Chapter 1

# Addressing Digital Competencies, Curriculum Development, and Instructional Design in Science Teacher Education

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## ABSTRACT

*The author reports on a mixed-methods study focusing on teacher candidates' (TCs') digital competencies as they integrated digital literacies in a science methods course. The emphasis is on course assignments which incorporated digital literacies on a variety of levels as TCs developed 1) digital case studies, 2) scientific timelines, 3) concept presentations, and 4) science resource websites focusing on multimedia interactive activities. Results indicate that the explicit integration of digital literacies created and engaged learning communities while improving technological and scientific literacies in a purposeful manner. Findings include enhanced technological literacy in terms of learning about technology, awareness of the process of knowledge construction, personalized learning pedagogy, and heightened self-efficacy. There was also evidence that TCs utilized digital literacies learned in the course during their practicum.*

## INTRODUCTION

New realities of the 21st century demand individuals with different competencies than those considered appropriate for success in the past. Consequently, education must change. Milton (2015) maintains that surface changes in education will not equip students for the 21st century and that change is needed at the core of educational practice. A shift must occur from the traditional view of educational practice to a transformative view. Moreover this shift must aim to incorporate technologies in schooling in a manner that digress from disciplinary experts' determinations of what and how students should learn – a classic

perspective which has resulted in challenges for educators as they continue to search for strategies to effectively address the development of skills reminiscent of the preferred learning styles of today's students.

With each passing year, technology becomes a more predominant part of educational culture (Bolstad & Gilbert, 2006; Cox, 2008). Simply introducing technological tools and infrastructure into schools will not trigger beneficial and meaningful educational change. Moreover, technology cannot be effective in the classroom without teachers who are knowledgeable about both the technology itself and its implementation to meet educational goals, that is, teachers who are technologically literate. Thus, it can be said that, while technology use in the classroom is increasing, improving learning through the application of these literacies should remain the goal. Changes are inevitable if technology is to make a difference in curriculum design and address the needs of 21st century learners. The impact of technology and the changing face of curriculum, as well as the accompanying changes in the roles of teachers can no longer be ignored; roles must be reconceived in order to engage learners in many decisions about their learning (Bennett, 2002; Bolstad, Gilbert, McDowall, Bull, Boyd, & Hipkins, 2012). Achieving changes associated with the integration of technology in the overall learning environment will require efficient teacher training in teacher education programs (Brush & Bannon, 1998). This begs the question: What kinds of modeling and scaffolding should educators or designers provide to help learners engage in this process?

Teacher professional development (PD) is absolutely essential if technology is to be used effectively; PD should entail initial preparation/training – pre-service, in-service, and ongoing pedagogical and technical support for teachers as they address their daily challenges and responsibilities. Training and on-going inquiry-based approaches imply that support should go beyond teaching skills in technology use and focus on the effective pedagogical use of the technology to support teaching and learning goals (DeCoito & Richardson, 2016).

In this article the author reports on a mixed-methods study with a focus on science teacher education. Specifically, the study addresses the development of secondary science teacher candidates' (TCs') digital competencies as they explored the integration of digital literacies in a science methods course, and its potential to enhance teaching and learning in science, including curriculum and instructional design. The author maintains that in order to develop the necessary skills and application practices of technology integration, and enhance technological literacy, TCs must be presented with appropriate experiences in teacher induction programs.

## BACKGROUND

### Teaching and Learning in the 21st Century

The preparation of young people for lifelong learning in a 21st century knowledge-based information society has become an increasingly important objective of educational systems worldwide (Dagienė, 2011). Multi-literate, creative and innovative individuals are seen as "drivers of the 21st century and the prerequisites to economic success, social progress and personal empowerment" (Canadians for 21st Century Learning and Innovation, 2012). A primary challenge for education is to transform student's learning processes to engage student interest in gaining 21st century skills and knowledge. Lemke (2004) reported a link between 21st century skills and academic achievement, making the case for incorporating teaching activities, including digital technologies that nurture these skills (see further elaborations,

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