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Personalized education and Artificial Intelligence in the United States, China, and India: *A systematic review using a Human-In-The-Loop model*☆

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ABSTRACT

The traditional "one size fits all" education system has been largely criticized in recent years on the ground of its lacking the capacity to meet individual student needs. Global education systems are leaning towards a more personalized, student-centered approach. Innovations like Big Data, Machine Learning, and Artificial Intelligence (AI) have given the modern-day technology to accommodate the distinctive features of human beings - smart machines and computers have been built to understand individual-specific needs. This opens an avenue for "personalization" in the education sector. From, mushrooming of Education Technology (EdTech) start-ups to government funding in AI research, it is evident that the next generation educational reforms would take a quantum leap forward piloted by Big Data analysis and AI. The objective of this paper is to organize the vast literature on the use of AI for personalization of education and to shed light on the key themes by which an AI-driven approach makes structural modifications to the existing education system. To this effect, the paper employed a systematic review using a Human-In-The-Loop natural language processing model of past two years' literature (2019–2021) in English language from IEEE Xplore on countries China, India and the USA. This process yielded more than 2000 search results at first and these were eventually shortlisted to 353 relevant papers for in-depth analysis. Being the pioneers in EdTech innovations, insights from research done in these three countries provides valuable input for the development of global education systems and research. The findings bring forward AI's success in catering to specific learning requirements, learning habits, and learning abilities of students and guiding them into optimized learning paths across all three countries. Not just that, it is also evident from the literature that AI augments educational content, customizes it for any individual according to their needs, and raises the flag of caution for anticipated learning difficulties. This recalibrates the role of instructors as well as optimizes the teaching-learning environment for a better learning experience. The upward trajectory of educational development with AI opens a new horizon of personalized education for the future generation, but also comes with its challenges. Data privacy issues, availability of digital resources, and affordability constraints have been reported in the recent literature as impediments in the way of promoting such technologies for day-to-day practice.

1. Introduction

A key goal of education is to foster the talents of students and to provide them with a holistic learning experience. Hence, it is imperative to teach in line with each individual's ability, which could not be provided by the conventional paradigm of one-size-fits-all in traditional education systems. The idea of personalized education paves the way for a more nuanced teaching technique. The concept of personalized education comes from the idea of "precision medicine", where data to identify patterns relevant to specific patients are analyzed so that prevention and treatment can be customized. This is why such

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Abbreviations

AI	Artificial Intelligence
CBI	Computer-Based Instruction
EdTech	Education Technology
EDM	Educational Data Mining
HITL	Human-In-The-Loop
ICT	Information and Communication Technology
ITS	Intelligent Tutoring System
LDA	Latent Dirichlet Allocation
NLP	Natural Language Processing
PLS	Personalized Learning Space

transformation of the education system toward a more personalized structure is called "precision education", although this term has been increasingly replaced by terms like "personalized teaching and learning" in the recent academic literature. Personalized education involves predicting students' performance and providing them feedback to optimize learning after analysis of student learning profiles and retention patterns. Overall, personalized education attempts to improve the diagnosis, prediction, and treatment of learning outcomes alongside the prevention of learning losses.

The advent of computer-aided teaching and learning has played a very important role in the propagation and development of personalized education. Computer-Based Instruction (CBI) came into the limelight in the 1950s, especially in developed nations like the United States. However, education technologists across the globe started developing programs to assist tutors and test students around the early 1960s. The teaching machines that were introduced at this time were predominantly contributions from the field of behavioral psychology. Skinner (1958) mentioned key characteristics of teaching machines and programmed instruction as the arrangement of materials so that the student could make correct responses and receive reinforcement when correct responses were made. With the advent of the internet, CBI transitioned into the broader header of Information and Communication Technology (ICT) which included computer, internet, and electronic delivery systems (Fu, 2013). Flourishing growth of the ICT sector over time has required up-to-date and reliable data, and this is where use and analysis of large datasets comes into play.

Big Data and Artificial Intelligence (AI) applications have great potential to help produce meaningful insights from the datasets to understand learning trajectories of students so as to enhance the efficacy of educational systems. From creating customized study material for a particular student as per their specific learning requirements, to creating customized tests and evaluating them; from cautioning an instructor about potential learning hindrances to answering a student's questions by simulating a human conversation, the application of data has penetrated deep enough into the education system to significantly modify its shape and structure.

This paper aims to assimilate recent research trends on the incorporation of technology for personalized education in the three top EdTech hubs of the world: the United States, China, and India. This study focuses on applications of AI and has used a systematic review methodology as the first attempt at exploring, curating, and documenting observational and causal research on the topic across the three countries. The rationale behind using a systematic review is precisely to get rid of technical or semantic digressions caused by the abundance of papers available in the field, and get on board with the thematic changes and work on them for better implementation. Put differently, the major themes that emerge from this review are intended to guide future researchers both in terms of technological innovations as well as policy design, and in turn aim to help in effective implementation of AI-powered personalized education systems.

2. Personalizing education with the emergence of data-driven EdTech

Personalizing education can be considered as an evidence-based approach in educational practice. A personalized system of education is designed to recognize and analyze the individual-specific learning abilities, learning requirements, and study goals so as to customize the content delivered accordingly. This customization can be comprised of revision, reorientation and even reconstruction of an otherwise unified curriculum. An individual-specific focus can also help to eliminate learning difficulties of marginalized learners for a subsequent enhancement in teaching and learning productivity (Yonezawa et al., 2012). In fact, personalization is not a new concept in the education sector. Terms such as personalizing, matching, or tailoring of educational content have been used interchangeably over time to recognize and better understand the heterogeneity among learners with specific problems so as to prescribe remedial interventions more precisely. In fact, problem analysis to examine student's needs is the first constituent of personalized education (Cook et al., 2018). Based on problem identification and diagnosis, solutions can be designed to match students' learning requirements and preferences. Here, the application of Education Technology (EdTech) has given a tactile medium to the education sector for personalization through data.

In the latter half of 1990s and even in the early years of 21st century, EdTech was primarily focused on the receiving end, i.e. to supplement student learning through the existing formats of offline teaching (Liu et al., 2017). However, recent innovations in data analytics have rendered a feedback system to the teaching-learning process. It means that the collected learner data provides a much in-depth comprehensive understanding of what works best as the most optimal learning environment. This approach has generated the basic idea of using data mining, Big Data, and related technologies in order to personalize education. Two areas of research should be mentioned here as the building blocks of personalization in the education sector, one is Educational Data Mining (EDM), and another is learning analytics.

EDM primarily deals with formulating algorithms to have a better understanding of the learning environment and make better predictions regarding that. On the other hand, learning analytics mostly caters to the problem of how to use those algorithms efficiently (Liu et al., 2017). In recent years, considerable success has been achieved by using learning analytics where data of students' responses to certain teaching techniques, contents, and learning resources are recorded in vast quantity. This data is then analyzed for pattern recognition and for building predictive models to prescribe suitable learning choices according to their learning characteristics of students. The structural shift towards using Big Data, EDM, and learning analytics in education has led to immense possibilities of using AI in the sector (Zhang and Aslan, 2021).

Instances of using AI in education include creating interactive Personalized Learning Spaces (PLS) with a primarily virtual operating medium that have been found to provide massified access by eliminating the geographic hurdles to learning. Using such systems anyone can learn from any location according to their own convenience. Besides, such systems can also recommend learning plans based on AI-driven adaptive iterations (Xu, D., & Wang, H., 2006). Similarly, an AI-based Intelligent Tutoring System (ITS) in the US that personalized educational content according to the extra-curricular interests of the student showed that such an approach in instruction could yield more effective learning (Walkington and Bernacki, 2019). In extension to this, AI-enabled education has also achieved considerable success in language studies. An empirical exercise conducted on students in Hong Kong (Fryer et al., 2017) revealed that AI companions, in comparison with human companions are claimed to enhance learning experience in language studies. Furthermore, AI-powered education systems also contribute to improving pedagogical planning. As an example, a study conducted in Taiwan in 2020 can be considered that found AI-driven educational systems helped reduce learning anxiety among learners by using

cognitive performance analysis and deriving a positive feedback loop (Hwang et al., 2020). The key aspect to be noted here is that AI-driven systems offer a feedback mechanism which intakes data and conducts predictive analysis using predetermined algorithms.

Moving forward, learning management systems, learning companions, virtual reality, intelligent tutors – are all potential and new-age tools built on the very essence of AI. The interactive nature of AI-enabled learning systems helps to receive feedback and understand the requirements of the learners on the basis of that and lastly, prescribe suitable learning choices for the learner depending on predictive algorithms. So far, the above discussion gives the reader a glimpse of the existing literature about application of AI in the education sector. The upcoming sections of this paper will discuss the more up-to-the-minute additions to the use of AI in education from the standpoint of personalizing education. It is important to note here that the existing literature has explicitly acknowledged the requirement of AI EdTech to be more connected to the mainstream pedagogical structure of the education system across the globe. Lack of an education-specific perspective to AI research has been clearly mentioned as a limitation in many previous systematic reviews of literature (Zhang and Aslan, 2021). Keeping that in mind, the main discussion of this review is organized from the standpoint of how AI infusion is shifting the educational paradigm and shepherding it toward the pedagogical objective of personalization across the three biggest EdTech hubs: USA, China, and India.

2.1. EdTech in USA, China, and India

AI is transforming the global landscape and is expected to touch all important aspects of human life in the time to come. Building data-driven intelligent machines to understand, analyze and even simulate human behavior is what makes AI the game changer in all the sectors including the education industry. Naturally, some of the world's biggest economic powers are chasing the crown of leadership and supremacy in EdTech by experimenting with newer techniques to integrate AI into the education system. Judging by the global EdTech scenario in recent years, the United States, China and India dominate the competition in the world to become global EdTech leaders (HolonIQ). Whether it is about growing EdTech startups or about innovating and developing better and more compact AI-driven EdTech; these three countries secure the top of the leaderboard.

The United States secures the position of being a longstanding and mature incumbent in the global EdTech scenario, with companies like Coursera, Udemy and Masterclass providing service to learners worldwide. China and India - the two booming powerhouses - have also proven themselves to be worthy competitors in the recent years. These two countries spend a considerable proportion of their GDP (around 4 percent) on educational development and innovation. As a result, in 2019 India and China together represented more than 70 percent of the global EdTech capital. Since January 2020, forty-two EdTech companies in China itself secured a combined USD 10 billion equity funding from investors as reported by HolonIQ. Yuanfudao, VIPKid, Knowbox are the notable Chinese EdTech startups in the list of global unicorns. The Indian learning app ByJu's is valued at $21 billion as per Holon (2022) which is the highest valuation given to any EdTech startup in the world right as of now. Apart from this, five other EdTech companies from India have secured the position of global EdTech unicorns between August 2021 and January 2022, namely: Unacademy, Emeritus, upGrad, Lead School and Vedantu. This signifies the importance of India in the context of EdTech research in upcoming years. Overall, the EdTech products across the US, China, and India are all catering to the personalization agenda. However, it is to be noted that although India and China are shelling out a fortune for AI development and smarter educational options, the US still holds a position where EdTech is more inclusive when it comes to on-the-ground proliferation. For instance, American startups cater to a wider variety of needs of the consumers, starting from online curriculum, career planning, corporate learning, amongst others, while the ones operating in China and India are mostly focused on tutoring, test preparation and language studies (Horn & Staker, 2016).

Coupled with these market-based developments, both Indian and Chinese governments have actively participated in this journey. The "New Generation Artificial Intelligence Development Plan" published by the State Council of China, which released in July 2017, presents an outline of strategies to build a USD 150 billion AI industry with a vision to make China a leader in Artificial Intelligence by the year 2030. Pari passu with these initiatives in China, the central government of India has also launched a program called "AI for All" as a part of their new National Education Policy 2020 - which is a self-paced 4-h inclusive learning program that explains the crux of AI to the common populace. While these Asian EdTech giants are taking their leaps forward to compete with the incumbent, the US government is definitely not lurking behind. Congress and the White House has also documented its desire to boost AI R&D funding yearly from about USD 5 billion in unclassified spending in 2020 to USD 25 billion by 2025. Rasser report (2019) also documented that "investment in AI would be around 19 percent of the total federal R&D spending in the budget for the 2020 fiscal year and this investment would be a small price to pay for a key driver of long-term economic growth".

With this brief outline on the use and successes of EdTech, especially AI, for personalization our paper explores the recent academic literature on the topic and the diversity across US, China, and India using a systematic literature review and natural language processing. The motto is to understand the intent and the forthcoming direction of EdTech research in the field of personalizing education in these three countries. To this effect, we undertake screening, collation, and review of new research to understand which trends have continued and what are the areas for future research for personalized education and AI. These steps have been detailed in the following section.

3. Research methodology

Recent research has made the role of Big Data and AI very prominent in the education sector. A more individualized learning and assessment system powered by Big Data analysis is being massively discoursed. To evaluate where the literature stands on personalized education, Big Data analysis, and AI in the current context, this study explores:

a. The recent status of research on AI and personalized education in the top three global EdTech leaders: US, China, and India
b. The main areas where AI has been incorporated for personalizing education
c. The present limitations in the field of AI-enabled education

3.1. Systematic review using a Human-In-The-Loop (HITL) model

This study follows a Systematic Review (SR) methodology that involves search, collation, and appraisal of all relevant mainstream and supplementary AI and Personalized Education (PE) literature for the United States, China, and India. An English database - IEEE Xplore is used for this purpose with a time-reference period of 2 years (2019–2021).

An SR is defined as "a review of the evidence on a formulated question that uses systematic and explicit methods to identify, select, and critically evaluate relevant primary research, and to extract and analyze data from the studies that are included in the review" (Booth et al., 2016). It is different from the traditional narrative reviews in several ways. Narrative reviews are mainly descriptive and do not involve a systematic search of the literature. They also often focus on a subset of studies in an area chosen based on the availability or author selection. Narrative reviews are mainly informative and create the problem of selection bias. Systematic reviews typically involve a detailed and comprehensive plan and search strategy derived a priori,

intending to reduce bias by identifying, appraising, and synthesizing all relevant studies on a particular topic (Popay et al., 2006).

The steps that were followed to undertake the systematic review for this study are listed below and also illustrated briefly through Figure A1 in Appendix.

i. The first stage was to formulate the review questions and a review title - aspects that are discussed earlier in this paper.
ii. The second stage was to define exclusion and inclusion criteria. Such criteria that we used in our study are mentioned below:

Inclusion Criteria (IC):

- Papers published in listed academic journals including conference papers
- Papers that were mainly focused on personalized teaching and learning
- Papers talking about various applications of AI and Big Data Analytics in education sector
- Papers mentioning challenges of integrating AI in the education system

Exclusion Criteria (EC):

- Papers that were published in magazines, books
- Papers that were focused on secondary studies like survey, reviews, posters, tutorials etc.
- Papers that were included and focused on topics like "medical education", "robotics education", which are based on technical disciplinary knowledge
- Papers that were more focused on computer sciences theories only including deep learning and other methods and applications of AI.

iii. The third stage was to develop search strategies that focused on the list of relevant keywords. For example, in this study across all three selected countries, articles were selected based on keywords such as: education, learning, teaching, and artificial intelligence.
iv. The fourth stage was to select the subset of relevant studies. After searching articles or papers with the help of the keywords, retrieval and review of a detailed list of abstracts and studies were performed. After obtaining the papers for each of the countries and minimizing duplication, an ML-based text mining technique was used to remove punctuation marks and "stop" words to clean the abstracts. Here, a Lemmatization process was also used where words in third person were changed to first person and verbs in past and future tenses were changed into present.
v. The fifth stage involved running the Latent Dirichlet Allocation (LDA) process, a commonly used ML technique for topic modelling. This process helped to create multiple groups of "bags of words" each of which form a topic. We limited our study to 10 topics.
vi. The sixth stage included exploring the different LDA characteristics like "number of topics", "number of words per topic", "coherence value" etc. to ensure that we are able to identify the most relevant topics for our study. This process also helped us to reject the papers that were evidently a part of the areas under our exclusion criteria or those out of scope for this study.
vii. The seventh stage included selecting the main relevant topics for this study. Three main topics focusing on "student" and "teachers" and "use of technology" (yielding a total of 999 papers) were used for further analysis in this study. A second stage LDA was applied to these 999 papers to develop a list of 25 sub-topics. Of these the main sub-topic (353 papers) that covered the maximum number of papers and also focused on "student", "teacher", "education", "use of AI", and "personalization" were selected for further consideration and analysis.
viii. The last stage included an analysis of these selected papers included reading the abstracts/key words of all the selected papers i.e. 353 papers and identifying broad themes from these papers. Of these, the papers that were fully read are listed in the Appendix in Table A1, out of 353 papers, 336 were read, 17 were not found to be relevant to the paper's research topic and were left out of analysis. Papers that explicitly discussed "application of AI in education" were read in full. The writing process involved summarization of the key observations from the literature, indicating the recent research trends in AI-enabled personalized education. The writing exercise also included identifying and summarizing the limitations of the literature thus providing future research opportunities.[2]

Key procedures followed under Steps (iii)-(viii) are discussed in detail in the section below.

4. Analysis

4.1. Search process and data extraction

For this review, the papers were collected from IEEE Xplore and it was last searched on June 11th, 2021.[3] As the initial stage of the search process, the keywords relevant to the present exercise were used in the search string for extracting relevant papers. Those keywords are stated below:

"Education" AND "Learning" AND "Teaching" AND "Artificial Intelligence" AND "China" (or "USA" or "India").

Mainly journal articles alongside conference and early-access papers, which were published from January 2019 to June 2021, were collected for this exercise. Web Scrapping was employed for extracting and exporting the data. This allowed the citation information to be collected, including aspects like: Title of the paper; Authors' names; Abstract of paper; Publication year; Publishing place; and Publisher name.

A total of 2067 journal articles covering literature from United States, China, and India were collected. Out of these, 600, 1133, and 336 papers were extracted using the search terms: the United States of America, China, and India respectively and these were appended together into a single database. Following this, exact duplicate entries were identified and removed. This left 1709 papers for further exploration.

4.2. Topic modelling

In order sieve out the key themes emerging across the abstract of 1709 papers, a text-mining approach using Natural Language Processing (NLP) known as "topic modelling" was used. Topic models are "probabilistic models for uncovering the underlying semantic structure of a document collection based on a hierarchical Bayesian analysis of the original texts" (Blei and Lafferty, 2009). The core idea of the topic modelling step is to identify keywords and groups of keywords that describe the content of the set of publications returned from the paper's search query. Topic modelling identifies the groups of words that are likely to occur together and represent a specific topic. The most commonly used topic modelling method for modelling the document collection (corpus) is the LDA, which is an unsupervised generative probabilistic method.

[2] As a next step to this paper, a sub-topic selection using the 999 papers would be undertaken for developing the writeup on each of the discussed themes.

[3] IEEE is the world's largest technical professional organization dedicated to advancing technology for the benefit of humanity.

To prepare the data extracted from abstracts for running the LDA model, it was important to first clean and organize the text. To this effect, all punctuation marks, html tags, whitespaces, and duplications were removed from the abstracts by using the "gensim" package in Python alongside the commonly used method of "lemmatization". Lemmatization combines all similar words into their root words, thus enhancing data efficiency. Finally, common stop-words were also removed. Post cleaning and coding, the LDA was used to identify words that would together represent a common topic/theme. The LDA learns to model the topics by going through each document and cluster bag of words that have a high likelihood of term co-occurrence. By analyzing the words that describe a cluster, the researcher can then interpret the underlying topic for each cluster.

LDA helped to generate 10 topics, of which only three broad topics were relevant for our analysis, given our research questions. The bag of words associated with these topics are provided in Appendix II. The three topics collectively covered 999 out of the 1709 papers. Next, using these 999 sub-selected papers, we re-ran a second-stage LDA to determine more precise sub-topics for further analysis. Fig. 1 presents the results from the second-stage LDA.

After this exercise was done, the topic that was found to be most applicable to studying personalized education (teaching and learning) and the use of AI was the one highlighted in red in Fig. 1 i.e. topic 1.[4] The left-hand side in the figure represents the inter-topic distance showing the marginal topic distribution of each topic. The horizontal bar chart represents top 30 most relevant terms under topic 1, along with its estimated term frequencies. The closer the circle with each other the greater is the chance of getting overlapped words under each topic.[5]

Topic 1 included all the relevant papers on student-technology and teacher-technology interactions. The derived "bag of word" contained under this topic were:

"teaching"; "technology"; "education"; "development"; "information"; "paper"; "college"; "application"; "quality"; "mode".

The selected sub-topic had 353 papers, which were read in full. Overall, this process set the right direction for the upcoming discussion which revolves around "technological development" i.e. AI and Big Data analysis in particular in reforming the education sector. As mentioned earlier, the main focus is on "personalized education".

5. Review and trends from the selected literature

5.1. Status of the IEEE xplore publications on AI and personalized education in the top three global EdTech hubs: US, China, and India

China has leading number of recent publications in IEEE Xplore on the use of AI in education, compared to India and the US (see Fig. 2).

Among the final list of 353 papers selected through topic modelling, 272 papers (77 percent) included China in their analysis. It is evident from this particular observation that although, so far the Chinese EdTech market has catered to tutoring and language studies and other basic requirements of the students, the researchers have experimented with a wide array of possibilities incorporating AI and personalization of education. So far this has not been reflected well in the market scenario and cannot be captured just by giving a glance on the Chinese EdTech market, but its effect is most likely to be observed more dominantly in the upcoming years. In other words, Chinese literature talks elaborately about implementation of different AI tools in vast and varied educational disciplines. According to the requirements of any particular field - which includes engineering to music lessons and of course, language studies - suitable tools are deployed to enhance learning experience. Compared to that, research catering to the Indian domain of the literature mostly talks about a supplementary system to enhance the performance of the existing traditional schooling system through a choice of personalization. In fact, Indian literature has also contributed to the discussion of personalization through some administrative usage of AI in this particular work as well. A part of Indian literature can also be connected to the sudden compulsion of using the virtual mode of education after the recent worldwide pandemic. This observation tallies well with the current EdTech scenario in India mentioned in the earlier section of this paper. Even though a number of EdTech unicorns are harboring in India, the general direction in which they are operating, is mostly tutoring and working as a supplement to the existing traditional setup of learning.

Apart from China and India, the US literature talks about varied application of AI in different disciplines as well, starting from vocational education, engineering education, K-12, preschooling and so on, the arguments can be similar as China, however, the quantity of papers on the US is relatively lower over the 2020–21 period. In addition to the publication bias (given we have only looked at the literature published in IEEE Xplore), one of the reasons that can be hypothesized is the incumbent status of the US in the field of AI-driven EdTech. The US already offers diverse array of EdTech services to its learners as mentioned before which gives it its incumbent status. Therefore, it can be said that only further significant innovation of AI can give the system a significant boost in the US education system.

5.2. The main areas where AI has been incorporated for personalizing education

The recent trend of personalization in education sector reforms calls for a suitable apparatus to analyze behavioral patterns based on data in order to recognize individual specific requirements leading to enhanced student performance. Big Data analysis and AI being the colossus of modern technological innovations, provide an efficacious way of "extracting useful insights from complex heterogeneous datasets to improve decision making through diagnostic, prescriptive and predictive features" (Al Hadwer et al., 2019). Big corporations like Netflix and Amazon use this technique to predict a particular consumer's set of preferences and recommend suitable products accordingly. In another way, one can think of it as a utility maximizing exercise where a computer algorithm tries to incorporate all the factors affecting a particular person's utility with the help of an existing database, and tries to prescribe the best among the available basket-of-goods based on its judgement, in order to maximize that person's utility. Therefore, because of this very nature of the technique itself, it possesses the potential to morph the education sector in the way intended. However, such a technique is relatively new and demands rigorous research about scopes, areas of application, and feasibility criteria for effective implementation.

5.2.1. Student-centered learning solutions

As discussed at the very beginning of the paper, the substantial paradigm alteration toward personalization is primarily motivated by the remissness of the traditional setup to concede the heterogeneity among students and the subsequent hindrances in learning. There is nothing but undisguised distinctive nature of human beings behind this notion. Learning requirements for a set of students cannot be identical. In the traditional system, the instructor holds a pivotal position and instructs the entire set of students according to the curriculum. Evidently the instructor, the curriculum, and the instructor's pedagogy of communicating the curriculum to the students become the fulcrum of the entire system. In reality it is observed that some students in fact find a guided, structured way of teaching helpful while others benefit from

[4] Selection of topic 1 was also validated through a manual check by reading all the paper abstracts. The other topic identified through the second-stage LDA included aspects of AI use in other disciplines or generic educational problems rather than a combination of AI and personalized education – which is the main area of focus for this paper.

[5] This is an interactive visualization. By changing topic number top 30 words for each topic can be seen.

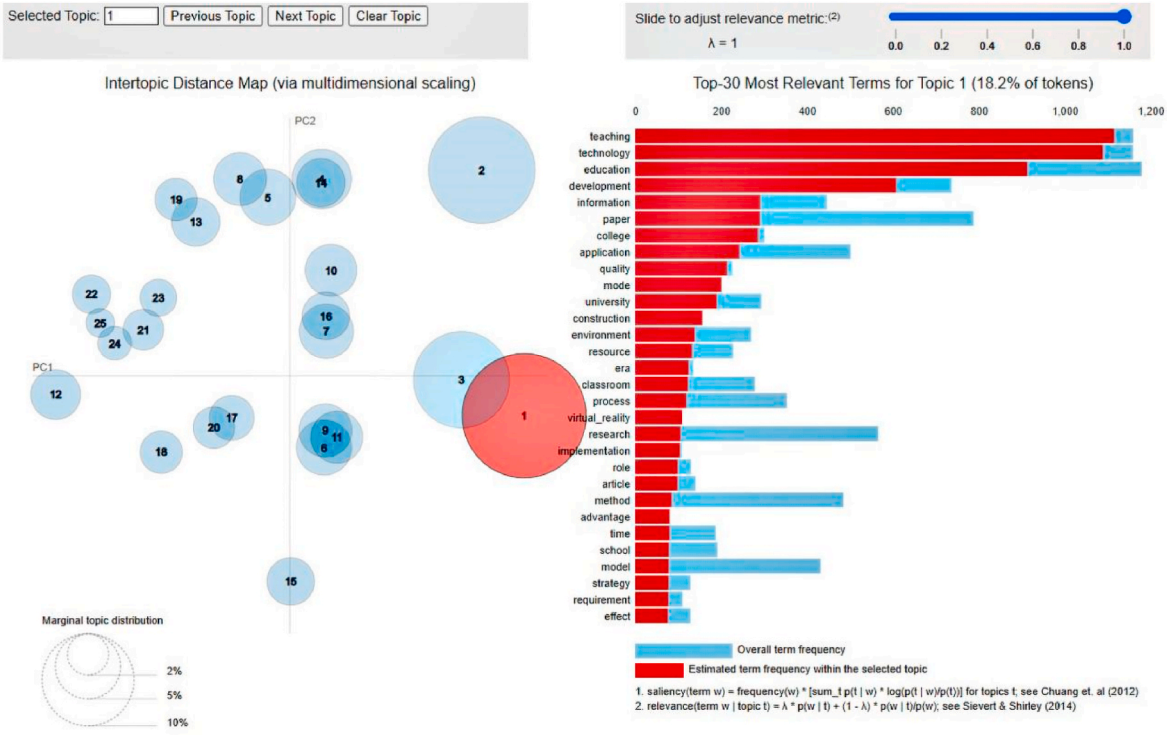


Fig. 1. Topic Modelling using LDA (Latent Dirichlet Allocation): Snapshot of the Model Results.

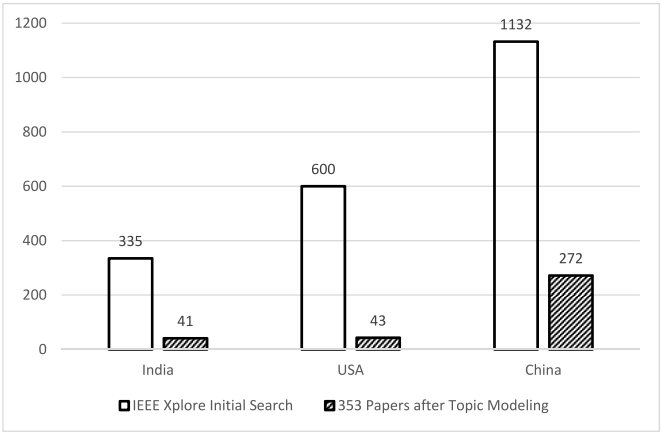


Fig. 2. Distribution of papers among three countries.

opportunity of self-motivated exploration and discovery (Tang et al., 2020). Therefore, it becomes increasingly important to assess the requirement of a particular student, or a group of students and build a collaborative structure where the primary focus will be on a student's learning requirements. This is likely to provide a much more engaging learning experience and thus reduce the risk of failure or dropout (Al Hadwer et al., 2019). In brief, the learning will become more "student-centered".

This dire necessity to accommodate individual specific factors in the education system brings AI into the scenario as the building block of the new generation education system. AI, coupled with the existing technological involvement in the sector, is directed to systematically modify and redesign certain crucial components of the education system to capture and accommodate individual-specific factors. This theory-of-change supports its contribution to the overall enhancement of the learning experience across all levels of education, namely: preschool-, primary and secondary school-, vocational-, and tertiary-levels. This is further discussed in the following sections.

5.2.2. *Incorporation of learning abilities and habits*

AI has been found to ease the herculean task of administering complex exercises on massive datasets while retaining the heterogeneity talked about earlier. This qualifies AI as the driving force behind a personalized education system - since it liberates a system to provide an inclusive platform for all types of learners. AI-powered personalized learning enables a student-centered educational ecosystem which stands on two pillars (Horn and Staker, 2016). One relates to catering to the specific needs of every individual student by means of personalizing and customizing the study material; the other involves taking account of the learning ability of any individual student. Every single student has a unique learning attitude, intention, and motivation to learn with varying levels of foundational skills and knowledge requirements to ensure the effectiveness of learning. The recent literature across the US, China, and India discusses that Artificial Intelligence can comprehensively record and track different learning characteristics of learners and recommend suitable teaching and learning strategies based on an individual's specific learning characteristics (Liang and Hainan, 2019). This transformation ensures that the students, the protagonists of the education system, do not remain on the passive side (Tong et al., 2019). Unlike being hyper-focused only on the scores as learning outcome, AI-powered systems have been found to be capable of including even the smallest individual-specific factors (such as the level of concentration in class, participation in learning activities, and even some non-cognitive skills such as communication or in-class behavior). This is where the paradigm shifts, the system gets pushed toward personalization and its overall efficiency is enhanced. Identification and incorporation of different learning styles (visual, auditory, reading/writing/kinesthetic), learning habits (regular tendencies of students which could be learning conducive - such as being organized and taking notes in class, or not – making systematic mistakes while problem-solving), and the learning pace of students enables an AI-powered system to recommend personalized "learning paths". A brief summarization can be done by highlighting the fact that the recent literature singularly resonates that AI provides a tangible way of recognizing and integrating the previously neglected heterogeneity among learners. In other words, an "average" student in

terms of overall scores can be "excellent" in terms of one particular aspect while very plausibly be "poor" in another.

5.2.3. Learning paths

The analogy of utility maximization given at the very beginning of this section mentions an optimal choice of "basket-of-goods" which maximizes utility, i.e. to say that it provides the most efficient way of getting the most out of the learning experience. This can be called a "learning path". AI-enabled "smart" machines, trained by analyzing existing data, have been reported to discern behavioral patterns among individuals, identify each factor responsible for learning experience and learning outcome and "predict" future moves and outcomes of an individual learner based on that analysis. This allows an AI-system to classify learners on the basis of those factors and recommend suitable learning choices as per the capabilities of any particular learner by predicting their moves.

Empowered by innovations e.g. data-mining which uses results from different exercises and uses it to extract valuable information implicit in individuals from large, unstructured and random data set (Wang et al., 2019) the system gains adaptive ability that can identify learners with similar characteristics and classify them (Wang et al., 2019); as well as recommend a learning path to a future learner. The system's ability to adapt to specific requirements and abilities of a particular learner enables the recommended learning path to enhance the learning effect of a learner pushing the performance over the learner's initial choice of path (Li and Zhang, 2019). Besides, pinpointing strong and weak points of a particular learner can work as a measure to eliminate learning difficulties.

5.2.4. Diagnostic and predictive solutions instead of remedial solutions

Clearly, AI offers an easement in detecting and addressing the shortcomings of an individual by proposing countermeasures based on the data analysis (Li and Wang, 2020). However, the role of data analysis is to be emphasized at this point. A preemptive "diagnosis" of data brings up "predictive" measures. This is what sets AI-enabled education way apart from the traditional approach. The "diagnostic" and "predictive" nature of the system opens up a new horizon. Instead of stumbling upon learning difficulties resulting in grave consequences like failure or dropout, AI makes it possible to raise a flag of caution beforehand, giving a chance to implement the solutions as a preventive measure, not a remedial measure (Tong et al., 2019). More importantly, the "diagnostic" feature of the system also helps detecting and monitoring the root causes of the problems, thus addressing it at a nascent stage. Therefore, it works as a proficient monitoring medium to caution any upcoming difficulties, fine-tuning the education management for all involved agents (Luo, S. 2019).

5.2.5. Augmenting educational content

Setting aside the role of AI as an overseer of the education system - optimizing educational environment, the literature is vastly vocal about its unmediated involvement in the learning process itself. Beginning at performing utterly generic tasks e.g. outlining the subject matter of a textbook to workable create study guide (Mondal, K., 2019); using data fueled assessment prowess, AI builds "Intelligent Examination Systems" which uses automatic computer-aided evaluation for higher efficiency. Such systems are capable of a wide variety of tasks which includes setting up customized test for a particular respondent, conducting remote examinations, evaluating subjective and technical answers, and so on (Li and Wang, 2020). In fact, AI-integrated software like Gradescope can assess an answer to a question as well as can judge the merit of a piece of writing. This quick glance at the grassroots assimilates the vast literature's take on AI powered educational resources which "carry the dissemination of teaching content and the organization of teaching activities" (Zhao et al., 2020). This is why AI has secured its place in augmenting educational content - either by supplementing the traditional classroom teaching or by simply being a self-sustaining host of some learning activities. In both cases, the bigger picture of personalizing the education sector remains in the foreground. Whether it is language studies, vocational training or physical education, AI has active involvement in all of them. AI can work as a referee or a coach on the ground, Deep Learning enabled "Nine Songs" can generate Chinese classical poetry, Google's Magenta and Sony's Flow Machines can compose music using algorithms - the list goes on (Xu et al., 2020). Evidently, AI contributes to a substantial transformation of the educational content - sometimes optimizing the English teaching environment to get the most out of classroom teaching (Hui, Q., 2020); and sometimes by optimizing engineering education curricula based on the objectives of the course (Chen et al., 2019).

5.2.6. Incorporation of non-cognitive skill development

Indisputably, contribution of AI has not been straitjacketed into curriculum development and outlining textbooks. Built in the fabric of Big Data analysis, AI represents educational content embodied in a narrative game environment to guide the learner in a self-directed path of learning - also known as "gamified learning". A simulated environment is used to judge the knowledge and requirement of a player (learner) (Tang et al., 2020). Pilot results on student contests and interviews of focus groups point out that simulation-based virtual learning enhances strategic thinking and problem-solving skills of the learners. The most advanced development in the field of simulation is Virtual Reality or Augmented Reality (VR or AR). With the help of appropriate hardware and software, it is possible to build an interactive simulated environment providing and immersive experience appropriate for particular instruction purposes (Fan and Zhi, 2020). A real time flawless 3D simulation pushes the pedagogical experience beyond the limitations of space-time and can give access to otherwise inaccessible experiences in classroom teaching. This contributes massively to skill development and helps configure real world ideas in a risk-free way (Joseph et al., 2020).

5.2.7. Recalibrating the role of instructors

As discussed so far, systematic modifications in educational content substantiate significant changes in teaching methods. Not surprisingly, the role of instructors is recalibrated under this new paradigm. Access to MOOCs (Massive Open Online Courses), delivery of knowledge through eLearning platforms, cloud classrooms etc. construct a platform for sharing teaching resources (Feng et al., 2019). Clearly, in the era of AI, instructors are no longer expected to be only information providers, even in developing countries like India. Advancements in AI-powered assessment systems and content augmentation has been found to free up the instructors from the monotonous and repetitive tasks of preparing lesson plans and grading answer sheets. The teaching mode becomes blended with development of flipped classrooms where activities like recording attendance and designing quiz for the students is handled by computers (Liu, X., 2019). Most importantly, since teachers are relieved from the repetitive tasks, they can employ their creative and critical faculties in becoming facilitators and learning motivators, design better curriculum etc., which contributes to the all-round holistic development of the education system. For instance, Third Space Learning (Tong et al., 2019), an AI-enabled platform, was found to reduce teachers' workload in China. Identifying target students, arranging lecture materials, and preparing lecture notes all used a significant amount of time of teachers. By leaving these repetitive tasks for the computers to do, an average instructor was found to save 10 h 50 min per week. This additional time was reported to be used for building harmonious and solid teacher-student relationships and promoting overall long-term student development.

5.2.8. Incorporation of learning companionship

The literature distinguishes weak Artificial Intelligence from Artificial General Intelligence (AGI). Here AGI represents flexible machines that can simulate human interaction instead of being trained in one

repetitive task committed to one single objective. An application of such technology is a "chatbot". A chatbot is an AI-based software that can simulate human conversation over telephonic and textual platforms (Ranoliya et al., 2017). In the context of the Indian higher education sector, the application of chatbot - independent of the age, gender and level of education of the user - delivers a number of benefits. In the era of personalized learning, an AI chatbot works as a personal learning companion. There are chatbots which provide a stimulus in question form, assess the answer given by a learner, and gives feedback. It understands the "need and speed" of an individual learner, reflects on the performance and provides learning motivation; in short the actions of a chatbot can be categorized in three stages, initiation, discussion, response and feedback. Apart from being directly connected to the teaching and learning activity, chatbots provide student guidance and assistance thus contributing to the administrative side of the education sector as well by answering FAQs, resolve problems related to admission process, fee payment etc. Chatbots give the students an easy and efficient way of communicating with the institution which eases the administrative workload for any institution.

5.3. Present limitations in the AI-enabled personalization

A transformation from the traditional one-size-fits-all to a more personalized structure of learning is surely a key to rebuild the next-generation education system. However, as the discussion primarily revolves around the incorporation of AI and similar advanced technologies, which are relatively new in the education sector, it is expected to have a set of new challenges as well. While the existing literature under review provides a basic outline of some of those challenges, a more elaborate and detailed exploration of the same is definitely left for future research.

In its very nature, a personalized learning system is a self-motivated setup where a set of adaptive learning tools are available for the learners to adjust to their personal preferences and skills. Despite the availability abundance, "motivation to learn" is not guaranteed by this system. This is where the role of instructors as motivators come into play and that becomes different from what it traditionally was, yet even more crucial than before in this new system.

It is to be rightfully noted here that AI integration is not a very simple process. For example, collection of data, cleansing and effectively using the data to draw insights is a complicated task which requires a functioning, reliable and effective frameworks.

Furthermore, Big Data and AI integrated systems are tech-heavy. Which requires significant amount of digital equipment and other supporting infrastructural modifications for a successful implementation. In fact, on the user-end, it requires training for the agents involved in the teaching-learning process to adapt to this new system. Therefore, not only it requires professional experts to design and implement a digitally equipped system, but also it requires some additional training for the end-users to make the system operational.

In the countries considered in this study, namely USA China and India, there is a significant difference in technological literacy, access to digital equipment, and availability of proper infrastructure. Hence, implementing EdTech - despite being a fascinating prospect and a game changer - does have a possibility of creating a serious learning inequality in terms of opportunities and affordability in high- and low-income countries.

Another question that arises in this context is that even if EdTech and AI enabled education is made available, will it be affordable by everyone? Will the low-income groups of the economies will be able to avail this newer form of education? Therefore, AI-enabled personalized learning, while rolling out a series of significant quality upgrade over the traditional setup, also demands a significant investment for a system to be functional.

While accessibility, affordability and feasibility are primary concerns about widespread application of EdTech worldwide, the literature remains mostly, but not completely silent about the unforgettable issue of data privacy and data security. Personal data of the agents involved in the teaching-learning process is what fuels an AI driven system. Ergo, it becomes extremely important to stay vigilant for any sort of potential breach to ensure that the privacy remains protected. The incident of Gnosticplyers stealing 932 million user records from 44 companies in China (Tong et al., 2019) does prove the presence of a potential threat while operating an AI powered system. For instance, while using a Chatbot in order to resolve some issues with fee payment, one might feel threatened that sensitive information e.g. bank details and credit card numbers are not in the safe hands. Therefore, added attention toward data security and stronger data protection laws are of immense importance. It is important not only to prevent potential disruptions in the system, but also to earn people's trust so they do not feel anxious or hesitated to switch to a new system.

6. Conclusion

For the past two years, the educational technology literature has explored different ways of incorporating AI in education with the agenda of making education more personalized. The literature clearly mentions that the distinctive features of human beings call for the education sector to marshal its attention toward individual specific learning requirements of the learners. This motivates the shift from the traditional "one size fits all" to a personalized format of learning. The key idea is to switch the spotlight from the curriculum and instructors to the students; i.e. to make the system more "student centered". This means instead of compelling the students to fit in the curriculum and the instructions, which was the case earlier, this new system is designed to adjust the curriculum and instructions according to the learning requirements and learning abilities of a particular student. Catering to a learner's specific needs is likely to motivate the general populace of students.

The literature makes another important observation about modern EdTech systems. The essence of Artificial Intelligence makes the systems operate in a "diagnostic" and "predictive" framework; enabling them to take precautionary measures against learning difficulties and their root causes on a preemptive basis.

While the exercise was initiated to personalize learning, it is evident that technological innovations have taken it one step further. By augmenting educational content, providing platforms to share teaching resources and bringing in technologies like VR, Artificial Intelligence truly changes the paradigm of education to a massive extent - making the system more interactive, engaging and motivating for the learners.

Despite the promising ground of personalized learning, AI enabled education has its obvious shortcomings. Data privacy issues, availability of digital resources and affordability constraints surely come in the way of promoting such systems for day-to-day practice. Therefore, with the current discussion about the positive sides of EdTech, the question of learning inequality does not vanish, rather it becomes more pronounced than before. This discussion demands more attention to ensure disruption-free, reliable and effective application of AI in EdTech.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix I

The steps followed for the systematic review are explained in Figure A1.

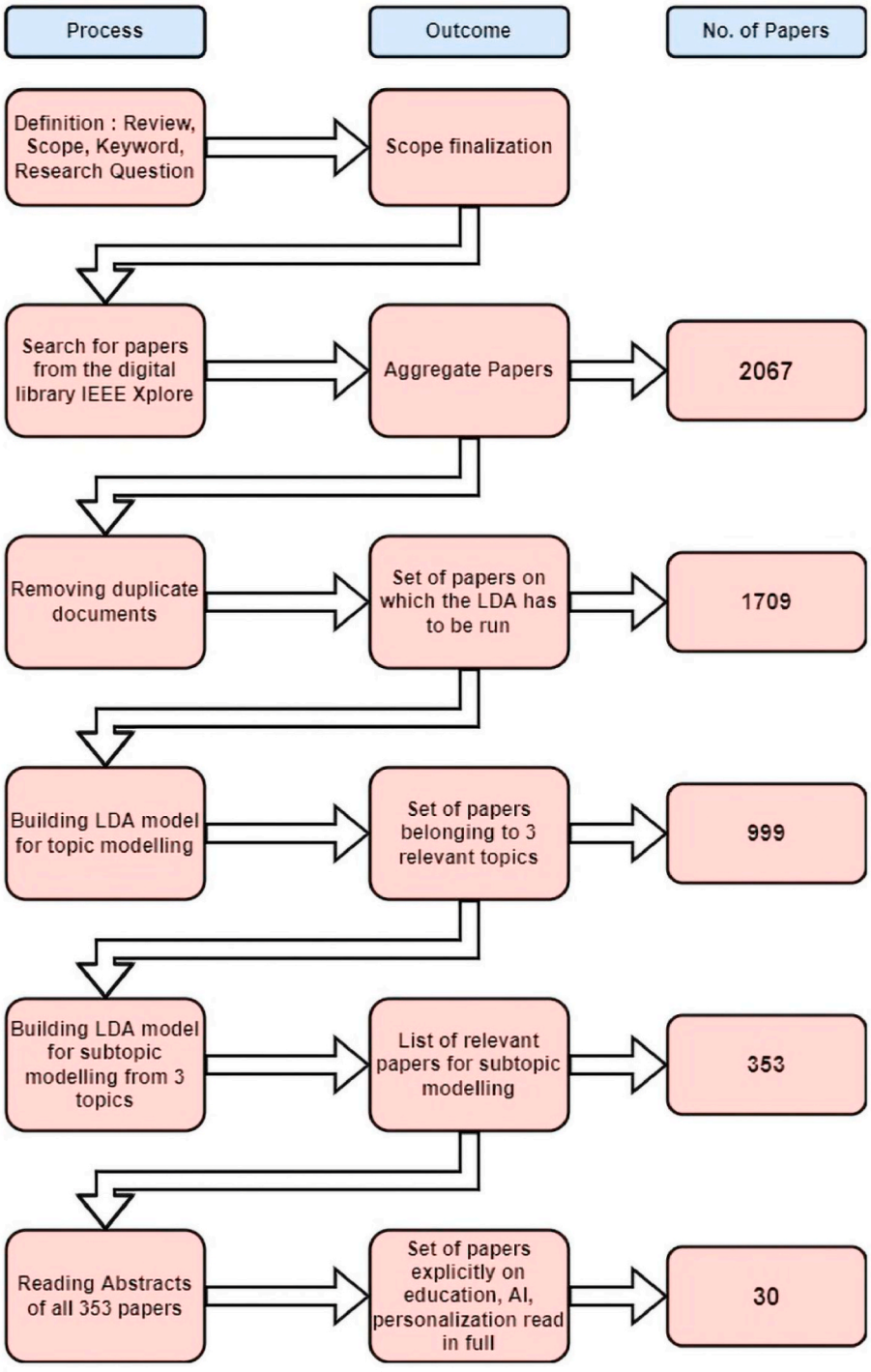


Fig. A1. Steps followed for the systematic review.

Appendix II

LDA topics

Listed below are the three selected relevant topics from the first-stage LDA (with 999 papers):

Selected Topic 1: “student”, “teacher”, “factor”, “program”, “influence”, “assessment”, “year”, “management”, “outcome”, “describe”
Selected Topic 2: “learn”, “learning”, “student”, “user”, “base”, “paper”, “provide”, “system”, “design”, “help”

Selected Topic 3: “technology”, “education”, “development”, “system”, “new”, “application”, “teaching”, “paper”, “teach”, “information”

Appendix III

List of papers covered in the Systematic Review are detailed in Table A1.

Table A1
Details of papers covered in the Systematic Review

Title of the Paper	Author	Year
Design and Development of self-Adaptive Learning System Based on Data Analysis	Shan Meijuan; Yang Kaili	2020
Eco-Environment Construction of English Teaching Using Artificial Intelligence Under Big Data Environment	Maohua Sun; Yuangang Li	2020
Massive AI based cloud environment for smart online education with data mining	Ying Pei; Gang Li	2021
The Construction and Discussion of Smart Learning Environment in the Context of 5G	Chen Chen; Sha Kun; Wang Yaping; Wang Yue	2020
Research on Individualized Teaching Based on Big Data Mining	Jie Jiang; Lei Zeng	2019
The Exploration of the Application of VR Technology in Music Education under the Background of Internet+	Duanping Gu; Fangyi Li	2020
Research on Music Teaching Reform and Innovation Development in the Era of Big Data	Fangyi Li	2020
An Applied Research on Big Data Analysis and Mining Technology in Education	Yanjie Wang; Chengpo Mu; Xuejian Li; Yu Yang	2019
The Optimization and Application of Blended Teaching Based on Artificial Intelligence	Gu Zheng	2020
Implementation of Online Guiding Framework based on Multimedia and PHP under the Influence of New Coronavirus	Yanxia Zhang; Xiang Gao	2020
Curriculum Reform in Big Data Education at Applied Technical Colleges and Universities in China	Xin Li; Xiaoping Fan; Xilong Qu; Guang Sun; Chen Yang; Biao Zuo; Zhifang Liao	2019
Debate with Maps: A new Pedagogical Architecture	Marcos Paulo Drago Lovati; Camila Zacché de Aguiar; Tânia Barbosa Salles Gava; Davidson Cury	2019
Assessment of Smart Learning Environments in Higher Educational Institutions: A Study Using AHP-FCE and GA-BP Methods	Zhicheng Dai; Chengzhang Sun; Liang Zhao; Zhi Li	2021
Research on Higher Vocational Teaching Quality Improvement Based on Educational Big Data	Ya Wang; Yanmei Yang	2020
Research on the Value of Smarter Education in the Era of Big Data	Jie Jiang	2020
The Construction of Accounting Curriculum System Based on Artificial Intelligence Technology	Yao Xu	2019
Design and Implementation of Dance Teaching System Based on Unity3D	Feng Tian	2021
A Study on the Training Mode of Preschool Education Talents in the Age of Artificial Intelligence	Lu Liu; Feng Xie; Ruyu Tan	2020
Application of Internet + Big Data and Artificial Intelligence in Vocational Education	Wenying Zeng; Siqi Kang; Binning Li	2019
Exploring and Evaluating the Scalability and Eficinecy of Apache Spark Using Educational Datasets	Jian Zhang; Zijiang Yang; Younes Benslimane	2019
Research and practice of the application of information means in the teaching of industrial design in the background of information	Ying Lin; Yue Sun	2020
Exploration of Multi-level Virtual Simulation Digital Printing Experiment Teaching Model	Wang Shi	2020
Construction of College English Ecological Teaching Mode under Computer Network Environment	Zhao Hua	2020
Construction of Accurate Teaching Model Based on Intelligent Teaching Tools——Take the Rain Classroom As An Example	Yuting Zhao; Yiyan Lei; Meng Li; Dongqiu Xin	2020
The Construction and Practice of Mixed Teaching Mode of Software Engineering for New Engineering	Mengzi Zhang; Shaowei Zhang; Xiande HU; Shuying Liu	2020
Towards an artificial intelligence strategy for higher education in Saudi Arabia	Majdi Elhajji; Abdulaziz S. Alsayyari; Adel Alblawi	2020
Research on Teaching Process Management and Quality Monitoring System for Higher Education	Zheng Liu; Gao Shanshan; Shaojing Yuan	2019
Discussion on Online Teaching Mode of Colleges and Universities under Multi-platform Integration	Feng Ling	2020
Teaching Practice of C Language Based on SPOC	Wenping Chen; Li Xu; Chaofeng Guan	2020
Research On The Innovation Mechanism Model Of Education Management Under The Background Of Artificial Intelligence Technology	Cao Fengchao; Peng Xuewen	2020
Teaching Exploration on the Deep Integration of Artificial Intelligence and Information Technology with Online Experiments	Meijuan Chen; Kaiwei Wang; Yufeng Wang; Xiaorong Zhu; Jianhua Shen	2020
Practical Study on Blending Teaching Model of College English Based on SPOC	Yun Sun; Yubo Fang; Xia Chen	2020
Thoughts on Application of Artificial Intelligence in Teaching of Different Disciplines	Fan Xu; Lan Wang; Jian Gao	2020
A study on the blended learning model of online course “Engineering Project Management”	Xiaolei JI; Xin Zhou; Haiya Zhang	2020
An Analysis of Oral English Teaching in College Based on Virtual Reality Technology	Ning Fang	2019
Preliminary Application Analysis of Mixed Teaching Mode in Colleges and Universities Based on MOOC Platform	Qingliang Jiao; Hui Xie	2020
The reform and practice of the training of computer innovative talents based on SPOC teaching model	Ran Li; Yan Lou	2019
Research on the Teaching Mode of Group Cooperative Learning Based on Blackboard	Min Song; Ying Song	2020
Prospects for the Application of 5G Technology in Agriculture and Rural Areas	Tao Li; Donglin Li	2020
Research and Practice of Hybrid Teaching Based on AI technology for Foreign Language Translation	Ting Liu; Eunyoung Kim; Xiaoyan Li; Takaya Yuizono; Yukari Nagai; Yifen Lu	2020
Flipped Classroom Teaching Practice of Compiler Principles Based on MOOC	Xinxin Liu	2019
	Chengxia Zhang; Ying Li; Chengcheng Cai	2020

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Table A1 (*continued*)

Title of the Paper	Author	Year
Application and Research of Virtual Reality Technology Based on Big Data in College Teaching Field		
Research and Implementation of Teaching System for Higher Vocational Specialty Courses Based on Hybrid Teaching Mode	Penglong Zhang; Yongsheng Zhang; Shaojun Fan; Xiaoxiang Huang; Jie Zhang	2019
Aspects to Foster Competences for Engineering Graduates: Education 4.0 Paradigm	K.M. Soni; Nitasha Hasteer; Anshul Bhardwaj	2020
Reform of University Computer Foundation Course Based on Mobile Terminals in Big Data Era	Yu Nie-fang; Peng Xiao-ning; Mi Chun-qiao; Li Xiao-mei	2019
On the Modelling and Predication of Teaching Effectiveness with Machine Learning	Kun Tian; Wen Liu; Ying He; Ming Yang; Danhua Zhao	2020
Construction of Modern Information Education Platform Based on Embedded Resource Scheduling	XuQiang Huang	2020
Construction of Classroom Teaching Model Based on the 5G Communication Technology	Hanhui Lin; Shaoqun Xie; Ken Cai	2019
The Reform and Exploration of Teaching Team in Postgraduate Courses	Wenhua Qian; Dan Xu; Guowu Yuan; Wu Hao	2020
Construction of Agile Teaching Team for Software Engineering Major under Background of New Engineering	Jiujiu Yu; Jishan Zhang; Yun Chen; Ning Wu; Yingying Mei; Canglu Zhu; Lili Zhu; Xiaoyu Chu	2020
Online Teaching Practice in Chinese Culture Course	Yi-Jheng Chang; Wei-Ling Hsu	2020
Exploration on the Cultivation of Innovative Undergraduate Talents in Computer Major Promoted by Organic Integration of Teaching and Scientific Research	Shanshan Gao; Jing Chi; Zheng Liu; Meiyao Tao; Wenhan Dou	2021
Application of the Online and Offline Blended Learning Mode in Innovation and Entrepreneurship Education	Zhichao LIU; Cuie XIONG; Dongxing XIE	2020
Design and Application of Smart Vocational Education Platform Based on New Generation Information Technology	Jinlong Wang; Jing Zhang; Jing Fan; Shuai Zhang; Jianbin Wang; Yu Geng	2020
Research on the Sustainable Development Model of Information Technology Literacy of Normal Students Based on Deep Learning Recommendation System	Haicheng Bai; Shuai Yang	2019
Discussion on the key technologies of Intelligent Teaching System application in the era of artificial intelligence 2.0	Tang Ming; Sun Yutong; Chen Jiajun; Zhong Qianyi	2020
The Marxist Chinese Political Teaching Innovation Model Based on Multimedia Database Management System	Xiuli Fang; Fengjuan Tian	2019
In Depth Interview on ICT Ability of University Teachers	Yan Zhang; Xiaoli Chu	2020
Applying Python in Brain Science Education	Xiaofei Zhang; Jiajin Huang; Yang; Xiang He; Ruohao Liu; Ning Zhong	2019
Strategies to Improve the Effectiveness of Business English Classroom Teaching Based on Intelligent Teaching System	Yichen Xing	2020
The Construction and Practice of Blended Learning Mode for the Course Market Research Based on WeChat Public Platform	LIU Juan	2020
The Application of Computer Information Big Data Technology in College English Teaching	Qu Hui	2020
Research on the teaching of "Internet plus continuing education" from the perspective of Al	Xuelin Qiu	2020
Research on English Teaching Mode in College Based on Artificial Intelligence	Tingyu Jiao	2020
Development and Implementation of Mobile Platform-Oriented Interactive English Grammar Learning System	Yanwei Yang	2019
Design and implementation of intelligent laboratory control system based on Arduino	Tang Mingjie; Zeng Qingtao; Zhang Xiaoliang; Huang Hui	2020
Research on teaching reform and work innovation of HRM driven by AI	Tian Wang; Jianbang Lin	2020
Investigating Critical Factors Affecting the Adoption of Technology for Overall Development of HEI	Sahil Manocha; Akanksha Upadhyaya	2019
Application of modern information technology in mathematical technology	Li Long	2020
Blended Teaching Based on Multiple Teaching and Learning Platforms: A Case Study of Programming Course	Chongming Zhang; Yanfei Zhu; Chunmei Wang; Yang Luo; Chuanjiang Li	2021
Cyber Security Social Engineers An Extensible Teaching Tool for Social Engineering Education and Awareness	Jin-Ning Tioh; Mani Mina; Douglas W. Jacobson	2019
A Full-chain Innovation Ecological Environment for Postgraduate Education	Degui Xiao	2019
Construction of STEM Interdisciplinary Integration Model Supported by Educational Artificial Intelligence	Lili Wu	2021
Research on the Teaching Reform of Managing the Software Process Course	Aijun Zhen; Guoqiang Ma; Kai Wu; Yan Liu	2020
Design and Implementation of Oral English Learning System Based on Speech Recognition Technology	Xiaoqin Zhang	2020
Interactive Teaching Path Analysis of Higher Vocational Ideological and Political Courses Based on Artificial Intelligence Algorithms	Zhang Yunfang; Wang Yuexi	2019
Exploration of Task-driven Blended Teaching of Marketing	Hui LI; Chen LIN; Qiaoyun Wei; Cheng Zhang; Nianwu Zhang; Min Guo	2020
Reflections on the Cultivation System of Innovative Talents in Universities in the era of Artificial Intelligence	Jianwei Hu	2019
Research on the Application of Artificial Intelligence Technology in Scientific Research Management in Colleges and Universities	Zhao Yongtao	2019
An Analyze and Actions to Increase the Quality in STEM Higher Education	Radu Vasiu; Diana Andone	2019
A LBS Method for Student Behavior Based on Hybrid Positioning by using big data Analyzation	Xiong Li; Shuna Yan; Yiming Shao; Jiangtao Hao	2019
A Big Data Acquisition And Analysis Method for Student Behavior Based on Hybrid Positioning	Xiong Li; Shuna Yan; Yiming Sao	2020
Design and Analysis of Intelligent Teaching System in Colleges and Universities Based on Big Data Application	Jing Zhang	2021
Research on the Course System of Data Science and Engineering Major	Zhenping Qiang; Fei Dai; Hong Lin; Yueyu Dong	2019
Data Science and its position in university education within National Project IT Academy-Education for 21st Century	L. Antoni; J. Guniš; P. Gurský; Š. Horvát; S. Krajči; O. Krídlo; M. Opiela; A. Szabari; L. Šnajder; G. Andrejková; D. Šveda	2020
Analysis And Visualization of Online Learning Data Based on Crowd Sensing	Zhongxian Bai	2020
College Students' Learning under the Environment of Internet Technology: Strategies and Suggestions	Ling Wang	2021

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Table A1 (*continued*)

Title of the Paper	Author	Year
Prediction of Student Performance Using Linear Regression	Boddeti Sravani; Myneni Madhu Bala	2020
A Study on the Cultivation of College Students' Political Values in the Era of Big Data	Fang Hua; Pan Jian; Hao Wenhui; Yi Kang; Bi junfei	2020
The Influence of Digital Virtual Technology on Contemporary College Students' Ideological and Political Education	Baolian Song	2020
Research on Effective Cooperative Learning Strategies in Group Teaching of Practical Courses	Xia Ming; Liu Dan	2020
ESP Course Construction and Learning Behavior Analysis	Ya-mei Zhang	2020
Research on Ways to Improve College Students' Moral Cultivation Based on Virtual Simulation Technology	Bai Yi	2020
Research and Practice of the Teaching Model of Mechanical Practice Courses in Colleges and Universities Based on "Craftsmanship"	Tang Rong jiang; Zhao Rui; Bao Jia ding	2020
Research on College English Teaching Strategies and Applications Based on Big Data	Juanjuan Wang	2019
Teaching Design and Implementation Based on R Language Under the Background of Big Data	Dong Wang; Honghe Wei; Baodan Bai	2021
Building Smart Classroom of Combinatorial Mathematics Based on PBL Teaching Model	Benchao Yang; Guang Zeng; Gang Yu	2019
Practice of ideological and political education in the course of "R language foundation"	Dong Wang	2020
Application of Artificial Intelligence Technology in English Learning Platform	Chu Yongjuan	2020
Future Education Trend Learned From the Covid-19 Pandemic: Take « Artificial Intelligence » Online Course As an Example	Liu Kexin; Qu Yi; Song Xiaoou; Li Yan	2020
A Review: Predicting the Performance of Students Using Machine learning Classification Techniques	Rahul; Rahul Katarya	2019
Practice Teaching Design and Implementation Based on Kolb's Learning Theory	Pei-shun Liu; Xue-fang Wang	2020
Research and Application of performance Evaluation Model of Rural Preschool Teachers based on big data Algorithm	Peng Li	2020
Technical Practice of Making Online Workplace Etiquette Courses Based on Camtasia Studio	Yan Wang	2020
Knowledge Graph Based Teaching Analysis on Circuit Course	Xu Xing; Ji Dou; Wang Xiangjun; Yan Xiaolin	2020
Work-in-Progress—Utilizing Virtual Reality to Promote Active Learning in Construction Management	Sathish Akula; Nikolay Sargsyan; Soundarya Korlapati; Xin Wei; Cheryl D. Seals; Jeff Kim	2020
Face Detection to Recognize Students' Emotion and Their Engagement: A Systematic Review	Benyoussef Abdellaoui; Aniss MOUMEN; Younes EL BOUZEKRI EL IDRISSI; Ahmed Remaida	2020
The Design of the Challenge Experimental Course of "Information Security System R & D" under the Background of Emerging Engineering Education	Ruijin Wang; Shijie Zhou; Mengjie Zhang; Xuchenghao Luo; Jin Wu; Fengli Zhang	2020
A Comparative Study of Information Technology Curriculum Standards in Primary and Secondary Schools in China and the United States, Japan and Britain	Jing Liu; Xiaoyan Li; Jun Han	2021
INDReview on Facial Expression Analysis and its Application in Education	Qiang Li; Xiwei Liu; Xiaoyan Gong; Sifeng Jing	2019
A Taxonomy of Various Applications of Artificial Intelligence in Education	Pooja Rana; Lovi Raj Gupta; Gulshan Kumar; Mithilesh Kumar Dubey	2021
Discussion on Teaching Reform of Computer Education Major Based on Information Key Competency	Yan Liang; Changhe Li	2020
ICT- The Smart Education System in India	Mantosh Kumar; Thipendra Pal Singh; Tanupriya Choudhury; Subhash Chand Gupta	2019
Exploration on Curriculum Teaching Based on OBE and AI	Jianguo Chen; Huijuan Lu; Hangxia Zhou; Yongxia Zhou	2019
Strategies for Improving the New Media Literacy Education for University Students	Dongmei Liu	2020
The Mechanism of Intelligent Technology Reforming Education Based on the Perspective of Embodied Cognitive Theory*	Weina Cheng; Xinguo YU	2020
Digital Communication of Chinese Classical Literature in the Era of Big Data	Zehao Yao	2021
Awareness, Knowledge, and Attitude towards Artificial Intelligence: Perspectives of Vietnamese Information Technology Students	Pei-Ju Chao	2020
Adoption of AI-Chatbots to Enhance Student Learning Experience in Higher Education in India	Nitirajsingh Sandu; Ergun Gide	2019
AI based Smart Teaching Process During The Covid-19 Pandemic	Milan Štrbo	2020
Effects of "4D Situational Multimedia Interaction" on Modern Non-commissioned Officer Education	Zhou Yucheng; Zhang Na; Song Mei; Li Meng	2020
A Comprehensive Methodology to Develop an Efficient Electronic Learning Management System that is Compatible with Various Applications	Huda Khurshed Shawkat Aljader	2019
Learning Analytics to Support Teaching Skills: A Systematic Literature Review	Luis Magdiel Oliva-Córdova; Antonio Garcia-Cabot; Hector R. Amado-Salvatierra	2021
Research on the evaluation model of subject competition based on the "four in one" practical innovation ability training mode	Znahg Rui; Shi Wenyu	2020
Intelligent evaluation of non-party middle-level cadre team construction in colleges based on data mining in the Internet background	Yue Cao	2021
The Impact of ICT Advances on Education: A Case Study	Chao Duan; Dongpo Guo; Jerry Xie; Jing Zhang	2020
The Role of Technology to Teaching and Learning Sign Languages: A Systematic Mapping	Venilton Falvo; Lilian Passos Scatalon; Ellen Francine Barbosa	2020
Interactive AI for Linguistic Education Built on VR Environment Using User Generated Contents	WooHyun Park; DoJin Park; ByungJune Ahn; SeokHun Kang; HaengYeong Kim; RaeHyeon Kim; JaeHeum Na	2019
Exploration and Practice of Internationalization of International Economic and Trade Major- a case study of Shenyang Aerospace University	Zhang Bo; Gao Lianting; Cheng Li	2020
Path for Implementing Ideological and Political Education in the Major of Equipment Economic Management	Yan Peng; Xin Liang; Yuanyuan Chen	2020
Upgrading Higher Education through Open Online Courses	Gulchera Shadmanova; Sayibdjan Mirzaev; Xabiba Karimova	2019
Research on the Practice of Course Ideological and Political Education in Applied Undergraduate Colleges	Shunmin Wang	2019
Research and thinking about the construction of online courses	Liu Hui; Li Fengyong	2020

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Title of the Paper	Author	Year
Improvement on Teaching Microwave Engineering Course by Incorporating the Artificial Intelligence Technology	Yu Miao Gao; Xin Yu Guo; Mei Song Tong	2019
Innovation and Practice of Training Management of Major Directors under the Dual Backgrounds of Intelligent Society and Epidemic Prevention and Control	Xiaozhuo Wei; Xing Dong; Yunpeng Li; Wenjun Shao	2021
Intelligent Study on the Opening and Selecting Course Management Model of URP System Based on Individual Preference	Hailing Xu; Feng Yuan; Tingting Xie	2020
Study on Experimental Teaching of Building Environment and Energy Application Engineering	Jian Chen; Donghua Liu; Guannan Li	2020
Analysis and strategies of the Professional Development of Information Technology Teachers under the Vision of Artificial Intelligence	Qingmin Wei; Mingyong Li; Kaiyue Xiang; Xue Qiu	2020
Research on University Education Reform in the Era of Artificial Intelligence	Xinyi Ling	2020
The Application of Artificial Intelligence Technology in College Physical Education	Xinyu Fu	2020
A Survey of the Development of Artificial Intelligence Technology	Zhi Li; Yilin Wang; Yunfang Ji; Wenyu Yang	2020
Research on school education reform under the background of "5G + education"	Shuai Yang	2020
Research on the Application of Artificial Intelligence in Education	Huiyan Li; Hao Wang	2020
Analysis of Key Technology Application of Computer Multimedia Technology	Yunxiang Zhang; Yunpeng He; Shengcan Jin	2019
Application and Innovation of Artificial Intelligence Technology in College Sports	Zhang Caixia; Liu Liguo	2020
Development Trend and Thinking of Artificial Intelligence in Education	Weiyan Liang	2020
Improvement of Education Method by Using Artificial Intelligence Technology	Mei Song Tong; Hong Qin Zheng; Guo Chun Wan	2019
The Development of Artificial Intelligence Education Resources under the Background of the Internet of Things	Shuying Zhao; Shuang Chen; Wanjing Li; Dongming Li; Xin Liu; Jie Chen	2020
Study on the Application and Challenges of Educational Robots in Future Education	Dehua Li; Xianning Chen	2020
Research on the Development Status and Trend of K12 Online Education in China	Hang Gao	2020
Research on Education Development Based on Artificial Intelligence Technology	Ya Wang; Yanmei Yang	2020
Research on the Design and Construction of Intelligent Learning Space in the Era of Big Data	Juntao Fan; Lin Zhi	2020
Conversational Agents to Democratize Artificial Intelligence	Jessica Van Brummelen	2019
Review on Development of Smart Education	Wanruo Shi; Xiwei Liu; Xiaoyan Gong; Xiaojie Niu; Xinzhu Wang; Sifeng Jing; Hao Lu; Nan Zhang; Jie Luo	2019
Status of Smart Manufacturing in the United States	Khalid Hasan Tantawi; Ismail Fidan; Anwar Tantawy	2019
Reflections and Countermeasures on the Development of Secondary Vocational Teachers' Teaching Ability Based on AI and Students' Characteristics	Lining Liu; Yongsheng Zhang; Penglong Zhang; Wenqian Sun	2020
Research on New Teaching Platform Under the Background of "Internet +"	Xi Xu; Guohua Zhan; Zhihua Li	2019
The Human Resources Development Applications of Machine Learning in the View of Artificial Intelligence	Jing Tian	2020
Research and application of practice teaching reform of HRM major under the background of AI	Tian Wang; Jianbang Lin	2020
Hotspots and Trends of Virtual Reality, Augmented Reality and Mixed Reality in Education Field	Hai Zhang; Yulu Cui; Huaming Shan; Zhili Qu; Wanxiong Zhang; Lujie Tu; Yining Wang	2020
Research on the Effect of Artificial Intelligence Technology on English Learning Efficiency	Li Xianhua	2019
The Application of Artificial Intelligence in Foreign Language Teaching	Zhu Yanhua	2020
The development of distance education in China	Qiang Ding; Zhibing ZHONG; Sumeng Xiong; Shimin Guo; Shichao Liao	2020
Research on the Change of Educational Management in the Era of Artificial Intelligence	Shuiping Luo	2019
On the Application of Artificial Intelligence in the Development of New Sports in Colleges and Universities in Shanghai	Xu Jian	2020
Research on personalized service of military vocational education under the perspective of "internet +"	Xiao shuang Wang; Jing Zhao; Ya ni Zhang	2020
Research on the talent training mode of Application- oriented Undergraduate Cross-border e-commerce Innovation and Entrepreneurship Education	Xi Yang; Ming Luo	2020
The change of teachers' role in teaching under the environment of "Artificial Intelligence +"	Jing Liu; Shuli Wang	2020
The concept change and organization transformation of Vocational Education under the Internet thinking	Guohua Zhu; Zhaoxue Wu	2020
Augmented Reality for Smarter Bangladesh	Muhtasim Riffat; Abrar Yasir; Intisar Tahmid Naheen; Shuva Paul; Md Tanvir Ahad	2020
Research on the Application of Internet Technology in Adaptive Education of Accounting Major	Yan Xu; Nanyun Xiao	2021
The Impact of Artificial Intelligence and Blockchain on the Accounting Profession	Yingying Zhang; Feng Xiong; Yi Xie; Xuan Fan; Haifeng Gu	2020
Research on the New Capability Structure of University Accounting Talents under the Background of Artificial Intelligence and Blockchain	Yanli Yang	2020
Research on Construction and Application of Accounting Information System Based on Blockchain Technology	YanRu Kong; HuiYing Chen	2020
Research on the Teaching Reform of Finance and Accounting Major under the Background of Big Data	Li Huimin; Song Guomin	2020
Research on the construction technology of college students' thought and behavior guidance system based on 5G environment	Yunli Cheng; Xiaohui Wang; Shuang He	2020
Enlightenment of Digital Technology on Stop Motion Animation Teaching	Jiang Tao; Gao Zhuo	2020
The Application of Stereo Image Generation and Composition Algorithms in Desktop-Based Virtual Reality Teaching System	Hongling Liu	2019
Virtual Reality – A Paradigm shift in Education Pedagogy	S Iwin Thanakumar Joseph; S Benson Edwin Raj; Jamal Mohamed Kiyasudeen	2020
Affective Computing Oriented to Intelligent Education — Reflection and Prospect	Chaoyang Wang	2019
The Framework and Thinking of the Future Primary and Secondary School Information Support Environment	Jun Han; Xiaoyan Li; Jing Liu	2021
The challenges of the online teaching process - a short review	Mihai Oproescu; Adriana-Gabriela Plaiasu; Ionela Niculescu; Viorel Nicolae	2020
Study on the New Models of Music Industry in the Era of AI and Blockchain	Mingli Shang; Hui Sun	2020

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Title of the Paper	Author	Year
IoT Application Technology Recent Development and the Engineering Talent Comprehensive Training Intelligent Framework	Haiye Qiao; Zhiliang Xiao; Jiahao Yu	2020
Instructional Use of Virtual Reality in E-Learning Environments	Ghaliya Alfarsi; Azmi bin Mohd. Yusof; Ragad M Tawafak; Sohail Iqbal Malik; Roy Mathew; Mohammed Waseem Ashfaque	2020
Design and Implementation of Virtual Immersive Classroom in Big Data Environment	Juntao Fan; Lin Zhi	2020
Work-in-Progress—A Proposal to Design of Virtual Reality Tool for Learning Mechatronics as a Smart Industry Trainer Education	Leticia Neira Tovar; Edson Castañeda; Víctor Ríos Leyva; Daniel Leal	2020
Design Research of Physical Virtual Experiment Based on Virtual Reality Technology	Yuan Jiugen; Yang Jing; Xing Ruonan	2020
Analysis of the Application of Artificial Intelligence Technology in the Construction of Smart Campus	Weiyan Liang	2020
Privacy, Data Rights and Cybersecurity: Technology for Good in the Achievement of Sustainable Development Goals	Katina Michael; Shannon Kobran; Roba Abbas; Salah Hamdoun	2019
Research on Building Smart Campus Based on Cloud Computing Technology	Yizhi Li	2020
Guest Editorial Special Issue on Game Competition Frameworks for Research and Education	Liu, J., Perez-Liebana, D., Cazenave, T., Thawonmas	2019
An Overview of Electronic Games in the Academic Areas	Ghaliya Alfarsi; Azmi bin Mohd. Yusof; Ragad M Tawafak; Sohail Iqbal Malik; Roy Mathew; Mohammed Waseem Ashfaque	2020
Application of Artificial Intelligence System in Smart Education in Cloud Environment with Optimization Models	Zhiyuan Huang	2021
Personalized Elearning Open Platform For Alphabetization Awareness In Rural Areas Of Morocco	P Subashini; M Krishnaveni; TT Dhivyaprabha; B Preethi; A. Hayar; M. ElAlaoui ElHanafi; M. Joundi; Elm. Kheddioui	2019
Romanian pre-university education from the perspective of school management	Jianu Eugenia; Mihai Oproescu; Dumitru Tudosoiu	2019
The Application of IoT Technology to a Manufacturing Process: Case Study	Khaldoon Hijazin; Tieling Zhang	2019
Information Security Practice of Intelligent Knowledge Ecological Communities with Cloud Computing	Yingjue Ma; Hui-jun Ni; Yanping Li	2021
Research on the Construction of Online Learning Education Space Under the Background of Artificial Intelligence + Education	Yao Wei	2020
A Study on Providing Blended Learning Support to EFL Students of Advanced English Course	Duan Yuan-Bing; Wang Jing-Zheng	2020
Holographic Classroom Based on Digital Twin and Its Application Prospect	Liu Shuguang; BA Lin	2020
A Survey on Future of Augmented Reality with AI in Education	R Kaviyaraj; M. Uma	2021
Framework for the Development of Virtual Labs for Industrial Internet of Things and Hyperconnected Systems	Maurice Dawson; Francisco Garcia Martinez; Pedro Taveras	2019
Issues and Challenges in Learning Foundation Linear Algebra Course with Technology: A Literature Review	Gurwinder Singh; Neha Tuli; Archana Mantri	2021
Research on the Cultivation of the Core Competences and Values of Information Technology for Normal School Students Based on Maker Education	Mo Zhihui; Zhang Shilan	2020
Investigation of Machine Learning Assistance to Education	Megha Gupta; Gunjan Batra	2021
VR Course Construction Oriented by Innovation Project Development	Jin Ying	2019
Research on the Disciplinary Evolution of Deep Learning and the Educational Revelation	Xue Wang; Haiyan He; Ping Li; Lei Zhang	2019
Application of Machine Learning in Network Security Situational Awareness	Zhao Yifan	2021
Research on the Construction of Information Platform of Employment and Entrepreneurship for College	Bin Xu; Bo Zhang	2020
Do MOOCs Sustain the UNESCO's Quality Education Goal?	Edmundo Tovar; Bernardo Tabuenca; Ahmed Alzaghoul; Carlos Delgado Kloos; Jim Sluss; África López-Rey; Elena Ruiz; Félix García-Loro; Elio Sancristóbal; Miguel Rodríguez Artacho; Sergio Martin; Manuel Castro; Russ Meier; Nelson Piedra	2019
Creating Virtual Reality and Augmented Reality Development in Classroom: Is it a Hype?	Vinh T. Nguyen; Kwanghee Jung; Tommy Dang	2019
MathCloud: A Discrete Cloud Implementation to Enhance Learning Experience in Mathematics	Anjum Zameer Bhat; Lakshmi Kameshwari; Baldev Singh	2020
AI-NLP Analytics: A thorough Comparative Investigation on India-USA Universities Branding on the Trending Social Media Platform "Instagram"	G. S. Thejas; Kundan Kumar; S. S. Iyengar; Prajwal Badrinath; N. R. Sunitha	2019
Malware Analysis Platform Based on Software Gene for Cyberspace Security Practice Teaching	Fudong Liu; Ping Zhang; Yifan Hou; Lixin Wang; Zheng Shan; Junchao Wang	2020
Research on the Construction and Innovation of Lifelong Education System Under the Background of Big Data	Jian Sun; Ting Wang; Ming Luo	2020
Research on Optimization Strategy of University Maker Space Ecosystem under Artificial Intelligence Background	Hongli Hu; Mi Ding	2020
Assisting Information Systems students to Engage with the Internet of Things (IoT)	Marita Turpin; Machdel Matthee; Sean Kruger; Jean-Paul van Belle	2020
The reform and development of education promoted by information technology in the artificial intelligent era.	Xia Shan Dai; Ling Luo; Hao Li; Rong Chen	2020
Blockchain: Application in the System of Teaching Informatization Management of Higher Education	Linlin Zhang	2020
Management of Online Education Based on Blockchains	Lei Gao	2020
Analysis on the Thinking Innovation of Ideological and Political Education Based on the Theory of Blockchain in the Information Age	Xiaoyu Liu; Xiaofu Liu; Zhenpeng Guo	2020
Research on the Development Status and Future Trend of Early-Childhood Education in China under the background of Education Informatization	Chengnan Liu	2020
Research on the construction of school education management decision system based on Data Mining Framework	Yihong Liu	2020
Project analysis of "Intelligent Robot Experience Center" based on "Idea VR" platform	Bei Han; Luo Yang; Yang Qu	2021
The Case for a Portable Open-Source 3D Ultrasound: Issues, Benefits, and Challenges	Yazmin Feliz; Pooja Jethani; Patricia Jastrzebska-Perfect; Hod Lipson	2019
Research on practice of online and offline mixed teaching based on wisdom tree platform — taking course of "principles of electrical appliances" as an example	Lei SHI	2020
The practice and exploration of Internet online education	Shichao Liao; Qiang Ding; Sumeng Xiong; Maorong Hu	2020

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Title of the Paper	Author	Year
Construction and analysis of foreign language online guiding model based on classroom network environment and face recognition	Junhui Shi	2021
Research On New Models Of "flipped classroom" In Higher Education	Ning Sun; Xinyan Shi	2020
Exploration and Practice on Industrial Robot Experimental Teaching Based on Virtuality and Reality Combination	Lingyun Feng	2020
Analysis of the college students' online learning status and implementation strategies during the epidemic	Dongqing Wang; Wenjun Pei; Huan Liu	2020
Internationalization Process of "Double First Class" Universities Based on Big Data	Chan Wu	2020
Research on the New Era Artificial Intelligence Promoting the Reform of College English Ecological Teaching	Ling Gui	2020
Discussion on the application of artificial intelligence technology in the construction of physical education class in Higher Vocational College	Lin jia huan	2020
An Analysis of the Optimization Strategies of Ecological College English Teaching Based on Artificial Intelligence	Weishi Wang	2020
Suggestions on Accelerating the Implementation of Artificial Intelligence Technology in University Information System	Kun Niu; Cheng Cheng; Hui Gao; Xinjie Zhou	2019
Construction and Application of Teaching Resources Library Regarding Flight Attendant Specialty	Mei He	2020
Exploration and Practice of Online Teaching for Data Structure in Epidemic Period	Xuemei Wang; Xuelan Zou; Weifeng Yin	2020
Research on the Application of Smart Classroom in Higher Mathematics Teaching	Jie Shen; Qinglin Wu	2021
An Application of Face Recognition Technology in University Classroom Teaching	Yang Tao	2020
Problems and suggestions of online learning for Chemical Engineering Majors in colleges and universities	Yue Zhe; Shi Binbin; Liu Chunrun; Bao Minghao; Wu Yutian	2020
The Application of SPOC-Based Deep Learning Model in Psychological Health Education of College Students in Post-MOOC Era	He-Chen Yang; Han-Bin Wu	2019
Study on the application of network resources in home teaching	Li Guoxia; Mao Jianjing; Zhang Dongpo; Yang Jing; Sun Bin	2020
The Support of Internet Technology in Physical Education Classroom in the New Coronary Pneumonia Epidemic	Xiaoming Zhang	2020
Hybrid Teaching Practice Based on Internet Platforms —A Case Study of the Course"Introduction to Tourism"	Guo Yajuan; Zhang Cheng; Kang Xinmeng	2020
The Reform of Ideological and Political Course Online Teaching During COVID-19 Outbreak A Case Study of Sichuan Technology and Business University	Zhao-xue Zhang; Meng-xuan Zhang	2020
Application and Practice of VR Virtual Education Platform in Improving the Quality and Ability of College Students	Qian Zhang	2020
Research and practice of Internet Teaching – Take the course of Innovation and Entrepreneurship Education and Practice as an example	ManJu Deng; ZeZHou Feng	2020
Application and Model of Virtual Reality in Physical Experiment	Yuan Jiugen; Fan Anqi; Xing Ruonan	2020
Robotics to Enhance the Teaching and Learning Process	Rawaa Al-Jumeily; Hoshang Kolivand; Shatha Ghareeb; Jamila Mustafina; Mohammed Al-khafajiy; Thar Baker	2021
Research on the construction of digital media professional group under the guidance of "1 + X" vocational skills	Hainie Meng	2020
On Application of "Artificial Intelligence Plus Large Data" in Public Maths Course Teaching of Engineering Colleges	Zheng Mali; Chen Huaxi	2019
Problems and Reform Ideas in Law Theory Teaching in Universities Based on Big Data Analysis	Li Yayuan	2020
An FFM-based Model for Students' In-class Learning Postures Estimation	Ziyun Zhao; Shifeng Zhang; Kangying Hu; Zhan Chen; Junqi Guo	2020
Practical Teaching and Vocational Integration Orientation of Applied Undergraduate Civil Engineering: Take Fuzhou University of International Studies and Trade as an example	Hu Yukui	2020
Investigation and Analysis on the Training Methods of International Skilled Talents in Higher Vocational Education	Chunqing Meng	2020
On the Application Analysis and Innovation of New Media of Party Building in Colleges and Universities Based on SPSS	Jian Dong; Shenshen Guo; Bin Wu; Jianru Xie	2020
Research on the Application of Virtual Reality Technology in the Teaching Model	Jie Jiang; Lei Zeng	2019
Research on the Construction and Application of Desktop Virtual Reality Teaching System	Hongling Liu	2020
Research on the reform of foreign training teaching under the background of informatization	Hong Ju Xiao	2020
Course of Circuit and Electronic Technology for Computer Major	Xiao-feng Zhang	2019
Practice and exploration of modern apprenticeship system of accounting major —Based on the mode of "Financial Sharing Center"	Zhao Yan	2020
The Innovative Education of "Smart Finance" under the Promotion of Educational Informationization	Yuan Zhang; Yi Wu; Murong Zheng; Xinyi Lin; Yutong Zhang	2019
Reform Research and Practice of Army Equipment Teaching Model Based on Education Informatization	Jingjing Wang; Wei Zhang; Ming Lu; Hui Yi	2020
Development of Job Skill Model Based on EIS—Take Purchasing Role as an Example	Runxin Yang; Jimei Li; Meijie Du	2020
School-Enterprise Cooperation on Python Data Analysis Teaching	Xinxin Liu; Hongyun Xu	2019
Research on Efficient Teaching Mode for Group Training Course Based on Dynamic System Simulator	Xin Zhang; Shaoke Shi; Bin Sun	2021
Research on the Co-construction and Sharing of Teaching Resources Under the "Internet Plus" Environment	Yinqiang Feng; Guohua Zhan; Zhihua Li	2019
Education of society as a tool to counteract disinformation in implementing new technologies. On the example of 5G mobile telecommunications network and Warsaw sewage system.	Urszula Soler; Mariusz Busilo	2019
A review of 5G applications and key technoligies	Rongli Gai; Xiaoyan Du; Shuya Ma; Na Chen; Shouchuan Gao	2021

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Title of the Paper	Author	Year
Application of WeChat Mini Program in Secondary School Students' Homework Guidance	Zhijun Yang; Cuilian Lv; Jianhou Gan; Ning Lei	2019
Research on the Deep Integration of Modern Information Technology and Five Education	Yujiao Wang; Haiyun Lin; Li Sun; Dawei Zhang; Junwei Wang; Lina She	2020
Supply and Demand of Ai-Aided Language Education	Aihua Zhu	2020
Research on semantic Retrieval Framework Design based on Ontology	Shi Jing; Liu Jia	2020
Design of online teaching quality evaluation system for Private University: Research based on deep learning algorithm	Cui Beiqing; Zhou Chunrong	2020
How to Promote the Development of Youth Information Technology Education in China through Programming Ability for Adolescents Standard	Jin Ying; Zhang Jie; Tao Ye; Zhang Li	2020
Study on the Evaluation of Practical Teaching Quality in Applied Undergraduate Colleges	Zaijuan Xu	2020
Research on Information-based Teaching and its Influence on Future Education under the Background of Epidemic Situation	Wanhong Peng; Xiaoniu Li; Lilin Fan	2020
Isea: An Interesting Application of Chemistry Education Based on AR	Jing Jin; Tong Liu; Yilei Wang; Chunpeng Wang	2019
Construction of Double-Precision Wisdom Teaching Framework Based on Blockchain Technology in Cloud Platform	Shukun Liu; Yinglong Dai; Zuowei Cai; Xianmin Pan; Chaoliang Li	2021
Research on College English Teaching Model Assisted by Computer Software	Yi Huang	2020
Exploration of Interactive Foreign Language Teaching Mode Based on Artificial Intelligence	Ming Luo; Lian Cheng	2020
Construction and Application of Information-Based Teaching Resources Sharing Platform Based on Deep Learning	Baiqiang Gan; Fei Deng; Chi Zhang; Jing Li	2019
Investigation and Analysis of Online Teaching in Higher Vocational Colleges during the COVID-19 Epidemic	Juan Ang; Hongmei Zhang	2021
Research on the Balanced Development of High Quality Compulsory Education	Yujiao Wang	2020
Research on Artificial Intelligence Assisted Teacher Developmental Evaluation from the Perspective of Reflective Practice	Liu Yangjun; Li Hao; Chen Rong	2020
Competition Neural Network Model Application in the Bilingual Teaching Quality Evaluation of Universities	Chao Wan; Hua Kang; Feng Jin; Xin Long Zhu	2020
Design and Implementation of intelligent Learning Companion System Based on WeChat Mini Program	Xue Zhang; Xiaomei Yu; Wenqian Sun	2020
A Review on Techniques, Characteristics and approaches of an intelligent tutoring Chatbot system	Mohammed Waseem Ashfaque; Sumegh Tharewal; Sohail Iqhbal; Charansing N. Kayte	2020
Instructional Design of Blended Teaching Based on Mosoteach: In the Case of Customer Service Course (Bilingual)	Liu Haiyan	2020
Construction of Intelligent Learning Environment for Multiple Learning Methods	Fei Li	2019
The Teaching Reform of Higher Vocational Business English Course Informationization on the Background of Education Informationization 2.0	Jine Deng	2019
A Synergy of Artificial Intelligence and Education in the 21st Century Classrooms	Kuheli Mondal	2019
Novice Programmer to New-Age Application Developer: What Makes Python their First Choice?	Ramachandran Trichur Narayanan	2019
Analysis of Teaching Evaluation in the Field of Vocational Education in China	Wenqian Sun; Xiaomei Yu; Xue Zhang; Lining Liu; Penglong Zhang	2020
A Virtual Reality-based Spoken English Learning Platform	Chengyao Wang	2021
The Framework of Constructing University Comprehensive Evaluation System Based on Online Comments	Xue Li; Qian Wang; Qian Jia; Juan Shi	2019
Strengthening the Practical Capacity of Students: an Educational Case Study about Teaching Feedback in Electronics Circuit	Hua Fan; Zonglin Li; Quanyuan Feng; Qi Wei	2021
Research on the Strategy for Constructing Smart Kindergarten System	Qiu Huaxiang	2020
Strategies, methods and problems of online education in China during the epidemic*	Yu Bai; Zhe Li; Fuzheng Zhao; Yan Jiang	2020
Research on Problems and Countermeasures of English Education Activities in Kindergartens –A case of kindergarten A in Dazu District of Chongqing	Liu Jingjing; Yang Xuelan	2020
The Creation and Case Study of Smart Learning Environment	Jie Jiang; DeKun Xu	2020
Artificial Intelligence and Education	Adina Magda Florea; Serban Radu	2019
Logical Construction and Realization of Intelligent Service in AI Library	Zhang Jing	2019
Industry 4.0: An Integrated Distance Learning Solution	Sara Nuñez; Jesus Mendoza Padilla	2020
Research on the Construction of Liberal Arts Laboratory in Universities under the Background of New Liberal Arts Education	Hang Gao	2020
IoT based Empowerment by Smart Health Monitoring, Smart Education and Smart Jobs	Sreenivas Eeshwaroju; Praveena Jakkula; Subramanian Ganesan	2020
Sharing Cloud Platform Applied to Teaching System Reform based on "5G + Smart Education" Innovation	Fan Yang; Wang Luo	2020
Incorporation of Modelling and Simulation Techniques with the Education on Electromagnetics and Microwave Technology	Si Ce Wang	2019
Research on Teaching Design Strategies in the Field of Science for Top Class in Inclusive Private Kindergartens	Shu Wang; Xiaoying Yang; Zhenyan Liu	2020
Design of Training Platform for IOT Based on Cloud Services	Xiangrong Zeng; Hongbo Li; Zhiyuan Zhu; Ming Tang; Chuyan Zhang; Jing Guo	2020
Evaluation of Smart Humanity Systems and Novel UV-Oriented Solution for Integration, Resilience, Inclusiveness and Sustainability	Shengsheng Cao; Chaoyi Wang; Zhiyuan Yang; Hao Yuan; Aijing Sun; Haoyu Xie; Lifeng Zhang; Yajun Fang	2020
Reverse thinking teaching discussion in high school information technology under new curriculum standards	Jian Gao; Lan Wang	2019
The Intelligent Management of Counselors in Higher Vocational Colleges under the Background of Informatization	Dai Shasha	2020
Design of Children's Education Auxiliary System Based on CNN	Shen Mengting; Cen Gang; Zhou Wen; Zhu Runkai; Liang Yaqin	2020
Research on the Cultivation Mode of Application-Oriented E-Commerce Talents Under the Background of Smart New Retail	Luo Lisheng	2021
		2021

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Title of the Paper	Author	Year
Development of Information Technology Telecom Chatbot: An Artificial Intelligence and Machine Learning Approach	Mallikarjuna Gowda C P; Anupam Srivastava; Shubham Chakraborty; Anurag Ghosh; Harsh Raj	
The Application of Novel Information Technologies in the Health and Educational Systems of Montenegro	Vanessa Mahoney	2019
IBM Watson Application as FAQ Assistant about Moodle	Jeferson da Silva Oliveira; Danubia Bueno Espíndola; Regina Barwaldt; Luciano Maciel Ribeiro; Marcelo Pias	2019
An Innovation in Craftsman-like Talents Development Mode Based on Intelligent Manufacturing Specialty Group Construction	Sike Jin; Jiali Jin; Weihua Zhou; Junhuan Lin	2021
The Research on the Application of Big Data in the Credit System of Higher Vocational Colleges	Wei Zhang; Jialiang Liu; Liwen He; Fang Zhang	2020
Application of SalesForce Platform in Online Teaching in Colleges and Universities under Epidemic Situation	Jing Hu; Bo Zhang	2020
Composition of Online Teaching and Academic Ability under the Background of Artificial Intelligence and HTML	Zhida Zhu	2021
Analysis of the Construction of College English Ecological Teaching Model in The Age of Artificial Intelligence	Chu Yongjuan	2020
Ways to Enhance the Influence of Academic Journals Based on MOOC Resources	Shuhui WANG; Xi CHEN; Jian YAO	2020
Education Technology for Online Learning in Times of Crisis	Haiyan Cai; Irwin King	2020
Educational Technology Market Analysis	Victor V. Timchenko; Sergey Y. Trapitsin; Zoya V. Apevalova	2020
Research on The Construction of Course Knowledge Graph of High School Information Technology	Jian Gao; Lan Wang; Fan Xu	2020
Teaching Reform and Innovation in "College Movie English" Course under the background of "Internet Plus"	Lingjun Zheng	2020
Advanced practices: web technologies in the educational process and science	Yelena Chaiko; Nadezhda Kunicina; Antons Patlins; Anastasia Zhiravetska	2020
Analysis and Design of Voice Assisted Learning System Based on Baidu AI	Ru Zhang; Weiyang Chen; Min Xu; YangYang	2019
Preparing Software Quality Assurance Professionals: Metamorphic Exploration for Machine Learning	Sen Yang; Dave Towey; Zhi Quan Zhou; T.Y. Chen	2019
Application of Virtual Reality in Building Interior Decoration Engineering Practice	Yen-Kun Hsu; Szu-Hsien Peng; Meng-Shiou Wu	2019
Cultural Structures of Knowledge from Wikipedia Networks of First Links	Maxime Gabella	2019

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Fan, J., & Zhi, L. (2020 August). Design and implementation of virtual immersive classroom in big data environment. In *2020 15th international conference on computer science & education (ICCSE)* (pp. 430–432). IEEE. https://doi.org/10.1109/ICCSE49874.2020.9201648.

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