Evaluation of Artificial Intelligence in Online Learning: A Review of the Literature

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Abstract

Technology is making teaching and learning more complicated, specifically in online education, and artificial intelligence (AI) is contributing to these complications. While problems exist for all students, the pace of today's technological changes is affecting student readiness for the workforce and needs addressed (IBM Institute for Business Value, 2015). Research revealed personalized learning is key and AI may be the answer. Although there was a significant amount of research concerning personalization in online education, most of the research around AI focused on virtual agents, intelligent tutors, and chatbots. The literature revealed there is a need for deeper understanding of AI and how the technology can help solve educational problems through adaptive learning and analysis of student data. This review of literature discusses possibilities with AI; outlining definitions, exploring current affordances and limitations in online learning and how AI contributes to success, as well as themes identifying the need for further research in this area. In closing, the literature revealed what's needed to set learners up for success and why today's instructor needs to the right insights to tailor content to individual student's needs, achieve superior outcomes, and do it in real-time.

Keywords: Artificial intelligence, AI, online learning, adaptive learning, collaboration, personalized learning, intelligent tutoring systems, higher education, technology, analytics

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Within the last several years, technology's growth has created a paradigm shift in how we live, work, and learn (Manyika et al., 2013). While technology presents opportunities to do things never been done before, there is no doubt it's disrupting the business and social landscapes; affecting the skill sets essential for a successful workforce (IBM Institute for Business Value, 2015). Whether it's cost or convenience, more and more people are moving away from the traditional educational model and into an online learning environment. Institutions, who want to stay competitive, need to adapt quickly to the changes and provide students with an experience that strengthens the collaboration skills necessary for workforce success (IBM Institute for Business Value, 2015). Today's education needs to be highly personalized however, technology barriers often interfere with the instructor's ability to provide individualized learning at scale; further widening skill gaps (IBM Watson Education, 2016). AI, by way of adaptive learning systems, or intelligent tutors, and analytics may be a solution for instructors to gain the right insights to provide the personalized learning experience that strengthen the collaboration skills necessary for workforce success.

Artificial intelligence (AI) and collaboration

In order to understand how AI may help improve the learning experience and strengthen collaboration, it is important to define the term and explore why collaboration is important and necessary in the first place. At its core, AI refers to "intelligence exhibited by machines" (Wikipedia, 2016). The term may seem like a new technological innovation, but researches have been studying mechanical reasoning as early as the 19th century and AI, as a field of research, began in the mid 1950's (Wikipedia, 2016). The goal of AI is to demonstrate cognitive capabilities of understanding, reasoning, and problem solving (Wikipedia, 2016) thus changing the way humans gain and share knowledge. Understanding how these capabilities affect collaboration and learning is vital to success, specifically in online learning.

As AI becomes more prevalent in online learning, considerations on how humans collaborate and understanding why the skill is declining is key. A recent IBM Institute for Business Value (2015) survey revealed that collaboration is a skill needed for workforce success, and a skill most students lack. Research suggests that learning happens within a social context through various forms of engagement, support, and motivation (Kim, Smith, & Thayne 2016). Kim, et al. (2016) refer to this as "affective learning" and write that "positive affect reduces cognitive error, allowing for learning to occur more naturally" (p. 115). Their research implies that when "humans interact with machines who lack affect, their perception and/or trust towards the agent may change; especially in adult learners" (p. 124). Today, "humans don't have the same experience collaborating with machines as they do with other people" (Hill, Randolph, & Farreras, 2015, p. 250) so naturally, there are noticeable differences in how we interact with them. However, what happens when AI systems become so sophisticated that collaboration with machines become the norm? And, if students are already entering the workforce ill-prepared, how will AI affect collaboration and learning, specifically online? Unfortunately, these questions were not addressed in the study.

To further investigate how AI affects collaboration and learning, Sidner (2016) explored the impact of affective learning and engagement with computer-based learning systems. In her study, she identified a series of connected events necessary for collaboration. These events consisted of gaze (direct and mutual), adjacency pair or, response to question, follow-up, etc., and backchannel or, gestural communication (pp. 276-277). Currently, AI is not able to imitate these connected events when humans engage with these systems. She argues however, that as AI systems become more advanced and embedded in our everyday lives, they will provide "more natural, long-term collaboration with humans" (p.289). It is interesting to consider long-term collaboration with AI and the potential for personalized learning opportunities in online education. For instance, if a student received their own virtual agent as part of their program, they may rely on the agent for brainstorming or when working through assignments more so than their instructor or peers. The virtual agent may provide some level of emotional support when starting new courses or semester because the relationship, trust, and familiarity is already there. There is room for additional

reflection on how AI could improve online collaboration outside of Sidner's connected events. The relationship between student success with the support of AI could be investigated further.

Adaptive learning and intelligent tutoring systems

Adaptive learning systems, often referred to as intelligent tutors are collaborative AI systems making way in online education. These systems can take on a variety of instructional tools and methodologies, but are essentially computer-based systems that enables dynamic, personalized learning experiences based on a series of needs and responses from a student (Wikipedia, 2016). These computer-based systems help students achieve learning outcome through a series of functions like asking or answering questions and providing explanations and/or feedback (Kerly, Hall, & Bull, 2007). The combination of an increasingly large online student population and growing demand for personalized learning has presented challenges for instructors to provide the level of attentiveness needed for successful learning outcomes. Adaptive learning systems are one example of how AI makes personalized learning feasible for both educator and student (IBM Watson Education, 2016). Although adaptive learning systems may help alleviate some of the technological burden for the instructor, there is little evidence that proves it actually supports and strengthens collaboration skills between humans.

In one study, Kerly, Hall, and Bull (2007) explored criteria necessary to improve accuracy and adaptively within an intelligent tutoring system in order to understand the interaction between human and machine. Based on research that points to gaps in conversational capabilities between human and machine interaction, the authors developed an intelligent tutoring system to enhance their learning model and deepen the learning experience for each student. With valid and reliable technology, researchers and professionals could then begin to study how intelligent tutoring systems can produce more accurate learning models that allow for a personalized user experience. In the end, they discovered that participants in the study agreed that their interaction with the intelligent tutor did in fact help them understand the subject matter better and kept them engaged (Kerly, Hall, & Bull,

2007). Despite the fact this research is somewhat dated, it does show evidence that intelligent tutoring systems can support learning outcomes. The research doesn't, however, provide evidence that the system contributed to affective learning or collaboration skills. There is room for additional reflection on how adaptive systems affect communication within an online course. The relationship between student-student, student-teacher success and adaptive learning could be investigated further.

Because there is currently, no set "standard on how to design and optimize a web-based education system" (Tekin & Schaar, 2015, pp. 5545-5546) educators may find dissatisfaction in adaptive, intelligent tutoring systems. In another study, Tekin and Schaar (2015) explored solutions for standards and optimization in personalizing online education Based on research that points to the challenges in personalizing online education, they developed eTutor to assist in to designing an optimal online learning experiences. Their research suggests that although participants achieved effective time management, their eTutor was ineffective in achieving success with certain cognitive skills (Tekin & Schaar, 2015). This research provides a nice starting point for evaluating best practices and strategies when implementing adaptive learning systems within an online course. However, there is room for considerations around adaptive learning improving cognition and collaboration.

Improved learning outcomes through data and analytics

Another way AI is affecting collaboration and learning outcomes in online education is through the analysis of student data. According to the Online Learning Consortium, approximately six million U.S. students are currently enrolled in online courses (EDTECH, 2016). However, only 43% of industry and academic leaders believe higher education prepares students with collaboration skills necessary for workforce success (IBM Institute for Business Value, 2015). So, how can educators ensure they're meeting student demands with high-quality, personalized learning experiences that also prepares them for future success in the workforce? Freitas et al. (2015), suggest the answer lies in student data and analytics. "With technology assisted insights, instructors can learn about their students

more holistically and provide personalized and meaningful learning experiences" (IBM Watson Education, 2016, p. 1). If understanding student data is key to execute successful learning experiences, the question then is, what do institutions need to do to ensure instructors have the right tools, technology, and training to deliver? Additionally, how can the data be used to help identify gaps in students' collaboration skills? The literature reviewed did not address these questions. Further investigation would provide a more comprehensive understanding on how analytics can be used to improve learning outcomes and support collaboration.

An example of how data analytics methods create new ways to understand student trends and behaviors to improve the learning experience can be found in research by Freitas et al. (2014). Based on the limited research available, the authors proposed a foundational learning analytics model (LAM) for higher education that "supports personalized learning outcomes and reduces attrition" (p. 1176). The evaluation framework was a series of quantitative data sets for students enrolled in online and face-to-face courses. The research revealed that the collection of data did in fact provide insights needed to create personalized experiences and responses to students in real-time. The research however, did not include consideration around how it might affect collaboration among online students or address data privacy and ethical concerns of students. If research topics are geared towards personalizing curriculum through the analysis of data, the evaluation of the framework outlined by Freitas et al (2014), would be a good starting point for further investigation online collaboration, data privacy, and ethical standards.

Limitations and gaps

The review of literature revealed a need for more published research around AI in education as a whole. It appears evident that the expansion of technology is outpacing the time it takes to publish research; making it difficult for practitioners to stay ahead. Even the most recent article reviewed, seemed outdated. Additionally, the reviewed literature showed minimal research surrounding data privacy and issues with ethical and moral concerns. Researchers, Freitas, et al (2015), made note that "ethical procedures are

constantly in flux and aren't always considered at the forefront of research in the digital media sphere" (p.1187). Further investigation around policy, data ownership, and privacy could lead to stronger data protection systems and potentially ease fears associated with data security and AI adoption.

Reviewed literature also lacked understanding of costs associated with the integration of AI system, the platforms needed to successfully deploy it, as well as Return on Investment (ROI). Outlining these technical requirements could help build a more robust understanding on the impact AI systems have on gaining a competitive edge at the institutional level. Studies that did offer ROI implications for AI integration offered limited or no perspective on cost to value ratios.

Conclusion:

While technological advancements contribute to the growing demand for highly-personalized digital learning, it presents challenges in higher education. Institutions need to adapt quickly and ensure every student receives a high-quality, invaluable educational experience that prepares them with the collaboration skills needed to succeed in the workforce (IBM Institute for Business Value, 2015). Instructors however, struggle to manage administrative tasks, keep up with new tools and technology, and provide the level of responsiveness needed to effectively execute a personalized learning experience to each student (IBM Watson Education, 2016). AI, by way of adaptive learning systems, or intelligent tutors, and analytics may be a solution for instructors to gain the right insights to provide the personalized learning experience that strengthen the collaboration skills necessary for workforce success. Additional research around cost-to-value, ROI, and issues concerning data privacy could help shape a more robust understanding of the full end to end process. Nevertheless, AI is showing promising signs of its potential in online education. As researchers and engineers continue to make advancements in this field, we may begin to see improvements in collaboration and delivery for more personalized learning experiences. Adaptability and agility will be key.

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