Chapter 1
STEM in Early Childhood Education:
We Talk the Talk, But Do We Walk the Walk?

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ABSTRACT

The chapter reviews previously published articles and summarizes trends in STEM research in early childhood education over the last twelve years (2000-2012) by employing a content analytic procedure. The specific purposes of the study are to determine the general characteristics of the STEM research in early childhood education, to identify the research designs being applied in articles, and to reveal the common research topics/issues on STEM education in the field of early childhood education. A total of 41 articles are extracted from a wide range of publications. Thematic analysis reveals two main themes and nine subthemes on research topics/issues, including policy, management, equity issues, STEM schools, theories, models, professional development, teacher support, program development and evaluation, learner and teacher attributes, and pre-service teacher education.

INTRODUCTION

We all should have certain knowledge and skills about science and technology in today's Information Age society. Contrary to traditional schooling, this is an emphasis on what our students can do with knowledge rather than what units of knowledge and skills they have, that best reflects 21st century skills and requirements. It is believed that this core notion would ensure that children not only pursue science and technology for their careers but also become citizens literate in STEM areas (Yager, 2012). In order to capitalize the momentum, this action should step into education in these disciplines as early as preschool and kindergarten even though science is considered as the most neglected area in these periods (Moomaw & Davis, 2010).

DOI: 10.4018/978-1-4666-7363-2.ch001

Previous research in science, mathematics, and technology has found a new channel to replenish in recent years as STEM has emerged as an umbrella term. STEM is an acronym for fields of science, technology, engineering, and mathematics. It was coined by the National Science Foundation (NSF) in the early 2000s and until today numerous projects have been funded by the organization. Although STEM is applied to any policy, event, or curriculum dealing with Science, Technology, Engineering, and Mathematics, it has been mainly focused on Science and Mathematics, particularly in K-12 education. By integrating four disciplines in one cohesive paradigm, STEM education, naturally, calls for an integrative curriculum aimed at preparing students for being creative and innovative problem solvers, researchers, engineers, and designers. However, the United States National Academies in 2007 reported the declining status of STEM education and offered three recommendations to advance efforts towards preparing students for the challenges of the 21stcentury (National Academies, 2007):

- Increase the talent pool by improving K–12 science and mathematics education;
- Strengthen the skills of teachers through additional training in science, math and technology; and
- Enlarge the pipeline of students prepared to enter college and graduate with STEM degrees.

Other organizations like the National Aeronautics and Space Administration and the National Science Foundation have also called for action and have implemented programs and curricula to advance STEM education. Design of the early STEM experiences and environments is heavily dependent on the abilities of teachers. The teacher and the environment in early childhood institutions play key roles on successful applications of STEM learning. However, "we know almost nothing about the early teaching of mathematics and science, partly because they have seldom been taught to young children" (Ginsburg & Golbeck, 2004, p. 196). For instance, teachers' reluctance to teach science is considered to be associated with many variables like self-efficacy (Bandura, 1977), lack of knowledge (Wenner, 1993), attitude towards science, and misconceptions about science being difficult to teach (Seefeldt & Galper, 2002). Research has shown that the level of science knowledge is linked to increased positive attitudes towards science and in turn, positive attitudes are linked to more frequent and effective science teaching practices (Eshach, 2006; Faulkner-Schneider, 2005; Garbett, 2003). When teachers are not equipped with adequate science knowledge, they tend to stay away from science activities in early childhood classrooms (Cullen, 2000; Garbett, 2003; Hedges & Cullen, 2005).

This chapter will therefore contribute to the literature by addressing highly recognized but yet neglected topic of STEM education to young children. The current chapter attempts to review previously published articles and summarize trends in STEM research particularly in early childhood education over the last twelve years (2000-2012) by employing content analysis procedure. Research articles will serve as primary data sources for this study. It is believed that such a review would showcase the current status of STEM in 21st century early childhood education. It would also assist in directing future research, practices, and grant funding. In sum, this review would be a valid answer to a vital question: when it comes to STEM education, particularly STEM in early childhood education, we talk the talk, but do we really walk the walk?

BACKGROUND

The term STEM, which has been a popular part of the educational vocabulary since the beginning of the millennium, stands for science, technology, engineering, and mathematics as an acronym.