rooftop images from multiple geographic locations, importing them into Geometer's Sketchpad where they analyze the multiple slopes and determine the steepness of each roof. Next, they collaborate in creating a slideshow of the rooftops and the slopes with their multiple geographic locations as they explain factors influencing the design of the rooftops (environment with lots of snowfall; building cost for large commercial rooftops). What is the influence of student engagement in this higher order thinking, such as critical thinking and creative thinking, through this type of experience?

Teachers are crucial players in the design and implementation of the educational experiences that incorporate appropriate instructional strategies and learning environments for facilitating students in learning and the application of skills such as the 4C's as they develop subject matter competence. In the process, teachers are engaged in redesigning the curriculum and pedagogies. Such revisions are ones with which teachers are unfamiliar, have not experienced in their own learning, or have received little, if any, instruction in their teacher preparation programs. In essence, these redesign challenges require them to think outside their traditional views of how the content is learned, communicated, and taught.

Technological Pedagogical Content Knowledge (TPACK) describes the reformed knowledge that teachers rely on in responding to challenges for integrating ideas such as the 4C's when incorporating new

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