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Artificial Intelligence in Education (AIEd)

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Abstract: The use of Artificial Intelligence (AI) in education is no longer science fiction but becoming a reality in these unprecedented times of dynamic changes. This field encompasses a wide range of techniques, algorithms, and solutions that may resolve current predicaments and problems in today's classroom. This paper discusses how AI that is supporting the existing world can be extended into the fields of education and addresses the existing challenges of using AI within classrooms across Singapore.

Keywords: Artificial intelligence, education, analytics, future challenges

1. Introduction

We currently live in a volatile, uncertain, complex, and ambiguous (VUCA; Bennett & Lemoine, 2014) world, where a state of flux has replaced the sense of stability, certainty, and familiarity that people are used to. Technology and change are rapid and unpredictable, disruptive in almost every industry and country. In a world that is now supported by Artificial Intelligence (AI), there is a need to be empowered by an understanding of what AI in education is, what it can deliver, and how it goes about doing that (Luckin, Holmes, Griffiths, & Forcier, 2016).

Some existing empirical studies (e.g., Hao, 2019) have shown that as much as AI is currently being touted to be a worthy educational tool that can provide personalized learning at scale, there was also equal amounts of fear that it could backfire and entrench a global trend towards standardization of teaching and learning, thus leaving the next generation ill-prepared for a dynamic and changing world. Certain studies (e.g., Guilherme, 2019) have also examined the use of thought experiments to predict if the development of AI could potentially replace human teachers in the classroom.

The approach of this study is, however, not to introduce global standards and definitely not to replace teachers. We seek to create a future where teachers can utilize AI to transform their current roles as facilitators and providers of content, into co-constructors of knowledge with students who can take ownership of their learning processes. For example, AI can be used to provide collaborative learning support (Magnisalis, Demetriadis, & Karakostas, 2011) with potential to extend possibilities of teaching, learning, and research (Popenici & Kerr, 2017), so as to ensure resources are more effectively utilized and student's expertise can be augmented by AI.

2. Research objectives

This study seeks to address two existing challenges. First, by understanding and acknowledging the advantages and limitations of existing AI approaches and techniques, we could then identify potential knowledge gaps and deficits in expertise that are necessary to support the development and implementation of AI in education. This requires existing students to possess attributes akin to 21st century competencies not limited to creativity, critical thinking, collaboration (Tan, Choo, Kang, & Liem, 2017), in order for students to be active designers and productive contributors to local and global futures, be it economic, social, or cultural in nature. Second, apart from identifying a pool of competent students and future workers, teachers looking to utilize and implement AI-enabled tools also require support with integrating them into teaching practices. This includes consulting teachers during the design cycles of the tool, balancing personal and institution-wide pedagogic issues (e.g., reluctance to change based on experience and groupthink) with benefits from the tool, and feasible implementation of the tool in schools with considerations of local context and practice.

3. Methodology and building on current work

The interdisciplinary nature of this field often gathers wide-ranging definitions from experts with their own perspectives and terminologies. This study follows the definitions by Russell and Norvig (2020), that AI includes multiple aspects, such as problem solving, representation and reasoning of knowledge, machine learning, and techniques for designing and developing of intelligent agents.

This study then narrows the scope of these aspects to the design and implementation of AI-related tools within the field of education. Data would be collected from pilot trials in schools across Singapore and multimodal sensors will be used, such as audio, video, physiological and online detection mechanisms (e.g., online trackers), to record multimodal data in classroom lessons. Two case studies are currently identified to integrate the use of AI and analytics in education. The first case study will investigate students' collaborative processes related to knowledge building in the classroom, sifting out possible traits of students that allow them to be competent thinkers and learners. The second case study is related to teaching analytics, where the teachers' attention and physical locations in the classrooms would be tracked and analyzed to benefit their teaching practice. In both case studies, the intention was to implement unsupervised learning to draw insights from the unlabeled data, using techniques and algorithms such as k-Means clustering and Hidden Markov Models (HMM) to determine clusters of potentially meaningful data and recover sequences of states. Both case studies will also be built on ongoing work (Lee & Tan, 2017; Lee, Tan, & Tan, 2019) that provides an existing and appropriate framework for the respective case studies. It would be prudent to continue working on these frameworks, especially when it can be further scaled with nascent interest from local participants.

4. Future challenges

The implementation of AI in education has far-flung consequences, including considerations about ethics and equality of access across genders, age, and geographical borders. In addition to these considerations, another major concern would be to ensure that subsequent studies should attempt to avoid unintentional bias during data collection and processing, by leveraging on emergent technologies (e.g., Internet of Things and ambient smart sensors) to gain higher specificity of classroom analysis in a least intrusive manner.

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