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Pedagogy and Design of Online Learning Environment in Computer Science Education for High Schools

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ABSTRACT

This paper reviews literature about evolving and classical theories to understand pedagogical assumptions that inform concept of instructional strategy framework in optimizing online computer science education for high schools. Exploring these areas of research is valuable for understanding instructional practices that are needed for computer science educators to implement K-12 online computer science education. The study reveals that for students to achieve varying needs in computer science education, an online learning environment or management systems should adopt multiple pedagogical approaches. The researcher assertion is that, creating learning environment or augmenting learning management systems with plugins based on these pedagogical assumptions should for instance feature automatic feedback on programming exercises, visualization of algorithms and representation of concepts in animations or physical activities which are extremely important to incorporate computing principles in online education for K-12 students.

KEYWORDS

Computer Science Education, Learning Management Systems, Learning Theories, Online Learning Environment, Pedagogy

INTRODUCTION

The online studies in this paper refer to web based instruction instead of face to face instruction in computer science education at high schools. Literature refers to this type of learning as virtual learning or e-learning (Mishra, 2002). There are overwhelming supports for didactics in online computer science education. Hubwieser (2012) proposes that high school students should patronize computer science courses in their curriculums but this is not the case in all countries around the world. Consequently, Riddle (2012) advocates supplementing high schools curriculums with online computer science courses. At least developing countries are yet to witness the resurgence of computer science education for high schools. Several educators believe that online learning would lead to better teaching and learning outcomes (Young, 2004). Bower (2007) provided positive recommendations for teaching computing online. According to McDonald et al. (2004) online courses offer computer science students the relevant skills for their future careers. Online computer science courses have become increasingly popular amongst students who have tight schedules or geographically located from physical campuses of offering institutions (Palloff & Pratt, 1999). Student taking online courses learn as much as those in the classroom (McCloud, 2004). Most importantly, an introduction of online computer science courses in high schools, strategically attract students for computing education in higher education (Woszczynski, 2006). There is also evidence that having done programming in high school enables students to cope with a computer science degree program (Morrison et al., 2001). The offer of online

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courses for computer science students is easier than for students in other disciplines with a reason that most computer science students are comfortable with computers and web sites (McDonald et al., 2004). However, lack of pedagogical principles for online instruction may translate to ineffective learning experience for learners (Dringus et al., 1999). Online learning environment is defined as pedagogically meaningful information space where learning takes place at any time and any place (Dringus et al., 1999). Pedagogy also connects sets of dialogue between theory and practice, as well as learning and teaching and draws consciously on these traditions (Beetham et al., 2013). Effective online learning environments draw from instructional principles that are appropriate to the needs of the target group of students (Kuzu et al., 2010). Designing bridges theory and practices, such that it encompasses set of contextualized matters that are constantly adapting to circumstances (Beetham, et al., 2013). The current study presents evidence from literature aimed at understanding theoretical perspectives for using learning management systems or designing online learning environment in computer science education. To achieve these general objectives, the paper is subdivided into the following specific objectives: (a) Identify of theoretical and pedagogical assumptions for online computer science education (b) Propose instructional strategy framework that guides implementation of online learning environment in computer science education.

RELATED WORK

There are several inspiring studies in literature from conception of idea, designing to implementation of computer science education for high schools in developed countries. Hubwieser et al. (2012) developed Darmstadt Model which was based on categorization of case studies from five European countries (Lithuania, Israel, Austria, Greece, Bavaria) who had already introduced computer science subjects in high schools or colleges. The Darmstadt Model consist of three research dimensions namely responsibility level, educational relevant areas and Berlin model (preconditions, decision areas and consequence). The Darmstadt model was developed to guide assessment of computer science situation in a country, prior to designing and delivering high school computer science education. Hubwieser (2012) further elaborated on the sub dimensions of the Darmstadt model and used it to develop the new concept of computer science education for Bavarian high schools in Germany. More recently, Bell et al. (2014) further utilized Darmstadt model to clarify how computer science subjects where introduced in New Zealand schools. These researchers suggest that in attempt to introduce new computer science subjects for secondary schools; several types of information are required from different respondents to make the educational initiative workable. Bell et al. (2014) summed up these kinds of information from geographical location as the socio-cultural factors, nature of new standards, reactions and roles of the various stakeholders, teaching materials and methods that are to be developed. Unfortunately, beyond these aforementioned discourses, literature has remained silent on engaging discussions on designing learning environment that relates to pedagogy and instructional strategy for high school online computer science education. Most course learning management system vendors surprisingly distance themselves from pedagogical issues nevertheless online learning cannot last without pedagogical techniques (Govindasamy, 2002). Online learning environment without pedagogical principles results in poor performance of learners and quality of content (Govindasamy, 2002). According to Ben-Ari (1998), performance is no indication of understanding and that focusing on internal structures of the student, are pedagogically helpful than of performance alone and draws conclusions on success of techniques. Behn (2003) agrees with this assertion that performance measurement is a means to an end but not an end in itself. However, literature is scant in providing conceptual frameworks for the development and use of online learning environments (Dringus et al., 1999).

With this existing literature, the aim of present study is to explore pedagogical principles and instructional framework that guide designing online learning environment in computer science education for high school students.

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