

Artificial Intelligence in Promoting Teaching and Learning Transformation in Schools

Yufei Liu^a, Salmiza Saleh^{b*}, Jiahui Huang^c, School of Educational Studies, Universiti Sains Malaysia, Malaysia

With the development of science and technology, artificial intelligence technology has entered an unprecedented period of rapid development, and it is profoundly changing all areas of life. Various countries require implementation of intelligent education, but how artificial intelligent education promotes the development of school teaching is still lacking in systematic discussion. This paper discusses several aspects of artificial intelligence to promote teaching and learning reform, including artificial intelligence to promote the innovative development of teaching resources and teaching environment, teaching and learning methods, the development of school teaching management and teaching evaluation, and to promote the reform of subject structure and educational content. With a view to encouraging the application of artificial intelligence in promoting the transformation of teaching and learning, it is proposed that schools meet new requirements in the era of artificial intelligence.

Key word: *artificial intelligence; teaching and learning; transformation; education*

1. Introduction

As artificial intelligence (AI) is increasingly becoming a part of our daily lives, the government and schools are paying more and more attention to the development of artificial intelligence in education (Malik, Tayal, and Vij 2019). Artificial intelligence technology has not only promoted changes in schools' teaching methods, learning methods, campus environment, and curriculum, but the entire education industry is also undergoing changes through AI (Karsenti 2019). From basic education to higher education and adult education, schools are increasingly transforming with AI technology. These systems can help people learn better and achieve their learning goals (Hinojo-Lucena, Aznar-Díaz, and Cáceres-Reche, M. P., & Romero-Rodríguez 2019). Artificial intelligence technology is believed to play an important role in promoting the reformation of teaching and learning in schools. It will bring new intelligent teaching tools to

schools, form new teaching and learning modes, and promote innovation in teaching evaluation methods and teaching management methods. Educators should actively change their way of thinking, explore new forms of combinations between artificial intelligence and teaching, promote the deep integration of technology and teaching, and the innovative development of education and teaching (Guo and Xiao 2019). The reformation of education and teaching in schools will break the time and space restrictions in traditional education, thus form a superhighway of information, promote fair processes in education, and make education and teaching more interesting and reasonable (Zhang, Zhang, and Li 2019). Students are able to develop according to their own potential, whereas teachers' repetitive workload will be replaced by artificial intelligence systems, and the campus environment will become more intelligent (Fu 2019).

2. Artificial Intelligence Education Technology Development and Application

With the development of artificial intelligence technology, modern education will be combined with more technologies such as intelligent robots, speech semantic recognition, image recognition, AR/VR, machine learning, adaptive learning algorithms, quantum computing, block chain and so on. These technologies are collectively referred to as intelligent technologies. These technologies have begun and continue to accelerate in conjunction with the education industry. Wu Yonghe et al. (2017) pointed out that related technologies of "artificial intelligence and education" include machine learning, deep learning, natural language processing, neural networks, learning computing, image recognition (Wu, Liu, and Ma 2017). Mou Zhijia (2017) believes that artificial intelligence uses "two bottom layers" (ie, machine learning and deep learning) and "three layer services" (ie, physical service-oriented voice recognition and emotional computing technologies, content-oriented natural language processing technology, and behavioural service-oriented adaptive learning technology) to support personalised learning (Mou, 2017). Chen Kaiquan et al. (2018) stated that the introduction of five types of artificial intelligence technologies such as intelligent recognition, natural language understanding, learning analysis, virtual reality, and education robots can help the traditional digital intelligent teaching system achieve functional upgrades (Chen, He, and Zhong 2018). The continuous introduction of various artificial intelligence teaching products will restructure the education industry ecology. Education and teaching products that are based on artificial intelligence technology provide artificial intelligence education technology, tools and related services to schools and teachers. By accepting students' user data, and then carrying out analysis and feedback, then applied in the five sector of learning process, "teach, learn, test, train" to produce personalised solutions and effective feedback for learners.

Under the influence and dissemination of artificial intelligence, more and more artificial intelligence technologies and applications have appeared in the field of education: In classroom teaching, virtual assistant Jill Watson is used to help the teaching assistant to answer students' questions in a classroom that consists of more than 300 people. In terms of adaptive learning, Knewton, an adaptive teaching platform, can collect learners' behavioural data during their

learning process, thus analyse and predict students' learning interests, knowledge levels, learning styles, and learning progress to provide personalised learning services (Kasinathan, Mustapha, and Medi 2017). In terms of educational robots, MindstormsEV3, the latest generation of programmable intelligent robot products launched by LEGO (Takacs et al. 2016), has enhanced interaction with smart devices, as it added WiFi modules, and connects to iOS and Android devices to be controlled through the App (Barret et al., 2019). With improved microphone and speaker equipment, human-computer interaction can be supported (Murphy 2019). In terms of campus applications, a series of face access control and attendance systems are currently established in many campus entrances, classroom entrances, and dormitory entrances in China (Liu 2019). Compared with the traditional card swipe, fingerprint recognition and other modes, the face recognition attendance system has very obvious advantages, as it allows parents and teachers to see student's attendance at school at all times, effectively prevents students from problems such as skipping classes and not returning home etc. In addition, artificial intelligence technology has also been widely used in educational scenarios such as exam evaluation and diagnosis, campus management and teaching management, educational decision-making and educational governance (Zhou, 2019).

3. The Aspects of Artificial Intelligence in Promoting Teaching and Learning Transformation

Based on the existing research, it is found that artificial intelligence in teaching and learning transformation in schools are applied in several aspects such as teaching resources and teaching environment, teaching and learning methods, teaching management and teaching evaluation, reformation of subject's structure and system and reformation of educational content, as shown below in figure 1.

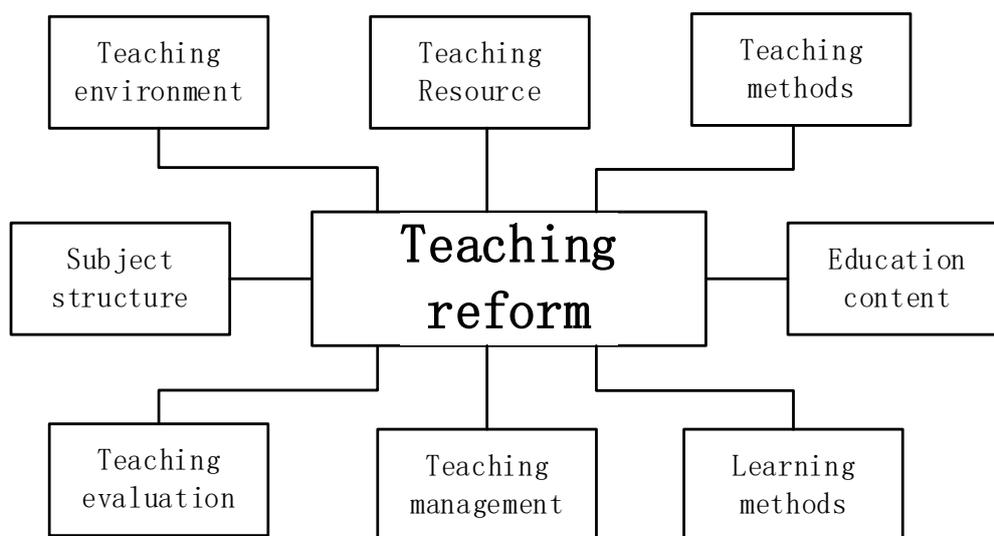


Figure 1. Direction of Education and Teaching Transformation

(i) Teaching resources and teaching environment

Changes in the resource environment is the foundation of teaching reformation. The changes in resources and environment will drive the reformation of teaching, and thus creates a learning environment that better meets the needs of students, forming a virtual circle. From a larger perspective, the impact of modern science and technology on teaching and learning is achieved through transforming teaching tools, media or the environment (Hill and Hannafin 2001). First, with the development of artificial intelligence technology, a large number of companies have developed a variety of intelligent teaching tools and learning tools, and intelligent auxiliary learning equipment, such as intelligent teaching platforms, teaching robots and intelligent learning software, etc. These advanced teaching and learning tools have brought a lot of convenience to teachers and students, bringing new vitality to teaching and learning. In the era of artificial intelligence, a large number of intelligent devices have entered the classroom. Teachers and intelligent assistants will exist together in the classroom. Students and teachers will each wear various intelligent machines with sensor devices. The entire education and teaching process is intelligent. Secondly, the development of artificial intelligence has brought great convenience for students and teachers to obtain learning resources. In the process of intelligent evolution of learning resources, the machine has performed quality control and semantic annotation on the resources, and resources are divided into text, video, and other forms. In this way, when the intelligent learning environment senses learners' needs, it can adaptively push learning resources that are suitable for the learners, and with the development of search engines, learners can quickly find the resources they need without wasting a lot of time in finding materials (Zhu and Wang 2019). Finally, the development of artificial intelligence has provided convenience in building an intelligent learning environment, driving the digital education resource environment to an intelligent learning resource environment. Schools can work with artificial intelligence education companies to use artificial intelligence to create an environment that is conducive for learners to carry out efficient and deep learning. Through intelligent perception, AI builds a learning environment that is more conducive to teacher-student interaction. In the era of artificial intelligence, the emergence of smart campuses will bring efficient and convenient services to students studying at school, allowing students to participate better in learning. The innovation of teaching tools, the optimisation of teaching resources, and the improvement of the teaching environment help teachers to easily carry out teaching activities and assist students to learn efficiently.

(ii) Teaching and learning methods

After artificial intelligence entered the field of education, changes in technical support resources and the environment prompted a series of changes in teaching (Yu and Hu 2019). In terms of the teachers' teaching, artificial intelligence can assist teachers to prepare lessons, teachers can use artificial intelligence, big data and other technical advantages, to help students' personalise learning, and to design scientific and appropriate learning programs. Artificial intelligence and big data can also be a powerful assistant for teachers. Artificial intelligence



technology allows teachers to monitor the teaching process in real time and accurately guide the teaching to achieve intelligent and precise teaching. Big data can help teachers understand students' learning situations at any time, help them solve difficulties, help teachers to correct homework, replace teachers' mechanical work, reduce the burden on teachers, help teachers to be free from simple and tedious teaching affairstasks, and enable teachers to have more time to communicate with students, to truly return to the work of "people", create innovative teaching content, reform teaching methods, and engage in more creative labour. Artificial intelligence can help teachers, it will change the role of teachers, and promote the transformation of teaching models from knowledge transfer to knowledge construction. Education in the era of artificial intelligence needs to cultivate the core literacy of students. The responsibility of teachers is not to instill knowledge, but to help students to grow, to become life mentors or psychological consultants, to help students discover the advantages and realise the value of life. In the near future, teachers' work will not focus on teaching. The core value of teachers in the era of artificial intelligence is not the development of professional knowledge, subject knowledge and professional skills, but the cultivation of core literacy of teachers' humanities, responsibility, national identity, cross-cultural communication, and aesthetics.

In terms of students' learning, through the construction of an intelligent environment, we must focus on how to guide students. By creating different types of learning tasks, we create a supportive learning environment to help learners adaptively preview new knowledge, intelligent interaction to learn new knowledge, intelligent companionship exercises, and intelligent guidance on deep learning, helping students to constantly understand, discover, and improve themselves (Li 2019). Today, knowledge-centered learning methods can no longer meet the needs of the development of the times. The knowledge or skills that can be mastered only by rote memorisation gradually lose value. Artificial intelligence can do better than people in these aspects. Therefore, this requires us to change the concept of education, accelerate the transformation of learning methods, from "learning to apply" to "use to learn", pay more attention to the unique experience of each student, and encourage them to learn to solve problems through process, learn to do things from the process of doing it, and to become a talented person who can adapt to complex challenges in the future. If school life is not closely related to social life, and students' learning does not grow out from their direct experience, education is dull and inefficient. A school should be an open organisation system, it should establish a connection with the real world, and make full use of external social resources in teaching. For example, the University of Minerva in the United States is a university with "no campus". Four-year undergraduate studies are distributed in seven major cities around the world, including San Francisco, Hong Kong, and London etc. Through the cooperation with the local high school, laboratories and high-tech companies, students can use first-class libraries, laboratories, etc. for learning, realising the structural innovation of higher education. Intelligent education must connect knowledge learning with real life (Chen 2016). Learning not only can be carried out in the classroom, but also in communities, science and technology museums, and enterprises. Education can even travel to different cities, any place that can

achieve high-quality learning is considered a school. Using mixed reality technology to integrate virtual scenes into the real world, giving students the opportunity to observe the micro world and perceive abstract concepts, making learning a first-hand experience in a rich context.

(iii) Teaching Management and Teaching Evaluation.

The development of technology and the optimisation of the teaching environment make the data of teaching and learning process more and more abundant. To make full and effective use of these data in order to optimise teaching and learning, educators are required to change their traditional teaching management models and teaching evaluation methods (Ahmad, Bakar, and Ahmad 2018).

With the development of artificial intelligence technology, in the aspect of the management of teaching, management of many programmatic tasks in ordinary schools can be realised intelligently. These matters cover academic management, student status management, student course management, teacher teaching management, scientific research management, financial management, energy management, human resource management, etc (Park et al. 2019). The intelligent platforms will reduce tedious manual procedures and improves schools' efficiency. At the same time, the intelligent platform can realise data collection and real-time monitoring, statistics and analysis of information, intelligent decision-making on management methods, efficient intelligent management of information optimisation, improvement of resource utilisation, improvement of education management, and ensuring the harmony and sustainable development of school work. The teaching management of students in the era of artificial intelligence needs to be more flexible and adjustment should be made based on the learning needs and mastery of students. At present, an increasing number of virtual schools in the United States have made many attempts in this regard, that is, to lengthen the cycle of teaching management units. Schools evaluate students by the number of hours, mastery level and their exam marks. As for when should the students study, and how long should they study each time, it is up to the student to decide (Wang and Hu 2019).

Teaching evaluation is an important way to check and promote learning. In terms of this, diagnostic teaching evaluation in particular, has been identified as one of the areas of most potential for artificial intelligence (Savin-Baden et al. 2019). At present, artificial intelligence technology has also spawned many intelligent diagnostic industries. From the aspect of teacher evaluation, currently, based on artificial intelligence, automatic data aggregation, feature analysis, deep learning and modeling simulation of teaching behavior characteristics can make a detailed and accurate evaluation of teachers' classroom teaching quality. The evaluation of teachers will move towards a comprehensive evaluation produced by artificial intelligence technology, rather than a single evaluation between students and teachers. In this way, diversity in evaluation will give fairer and more objective evaluations to teachers and provide teachers with greater space to improve, thus providing the direction for teachers development.



In terms of student evaluation, with the help of artificial intelligence technology, the platform actively collects and automatically captures various data points of student learning at any time to form a data set for all students as a whole and each individual student (Guerrero and Wiley 2019). Based on a specific analysis model, the platform quickly and promptly forms a diagnostic evaluation report for each student's learning, and gives personalised learning resources and development suggestions to effectively achieve “a student with a ruler and a student with multiple rulers” to promote students to be their best selves, by changing a ruler to evaluate the current situation of all students. This makes the evaluation more scientific, objective and timely.

(iv) Reformation of the Subject System

Artificial intelligence will have a greater impact on the training of talent in schools, the most direct manifestation is the reformation of the discipline structure of higher education. Artificial intelligence will have a comprehensive impact on the subjects' professional settings and future development. Scientific innovation and engineering progress needs to open the academic gate and expand its' professional space. Artificial intelligence can lead the industrial revolution and social reformation. Artificial intelligence will change the subject system and curriculum settings of universities. In recent years, many universities have carried out the reformation of subject architecture in the direction of intelligence.

In the United States, the professional direction of artificial intelligence is a new science technology that research, develop simulating theories, extending and expanding human intelligence's theory, method, technology and application systems (Zhang and Dafoe 2019). Among the top 300 universities in the United States, 26 schools offer 27 graduate programs in computer science (artificial intelligence). At Stanford University, their computer theory, computer hardware, computer software, computer database, and artificial intelligence are leading the United States and even the world. The university's undergraduate degree program in artificial intelligence covers courses that are comprehensive and cutting-edge, including computational biology, speech recognition, cognition, and machine learning etc (Yang, Gu, and Qian 2019). In China, June 28, 2018, Tsinghua University established an artificial intelligence research institution. This is an important achievement for Tsinghua University to build a world-class university, and it is also another milestone in the process of reformation of the scientific research system (Chen 2019). A number of universities have newly added “Artificial Intelligence and Robot Engineering Majors”, and Beijing University started undergraduate education and training in robotics engineering in 2019. The professional courses focus on cultivating students to master the development and application of typical robot dynamics and control, bionic structural design, intelligent perception, human-computer interaction, and micro-nano operations, and cultivate future talents in the fields of robotics, intelligent manufacturing, and artificial intelligence (Luo et al. 2019). Artificial intelligence majors have also gradually appeared on the directories of ordinary college majors. While artificial intelligence promotes the formation of new subjects and professions, it also makes



new layouts and adjustments to traditional subjects and professions. The advent of the era of artificial intelligence may weaken some traditional subjects and professions in order to cope with the elimination made by artificial intelligence technology.. In addition, with further development of artificial intelligence, the cross-contact of subject settings of higher education gradually appears, the boundaries between current subjects will gradually blur, and the boundaries of the subjects' professions will be re-examined.

(v) Reformation of Educational Content

The educational content in school is the embodiment of educational objectives, and artificial intelligence has a certain influence on educational objectives, so it will inevitably affect the educational content of the school (Li and Zheng 2019). First of all, as artificial intelligence will be integrated into our daily lives, it is indispensable that the school's curriculum include the basics of artificial intelligence and its application-related professional settings. By doing so, students can learn about artificial intelligence in all aspects. Secondly, the cross-border integration of artificial intelligence has broken the boundaries between subjects. This requires comprehensive talents, as the subject content that is independent and unrelated to each other is not conducive to development of students' comprehensive capabilities. This requires barriers to be broken down between various subjects and content integration, so that it is conducive for the students' positive transfer of knowledge. Again, education in the intelligent era is enhance rather than complement education, focusing on students' individual development. Therefore, in the future, the traditional class teaching system will be broken down, and customised educational content will be gradually moved according to everyone's interest and specialty. Finally, due to the large storage capacity of intelligent machines, acquired knowledge can be easily retrieved. Therefore, the education content in schools will focus on the construction of students' tacit knowledge. Instead of focusing on students' abilities to memorise, they will increasingly focus on training students' practical ability and emergency response ability in real life situations.

4. New Requirements for Schools in the Era of Artificial Intelligence.

Facing the opportunities and challenges of education development in the era of artificial intelligence, combined with the development of education and teaching and the development trend of artificial intelligence technology, schools will actively explore and promote new requirements for building a school in the era of intelligence.

For schools, it is first necessary to build a team of high-level teachers that are adapted to the development of education in the intelligent era. Teachers are the foundation of teaching and the origin of teaching. For example, establish a teacher education innovation base, innovative teacher training environment, explore and cultivate teachers' that can adapt to artificial intelligence and other new technologies challenges; carry out intelligent education literacy improvement actions, and conduct intelligent education leadership training and teaching ability



training for outstanding principals and teachers.

Schools should pay more attention to the fairness of education and achievement of fair education. Educational development goals will focus on new standards that are more equitable and of higher quality. In the era of intelligence, the acquisition of knowledge will become more accessible, the rights of vulnerable groups to obtain education will be more fully guaranteed, and the development of education will make the creation of knowledge more universal. At the same time, schools need to pay attention to the inclusiveness of intelligent education. Intelligent technology should become an important method to solve problems of education imbalance, and therefore, intelligent education should not be made a privilege for a small group of people.

Schools will face new challenges and new requirements in education governance systems, social ethics, and data security. The advent of the intelligent era will be accompanied by a generation of large amounts of data and algorithms, and the development of artificial intelligence will further blur the boundaries among human society, physical space and information space, thereby generating a series of ethical, legal and security issues. Schools should pay attention to the security risk challenges that artificial intelligence technology may bring, which is to further clarify the concept of norms, focus on social value guidance, strengthen forward-looking prevention and restraint, ensure data security and algorithm fairness, and ensure that the development of artificial intelligence is safe, reliable, and controllable.

At the scientific research level, schools should take a variety of measures to promote the mutual development of the artificial intelligence industry and school education, support university scientific research institutions, AI leading enterprises, primary and secondary schools and other parties to strengthen cooperation and optimise the production of one of the intelligent education technology research and development systems. In addition, schools should establish a long-term investment mechanism, bring together high-quality subject resources and research power, track the latest progress of the artificial intelligence industry, and tap into the actual development needs of schools. At the same time, it is also necessary to accelerate the in-depth integration and innovative development of artificial intelligence and education, and to study the development strategies, standards, and promotion pathways of intelligent education.

5. Summary

This paper introduces the current development of artificial intelligence technology in the field of education, and then focuses on the role of artificial intelligence technology in promoting education and teaching. This paper proposed that artificial intelligence technology will promote school education and teaching reformation in eight different aspects. It also discusses the current impact of artificial intelligence technology on the reformation of teaching resources and teaching environment, teaching methods and learning methods, teaching management and



teaching evaluation, subject systems, and educational content. Finally, it sums up the new requirements for the development of schools in the era of artificial intelligence. In the era of artificial intelligence, schools should reform and innovate the school from several aspects such as teachers, students, and the fairness of education to provide students with a better education.



REFERENCES

- Ahmad, S. Z., A. R. A. Bakar, and N. Ahmad. 2018. "An Evaluation of Teaching Methods of Entrepreneurship in Hospitality and Tourism Programs." *The International Journal of Management Education* 16(1):14–25.
- Barret, Mandy, Lisa Branson, Sheryl Carter, Frank DeLeon, Justin Ellis, Cirrus Gundlach, and Dale Lee. 2019. "Using Artificial Intelligence to Enhance Educational Opportunities and Student Services in Higher Education." *The Journal of the Virginia Community Colleges* 22(1):22.
- Chen, Bin. 2019. "Tsinghua University Opens Artificial Intelligence Class." *China Science News*.
- Chen, Kaiquan, Yao He, and Guoqiang Zhong. 2018. "The Transformation of Information Literacy Connotation and the Targeting of AI Education in the Perspective of Artificial Intelligence—Also on the Implementation of AI Curriculum and Teaching in Basic Education." *Journal of Distance Education* 1.
- Chen, Le. 2016. "Educational Implications of New American University Minerva." *University(Academic)* 01:53–61.
- Fu, Die. 2019. "Where Is School Education Going in the Era of Artificial Intelligence." *Modern Education Management* (05):52–57.
- Guerrero, Tricia A., and Jennifer Wiley. 2019. "Using 'Idealized Peers' for Automated Evaluation of Student Understanding in an Introductory Psychology Course." Pp. 133–43 in *International Conference on Artificial Intelligence in Education*. Vol. 11625 LNAI. Springer Verlag.
- Guo, Y., and Y. Xiao. 2019. "Artificial Intelligence in Education." In *4th International Conference on Modern Management, Education Technology and Social Science (MMETSS 2019)* Atlantis Press.
- Hill, Janette R., and Michael J. Hannafin. 2001. "Teaching and Learning in Digital Environments: The Resurgence of Resource-Based Learning." *Educational Technology Research and Development* 49(3):37–52.
- Hinojo-Lucena, F. J., I. Aznar-Díaz, and J. M. Cáceres-Reche, M. P., & Romero-Rodríguez. 2019. "Artificial Intelligence in Higher Education: A Bibliometric Study on Its Impact in the Scientific Literature." *Education Sciences* 9(1):51.
- Karsenti, T. 2019. "Artificial Intelligence in Education: The Urgent Need to Prepare Teachers for Tomorrow's Schools." *Formation et Profession* 27(1):112–16.
- Kasinathan, Vinothini, Aida Mustapha, and Imran Medi. 2017. "Adaptive Learning System for Higher Learning." Pp. 960–70 in *ICIT 2017 - 8th International Conference on Information Technology, Proceedings*.
- Li, Suang, and Qinhua Zheng. 2019. "Artificial Intelligence + Education: Opportunities and Challenges Coexist." *Teacher's Journal* 11:14–17.
- Li, Yunliang. 2019. "Thoughts on Teaching Reform of Artificial Intelligence Course Based on Innovative Teaching Concept." *Digital Communication World* 11:247.



- Liu, Shufei. 2019. "Analysis on the Application of Face Recognition Technology in Smart Campus." *Telecom World* 09:44–45.
- Luo, Dingshen, Wenxin Li, Zhihong Deng, Yunhai Tong, Jiaying Liu, Jin Chen, and Kunqing Xie. 2019. "Teaching Reform and Practice of Artificial Intelligence Course in Beijing University." *Computer Education* 10:3–8.
- Malik, G., D. K. Tayal, and S. Vij. 2019. "An Analysis of the Role of Artificial Intelligence in Education and Teaching." *In Recent Findings in Intelligent Computing Techniques* 407–17.
- Mo, Zhijia. 2017. "Rethinking and Unraveling the Personalized Learning Theory in the 'Artificial Intelligence +' Era." *Journal of Distance Education* 3(35):22–30.
- Murphy, Robert. 2019. *Artificial Intelligence Applications to Support K‐12 Teachers and Teaching: A Review of Promising Applications, Challenges, and Risks*. RAND Corporation.
- Park, C. L., C. Crocker, J. Nussey, J. Springate, and D. Hutchings. 2019. "Evaluation of a Teaching Tool-Wiki-in Online Graduate Education." *Journal of Information Systems Education* 23(3).
- Savin-Baden, Maggi, Roy Bhakta, Victoria Mason-Robbie, and David Burden. 2019. "An Evaluation of the Effectiveness of Using Pedagogical Agents for Teaching in Inclusive Ways." *Artificial Intelligence and Inclusive Education* 117–34.
- Takacs, A., G. Eigner, L. Kovacs, I. J. Rudas, and T. Haidegger. 2016. "Teacher's Kit: Development, Usability, and Communities of Modular Robotic Kits for Classroom Education." *IEEE Robotics & Automation Magazine* 23(2):30–39.
- Wang, Jiajia, and Tian Hu. 2019. "Review of the Operation Mechanism of American Virtual Charter Schools." *International and Comparative Education* 08:29–34.
- Wu, Yonghe, Bowen Liu, and Xiaolin Ma. 2017. "Building an 'Artificial Intelligence + Education' Ecosystem." *Journal of Distance Education* 5:27–39.
- Yang, Xixi, Tianyi Gu, and Xiaolong Qian. 2019. "Research on the Characteristics of Artificial Intelligence Talent Training in Stanford University." *Journal of Open Learning* 05:40–47.
- Yu, Wei, and Zhongfeng Hu. 2019. "Application of Artificial Intelligence in Foreign Universities and Its Inspiration to China." *The Modern Education Journal* 06:24–30.
- Zhang, Baobao, and Allan Dafoe. 2019. "Artificial Intelligence: American Attitudes and Trends." *SSRN Electronic Journal*.
- Zhang, Zhizheng, Linlin Zhang, and Mang Li. 2019. "The Due Analysis of Artificial Intelligence Education Application: The Necessity and Possibility of Teaching Automation." *Distance Education in China* (01):25–35.
- Zhou, Li. 2019. "Artificial Intelligence and Chinese Higher Education: Impact, Application and Countermeasures." *Education Modernization* 59:185–86.
- Zhu, Qiongli, and Minjuan Wang. 2019. "Team-Based Mobile Learning Supported by an Intelligent System: Case Study of STEM Students." *Interactive Learning Environments* 1–17.