Rethinking the Development of Technology-Enhanced Learning and the Role of Cognitive Computing

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ABSTRACT

Technology-enhanced learning (TEL) is important in social web. Recently, cognitive computing became significant to analyze sentiment and improve effectiveness in TEL field. So analyzing the development of cognitive computing, what and how its abilities improve TEL are necessary. For solving these issues, this study used systematic review approach based on technology view and enhancement view of TEL. Specifically, this study used topic search results in computer science field of “cognitive computing” and “anticipatory computing” in Web of Science database to do map analysis. Besides development footprints, the manuscript describes three development stages and key technologies of cognitive computing through burst study and step-by-step clustering. Finally, this study proposed influencing framework of cognitive computing on TEL and some research trends. This work provides an advanced background of TEL and a systemic review of cognitive computing, contributing to theory development and application of cognitive computing in TEL.

KEYWORDS

1. INTRODUCTION

Technology enhanced learning (TEL) is significant for improving effectiveness of Higher Education (HE) or training and has a long history from 1930s (Pressey, 1944; Wedman & Diggs, 2001; Kirkwood & Price, 2014). With advanced computational models of cognitive computing combined with learning or teaching process, TEL in HE has many new forms in social web environment and its development always attracts scholars’ attention (Lytras et al., 2019).

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The form of TEL is generally online class or e-learning, such as MOOC\(^1\) or Coursera\(^2\). With the development of cognitive computing especially its branch - artificial intelligence, TEL in HE has been influenced in a great degree. For improving learning effectiveness, intelligent adaptive learning system with artificial intelligence is used in education. Artificial intelligence in education (AIED) in China has been developing since about 2012, what’s more, companies of AIED in China have raised 11.03 billion yuan until December 2017 and covers more than 5 million users (Intelligence, 2018). Besides the large Chinese market of AIED, until August 2019, there are about 106 companies with investment of more than 15.42 billion yuan in market of AIED in USA, about 43 companies with investment of more than 500 million in EU and mainly in the UK, Germany and Spain (EO intelligence, 2019). Assessment and LEarning in Knowledge Spaces (ALEKS), an intelligent adaptive learning system for courses in science and mathematics, is proved to promote 15 percentage points of the pass rate for math-major students (Mojarad, Essa, Mojarad, & Baker, 2018). Therefore, cognitive computing promotes the TEL’s development, we explore the development of TEL in HE from the view of development of cognitive computing and its influencing mechanism.

Cognitive computing has attracted attention of educational and information system scholars because of its ability of forecasting which is on account of cloud computing, machine learning and other technologies simulating cognitive process (Ahmad et al., 2018; Lytras et al., 2019). For real sense of context and practice, scholars bring virtual reality into higher education, medical education and training to enhance learning effectiveness (Lytras et al., 2016; Papadopoulou et al., 2019). Combining TEL and cognitive computing, online learning community’s personalized learning recommendation become an advanced research in social networking for Open and Distributed Learning (Lytras & Mathkour, 2017; Shorfuzzaman et al., 2019). As important technologies of cognitive computing, big data analytics and personalized decision-making in the dynamic TEL environment have a huge impact on goal achievement and learning effectiveness (Lytras et al., 2017; Chui et al., 2018).

As for TEL, technology is always a vital concept, however, its specific contents are mainly “black boxes” in many conditions like Information and Communication Technology (ICT), Online Facility including cognitive computing (Sian, 2015). Back to previous literatures, we could find many specific algorithms or technologies based on cognitive computing for TEL like recommendation systems and at-risk student prediction algorithm, however, the influencing mechanism of technology on TEL is not clear (Verbert et al., 2012; Erdt et al., 2015; Chui et al., 2018). In the condition of rapid growth of cognitive computing, it is important and necessary for us to understand what abilities or specific technologies of cognitive computing could improve TEL in HE. Besides, enhancement view is also vital in TEL (Kirkwood & Price, 2014). Learning is a constructive process including content, context, collaboration, engagement and impact (Lytras et al., 2019). There are some important connotations of TEL on enhancing learning: learning through technology, design of learning materials, individualized learning and enhancing rather than replacing human teaching (Duval, et al. 2017).

Therefore, how cognitive computing, a new technology providing personalization of learning context and enhancing collaboration and engagement, influences TEL is an urgent issue to explain. In this regard, Lytras et al. (2019) proposed a framework of mutual relationships of cognitive computing, learning and higher education data driven decision making. However, specific influences of key abilities of cognitive computing on TEL in HE environment have not been revealed.

To answer these questions proposed in technology and enhancement view, this paper aims to conduct a systematic literature review to explore development and key technologies of cognitive computing, and its specific influence on TEL in HE to obtain influencing framework. However, there are some challenges for us. Cognitive computing integrates many fields, including cognitive science, cognitive brain processes, and psychology to design computational models and decision mechanisms (Gutierrez-Garcia & López-Neri, 2015). Therefore, the multidisciplinary character brings difficulties to analyze the development of cognitive computing aiming at TEL in HE and find its key abilities. At the same time, the number of related literatures is huge, so it is difficult for us to summarize milestones, development stages of cognitive computing and its influence on TEL.
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