Chapter 14
A Tool for Analyzing Science Standards and Curricula for 21st Century Science Education

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ABSTRACT

Twentieth century curricula are no longer sufficient to prepare students for life and work in today's diverse, fast-paced, technologically driven, and media saturated world of the 21st century. This chapter presents a new framework for analyzing science standards and curricula to determine the extent of alignment with 21st Century essential understandings and skills. The Tool for Analyzing Science Standards and Curricula (TASSC) was developed using the conceptual frameworks proposed by the Partnership for 21st Century Skills, the Organization for Economic Co-Operation and Development, and the typology of knowledge proposed by Jurgen Habermas. Development of TASSC relied on an iterative process of refinement, testing, and discussions resulting in an instrument with three sections and related rating scales: content, skills, and additional curricular components. TASSC was piloted using middle school science standards and curricula in the context of two US states (Ohio and New York) and two Arab countries (Lebanon and Qatar). The analysis procedure and individual case study results are presented and discussed in the chapter.

INTRODUCTION

For more than twenty years, reforms in science education have been calling for the preparation of scientifically literate students. However, standards and curricula promoting 20th Century conceptualizations of scientific literacy (see American Association for the Advancement of Science, 1993; Bybee, 1997; National Research Council, 1996) may not be sufficient to prepare students for the global economy of the 21st century. Today's students live in a world that is extremely fast-paced, constantly changing, increasingly culturally diverse, technologically driven, and media saturated (Wan & Gut, 2011). The kinds of skills students need to be prepared for of the 21st century are different from those needed 20 years ago (P21 Skills, 2009). To prepare for this *"second Renaissance period"* (Treadwell, 2011), we need to bring what we teach and how we teach into the 21st Century. Essential understandings and skills that are necessary for success in today's world must be included.

As Nations and States around the world revise existing curricula or develop new standards, a framework and instrument for analyzing science standards and curricula and determining the extent of alignment with 21st Century essential understandings and skills is necessary. BouJaoude (2010) created such a framework for the analysis of education programs (FAEP, see Appendix 1). In preparation for a National Association for the Research in Science Teaching symposium in 2011, the authors of this chapter decided to use FAEP to analyze and evaluate the standards and curricula of US states and several countries from around the world. After determining that FAEP was not adequate for analyzing science standards and curricula, the authors decided to develop a new framework. This chapter describes the development of this new framework entitled Tool for Analyzing Science Standards and Curricula (TASSC). The chapter begins with a discussion of the conceptual basis that supports the call for 21st Century essential understandings and skills. The chapter ends with a presentation of case studies using TASSC in multiple contexts.

CONCEPTUAL BASIS

The essential understandings and skills necessary for a college and career ready populace have been posited by several organizations. For example, the Partnership for 21st Century Skills (P21) proposed the Framework for 21st Century Learning. Similarly, the Organization for Economic Co-operation and Development (OECD[1]) proposed a set of competencies needed for a successful life and well-functioning 21st Century society. BouJaoude (2010) additionally used Habermas' types of knowledge (1971; as cited by Cranton, 2002) as he developed FAEP. These conceptual frameworks are described in this section.

Framework for 21st Century Learning

The partnership for 21st century skills (2009) developed a framework for 21st century learning delineating a set of learning outcomes that specify the knowledge, skills, expertise, and literacies needed for success in work and life. In addition to the core subjects of science, the framework identifies a set of 21st century interdisciplinary themes that, when integrated into core subjects, will result in much higher levels of learning. The themes consist of global awareness, financial, economic, business, and entrepreneurial literacy, civic literacy, health literacy, and environmental literacy.

The framework divides the necessary skills into three types, (a) learning and innovation, (b) information, media, and technology literacies, and (c) life and career skills. Learning and Innovation skills include the four C's: creativity and innovation, critical thinking and problem solving, communication, and collaboration. Life and career skills include flexibility and adaptability, initiative

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