

Impact of Artificial Intelligence on Higher Education in the Perspective of Its Application of Transformation

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Abstract: Artificial intelligence, as a strategic technology leading the future, has been widely used in various fields of society in recent years. In the field of higher education, AI technology has been applied and analyzed through algorithms to develop the application of various technologies such as machine learning, biometric recognition, and virtual reality. It has triggered and caused fundamental changes in the content of education methods, management mode, education theory, teaching methods, and learning methods of higher education. In the era of artificial intelligence, higher education will show the development trend of diversification of teachers' roles, the intelligence of teaching mode, personalization of learning mode, diversification of teaching evaluation and openness of education ecology. This paper mainly discusses the current application of artificial intelligence in higher education, its influences on the higher education system, and the limitation AI has on this field. It is proposed that higher education has again reached a historical juncture where change is needed; then, the pedagogical implications of the impact of emerging technologies on the way students learn and the way higher education is changing are examined, including how AI can automate essential activities in higher education, how AI can change our traditional teaching elements, etc. It can be concluded that people should follow the trend and actively promote the modernization process of higher education. Artificial intelligence will have a significant impact on higher education, which must meet the challenges and prepare for the AI revolution while providing students with the necessary skills to be more competitive in the AI era.

Keywords: Artificial Intelligence, Higher education, Machine learning, Teaching process

1. Introduction

As a constantly updated technology leading the future, artificial intelligence (AI) has been extensively used in various fields of society with the rapid development of the high-tech industry in recent years. Based on the role of AI in this field, a rather practical definition has been proposed: AI is a computational system capable of participating in human-like processes. i.e, learning, adapting, synthesizing, and using data for processing tasks. For example, AI technology has been applied in the higher education field and analyzed through algorithms such as PCA, LBP, MFCC, etc., realizing the application of various technologies such as virtual reality, machine learning, biometric recognition, etc. It triggers an overall change in higher education and causes fundamental changes in the content,

educational methods, management mode, educational philosophy, teaching methods and learning methods. And higher education will demonstrate a rising development trend of diversification of teachers' roles, the intelligence of teaching mode, personalization of learning mode, diversification of teaching evaluation, and openness of education ecology in the artificial intelligence era. People should follow the trend and actively promote the modernization process of higher education.

In 2019's first news section, the British weekly Nature had reported on the state of academic buzzword changes in the past two years. The statistically specific data reported comes from Scopus, which is the world's largest database of summaries and citations of scientific information. Looking into the reported data, it can be clearly seen that the term "cancer" has ranked first place for two consecutive years. Moreover, "blockchain", "big data" and "artificial intelligence" are following closely behind. It is worth noting that the term big data jumped from sixth place to third place and the other terms like "blockchain" and "artificial intelligence" were Newly shortlisted. The term "education", which is new to the list, performed out of the blue. Furthermore, this paper will discuss later involves the two keywords in the 2018year's buzzwords: artificial intelligence and education. The American Association for the Advancement of Learning in University Education Information Technology recently released the Horizon Report. The report predicts six technology applications that are likely to impact higher education globally between 2019-2023, also closely related to the aforementioned buzzwords. For example, mobile learning and analytics are soon or already being put into practice; mixed reality and artificial intelligence can be expected in two or three years. Clearly, the future development of higher education will be tied to the advancement of new technologies and computing power for types of intelligent machines. Therefore, the advancement of artificial intelligence will undoubtedly bring new opportunities and obstacles to higher education.

The biggest strength of AI over other human technologies is speed, accuracy, and consistency that humans cannot match. Thus, it can be clearly seen that those routine and structured tasks can be finished without human labor. In other words, more work will be replaced by artificial intelligence soon. Accordingly, artificial intelligence should not be completely abandoned in higher education but to be embraced by students and seen as a learning tool.

This paper introduces the development and trends of artificial intelligence, analyzes the current higher education model, discusses the application of artificial intelligence technology in higher education, and then explores the reform of higher education in the era of artificial intelligence. The rapidly developing AI has a profound impact on the higher education system and is worthy of in-depth study. By examining the current status of the development and application of AI in the higher education system, it is found that advances in information technology have accelerated the pace of higher education development and changed the teaching models and methods of teachers.

2. The Application of Artificial Intelligence Technology in Higher Education

Artificial intelligence can be categorized into many aspects. When examining its application to higher education, machine learning, biometric recognition, and virtual reality are three aspects that AI has the most significant application.

2.1. Application of Machine Learning in the Field of Higher Education

Machine Learning is an essential core in artificial intelligence technology, an interdisciplinary discipline among optimization theory, system identification, neural networks, approximation theory, computer science, etc. It mainly studies the way computers simulate human learning behavior, reorganize existing knowledge, gain new skills, and self-update continuously. As one of the ways artificial intelligence evolves, data-based machine learning studies find laws in observed data (samples), then use finding laws to predict unobservable data. More US universities have been

exploring machine learning applications and relying on big data technology to achieve data acquisition and analysis. They have achieved remarkable results in promoting educational equity, precise teaching, personalized learning, and assisted management[5] Machine learning based on big data in higher education is mainly carried out in the following ways: firstly, by tracking, recording, and analyzing students' learning behavior data, forming a "student profile" to help teachers and students better grasp their learning characteristics, so as to tailor teaching and personalized learning; secondly, by dynamically estimating students' learning performance, visualize their learning process and results, and provide timely feedback, teachers can make dynamic adjustments to teaching contents, methods, and difficulty, and students could reasonably adjust learning time and manners accordingly; the third, by matching students' characteristics in artificial intelligence era to accurately screen and pushing their learning contents. It is also the most basic and vital function of an online teaching platform.

2.2. Application of Biometric Recognition in the Field of Higher Education

Biometric identification technology means a kind of technology that identifies and authenticates an individual's identity through his/her physiological or behavioral characteristics, which includes voice recognition technology and image recognition technology, etc. Biometric recognition technology has now been widely applied in higher education. Through voice recognition technology, students are able to ask questions they face in their studies at any time; while artificial intelligence technology takes the form of human-computer interaction, with robots identifying and answering, thus helping students answer their questions more accurately and timely, which truly achieving the purpose of solving their problems. Voice recognition technology is also capable of recognizing speech and converting it into text, which not only helps teachers and students improve the efficiency of human-computer interaction using intelligent teaching platforms, but also enables automated assessment of some language subjects, which not only reduces teachers' repetitive workload but also avoids subjective bias and facilitates the formation of a more scientific teaching evaluation [8]. Image recognition technology is mainly applied to text recognition and facial recognition in higher education. Text recognition technology may recognize printed text and have a high recognition degree for handwritten text and fuzzy text, thus making preliminary recognition and automatic determination for students' homework and examination papers. Facial recognition technology can distinguish different students and enhance teaching management's efficiency and quality; for example, it is applied to the management of attendance and substitution of examinations and other behaviors.

2.3. Application of Virtual Reality Technology in the Field of Higher Education

Virtual Reality (VR) is a new type of audio-visual technology. It combines related scientific theory science and technology and the application of computer technology. The auditory, visual, and tactile senses generate digital environments that are highly similar to the natural environment to a certain extent. Therefore, users can gain experiences and feelings that approximate the natural environment, which is implemented through display devices, data acquisition devices, haptic interaction devices, tracking and positioning devices, and specialized chips [1]. When virtual reality technology is applied to higher education, it can use computers to simulate realistic environments and create practical teaching and learning scenarios that immerse students and allow them to respond to their own choices or interactions. For example, EON Reality has developed a virtual reality 3D database (ExperiencePortal) that collects more than 4,000 simulation teaching models and virtual scenarios. Teachers and students can download these highly simulated three-dimensional models from this database and use the VR software provided by this company to see all kinds of 3D models, including animal anatomy models, plant growth ecological environment change models, the relationship

between the planets in the universe model, etc [2]. By applying VR technology, people can establish a virtual teaching environment, which will provide learners with sufficient resources and experienced background as much as possible. Learners can acquire knowledge and skills and construct a knowledge system through human-computer interaction. The AI technologies applied in higher education are multifaceted, and with the deep convergence of higher education and artificial intelligence, much more AI technologies will be applied to the education field.

3. Transformation that AI Induced in the Field of Higher Education

3.1. Changes in Educational Methods

3.1.1. Grading

In higher education, grading students' assignments and exams is time-consuming and is an onerous task for larger classes. At present, artificial intelligence can handle many tasks, including grading. This can effectively solve the problems encountered by some teachers. According to statistics, German teachers spend up to 1,000 hours a year on grading, which is the time that could have been spent on interacting with students, preparing lessons, or improving professional ability. The grading time is also related to the specific courses and subjects taught. That is why teachers feel unbalanced about this status quo; students also report that their grades are not objective, inconsistent, and non-transparent [3]. In comparison, Artificial intelligence has the ability to address these tedious and subjective problems in grading. GradeScope, used at Berkeley and Stanford, is an artificial intelligence solution. Instructors (or students themselves) only need to scan the handwritten test's answer sheet, and the system will score the test paper based on predefined scoring criteria. This not only significantly reduces the scoring time but also provides transparency to the scoring process as these scoring criteria are known to the students. While automated marking of objective questions is a relatively straightforward process to implement, automated marking of essays is still in its infancy and is predicted to improve gradually over the next few years.

3.1.2. Teaching Process Measurement

Measuring a student's progress, which by its very nature is a profoundly social endeavor, is the greatest challenge every teacher faces and cannot be done with traditional rule-based software. However, if a teacher intends to test a student's ability to grasp a concept, he or she must repeatedly compare each student's classroom response. However, learning software in the traditional sense does not have real-time access to assessment data, so teachers can only rely on after-school assignment assessments to test students' mastery of the subject being studied. The goal of artificial intelligence research and development has always been the process from "simple reasoning" to "knowledge acquisition," and finally to "independent learning." Therefore, machine learning is one of the ways to achieve artificial intelligence at present. By analyzing patterns and correlations among data points, machine learning algorithms can be a valuable tool for teachers to quantify students' understanding in the classroom. Through specific data, AI can quickly help students lock in the areas they need, thereby comprehensively improving their learning ability and seeking teachers' support for corresponding problems. For instance, AI platforms collect real-time information about users' interactions with course materials as well as environments to create rich digital profiles for each student [10]. More advanced applications of artificial intelligence can also use computer vision algorithms to evaluate individual students' facial expressions, like a distraction, and correlate facial expression data with other students' data to create a whole picture of the learner model. The result is a real-time insight of students' degree of engagement and understanding among specific topics. Of course, it is also possible for data models to find general models and perform analysis. There are also

some more promising approaches. For example, the integration of information and communication technologies (ICT) in the classroom can be particularly useful for classroom interaction, enabling student-centered learning in the teaching and learning process; non-invasive brain-computer interfaces combined with AI could lead to a rethinking of the role of teacher – whether the virtual "robot teachers" can replace teachers [4]. Affordable brain-computer interface (BCI) instruments can deal with students' focusing on learning content; supercomputers like IBM's Watson could make managing Automated teacher engagement services become possible.

3.1.3. Teaching Process Assistance

The regression of students' educational processes is not only their own reason but also contains shortcomings in teaching methods and course content. However, it seems that teachers are not aware of the gap between the actual teaching content and materials in textbooks. Therefore, some students can not be able to understand certain concepts. Artificial intelligence can play a role in real-time feedback during teaching. If proven teaching practices can be an indicator, then AI guides teachers through this indicator to teach better. For instance, if a teacher deviates from the subject during the teaching process, the AI will remind him/her, or if the teacher speaks so fast that the student cannot keep up, the AI will remind the teacher to slow down the speed of speech so that the student can better absorb the knowledge of the lesson. [7]. Besides, artificial intelligence has the ability to monitor students' learning processes and behaviors. For example, in the exercise, if most students give the wrong answer to the same question, the system will alert the teacher to possible problems, and a warning message will be sent in advance if the student is late or leaves early. In short, the artificial intelligence system can allow teachers to find possible deviations in teaching and allow students to get help quickly and accurately. In particular, with AI applications, teachers can give students specific and targeted help. Instant feedback is also the key to helping students absorb knowledge. Students receive feedback in time, which contributes to the correct completion of the next task. This fills in the interpretation gaps that can occur among different lesson contents and makes sure students are building complete conceptual systems.

3.2. Reforms in Teaching Elements

Schools make sure the lessons proceeded, and teachers play a decisive role in planning, shaping, and directing the order of instruction. When comparing today's classrooms with those of the early 20th century, it will be found that a modern media blackboard has replaced the old blackboard, and most of the teaching tools and mediums have been digitized so that students can have class by sitting in the classroom or participate in instruction via the online meeting platforms from their home. So, if artificial intelligence is to play a more influential role in the learning process, there should be other elements of teaching and learning that need to change.

First and foremost, teaching devices will be changed to be much more specialized. Amounts of AI devices developed to date have been computer-based (with a few exceptions). This system is a "black box" for the teacher and is mainly intended to replace some of the teacher's roles, so few AI teaching devices exist in classrooms now. Even though AI devices exist, it is not tailor-made for education. In the past 30 years, some instructional assistive technologies, i.e., text-to-speech, speech-to-text, scaling tools, predictive text, spell-checking, and search engines. Those are basically R&D to be used for demonstrations of technology to help people with disabilities [2]. These technologies have been developed and grown and have become a common feature of almost all personal computers, handheld devices, or wearable devices. These technologies increase students' enthusiasm for learning interaction and increase the possibilities of teaching experience design. The most common smart teaching devices include the iPhone launched in 2007, the Android phone launched in 2008, and the

iPad launched in 2010. According to the current development trend, in the next 25 years, the current equipment may be replaced again by a new generation of equipment. Computer- and tablet-based teaching models will also be replaced by some new kind of approach in the future. Perhaps the cyborgs described by Carl Mitcham will emerge, and this type of human-computer interface will immediately enhance the methods people study, remember, acquire, and put information. People cannot yet predict how long it will take to use such interfaces to improve memory and cognitive abilities, but what is clear is that a "hybridization" of the human brain and machines is already possible, which fundamentally challenges instructors to explore new dimensions and pedagogical approaches for changes in the teaching environments. That is to say, education innovation is not simply about investing more in emerging technologies in the classroom but also about experimenting with new teaching methods so that students can acquire skills that can be grounded in the contemporary competitive environment.

Second, the current education system is based on age grouping, which clearly does not take into account distinct students' study speed, hobbies, and flair. As a result, students are easily weary in each class because they quickly understand what they are learning, and others are frustrated because they cannot understand the teacher's explanations [6]. Artificial intelligence apps quickly choose teaching methods for individual learning goals and status. Moreover, they personalize learning experiences based on students' different interests and knowledge levels. This change to non-age grouping is also a significant change to traditional elements of instruction, allowing content and pace of learning to be adjusted to the needs of the student. Trial and error is a critical step in learning. Many students are reluctant to express themselves in front of their peers for fear of failure; with AI, it is less daunting, and students are able to try new approaches in a freer way. In fact, AI itself is the perfect teacher to support this kind of learning, as they themselves often learn through trial and error.

Another key role of education is to promote social collaboration and interaction. Students need to be in group activities to acquire these skills. In personalized instruction, students are treated as independent learners. That is to say, they must not only find their own personal learning rhythm but also learn to cooperate with others [11]. Artificial intelligence itself is also the main force to promote cooperative learning. By comparing learner models, AI can find students with similar cognitive levels or complementary skills and encourage them to team up to learn collaboratively. Artificial intelligence will also participate in the learning progress and lead more productive discussions in the right direction and generate better human interaction.

If the quality of the educational content itself is good, then these technologies are the ones that breakthrough time and space bonds, and also present the "right" content to the learner at the "right" time. However, not all content is of high quality, and it can be boring, lacking clear instructional objectives, cognitively passive, and failing to incorporate research findings into the science of learning. To a large extent, we do not even have criteria to reasonably distinguish between high-quality and low-quality educational content. Now, AI-based smart content technology is being used to create customized textbooks for certain subjects using traditional syllabi to make textbook content more accessible.

4. The Limitation of AI's Application to Higher Education

4.1. The Application of AI in Higher Education is Falling behind Other Fields

Just as terms like "big data", "cloud" and "machine learning" are exploited by marketers and ad copywriters, "artificial intelligence" has also long been seized upon. Most so-called "artificial intelligence" actually refers to data analytics. The focus of it is to intensify interaction between much

more electronic life people have and the vast numerous of data it produces through intelligent software. And artificial intelligence widely influences higher education, either.

Another reason why artificial intelligence currently has so little impact on higher education teaching is that this kind of teaching seems to lag behind the time when it comes to new technologies. Under the traditional education model, people are mostly reluctant to apply new technologies to teaching and there is a lack of financial support for innovative teaching methods [12]. These are hindering the application of AI in teaching and training. It is clear that the education sector remains highly conservative about new technologies because there are still most educators who are not entirely certitude about the role of innovative technologies in enriching and expanding outcomes and experiences in education.

Today, most AI applications are very emphasized on content presentation and comprehension testing in education. It is not educators who use most of the AI in teaching, but computer scientists. Because artificial intelligence is often generated by computer scientists. So they will develop learning models due to how workings of computers and computer networks being (because it is obvious that only computers can run AI algorithms). Therefore, the learning model applied by AI applications is often rigid and behaviorist: presentation/testing/feedback. Using artificial intelligence to advance education, it is necessary for educators to have closer communication with artificial intelligence developers. Or artificial intelligence may create flawed teaching methods in the application process, and pedagogical teaching misunderstandings in teaching progress may unable to be solved. Comprehension skills, critical thoughts and knowledge management are fundamental skills for learners, while for improving these kinds of advanced skills, AI can help less.

Often in higher education, many people using AI, especially those with knowledge backgrounds in computer science, do yet realize or accept nothing that learning is a developmental and constructive activity. Instead, their approach is to apply a particular pedagogy based on behaviorist and objectivist epistemologies that do not capture the complexity of higher education well. Behavioral psychologists also hold the view that knowledge involves cognitive patterns “development and concepts” construction.

Therefore, testing knowledge acquired through memory and comprehension is not well suited to support individualized instruction, intelligent teaching, and student assessment. Advanced mental skills such as critical thoughts and emotional modes like empathy, are highly desirable in the digital age. Most educators agree that developing these skills requires the development of a learner-centered constructivist approach.

It has to be noted that while AI is currently mostly used in the "foundational" aspects of teaching and learning like memory and comprehension tests, other technologies such as virtual reality, simulation, and game-based studying approaches are more effective at cultivating problem-solving, critical thinking, and creativity.

4.2. Future Challenges and Questions for AI's Application to Higher Education

4.2.1. Artificial Intelligence is Serving Higher Education or Higher Education is Serving Artificial Intelligence

Clearly, it is not a question of whether the chicken or the egg comes first. People have now explored the extent to which new advances in artificial intelligence can benefit education. It may be that the intensive use of machines and data will be regarded as a way to fulfill and backed teaching and learning in higher education finally, but the reality is moving in a different direction. Although most higher education schools around the world are widely infiltrating the installation and application of multiple digital media platforms, there has not been a significant change in teaching and learning activities. And most free websites are providing platforms for students and workers to solve problems,

like Google, Facebook, Amazon AWS, etc., but many of these activities only contribute to providing hands-on opportunities for algorithm improvements from large technology providers.

Apparently, the field of higher education gains great merits of AI services from global technology vendors such as Big Data or Pattern Awareness Research. While ignoring the role of educational institutions (consciously or unconsciously) as data providers would be a grave mistake. These tech giants receive numerous massive personal data from universities to tweak their algorithms each day, greatly increasing their profit margins. AI research is becoming more and more transparent today, even though only a few companies are developing it, which creates a concentration of power. Private companies are well aware of these imperceptible exchanges, especially when they consider the profitability degree of data and AI services in the operations of large tech companies.

4.2.2. Artificial Intelligence Needs to Provide Specific and Additional Information at the Proper Time

Artificial intelligence is not the only black box, but also the human brain. Regardless of time or place, There can be no special divine formula that can impart knowledge to each people. More than four decades of research have shown that learning occurs only when many intervening conditions come together, which contain information about intellectual background, reasonable time and motivation, basic qualities and skills, and the other factors that may exceed cognitive abilities.

Therefore, instruction should play a greater role in considering more key factors, such as the presenting way of technology and information, the internal and external motivations, the specific groups targeted and the differences in skill levels. The education and technology research community know that earlier programs did not go as smoothly as expected, as many key factors are uncontrollable [13]. Researchers need to consider these lessons across three fields of artificial intelligence, higher education and learning.

Inevitably, in today's world where AI is increasingly linked to the labor market, the skills required of individuals will never be the same as they were when Windows 95 moved from the office to the home. Our mindsets will need to change as well. Humans are coming closer than ever to working with automated systems. The educational challenges faced in higher education schools are not only gradually novel but also accumulate much more over time. Whether there is sufficient time, competence, and opportunity to retrain the workforce before artificial intelligence has a deep impact on the labor market is still unknown.

5. Conclusion

This paper overall discusses and analyzes AI's application to higher education, the transformation it induces in higher education, and the limitation it has on higher education. It can be concluded that both the application and transformation AI has on higher education serve a significant contribution to the development of the current education system. With machine learning, biometric recognition, and virtual reality, students can find themselves in an immersive learning environment which ultimately promotes a more efficient learning process. On the other hand, the transformation AI induced helps teachers to deliver a more productive lecture to the students; as well as the teaching elements which are reformed by AI to assist both students and teachers. However, the limitation AI has on higher education is obvious to observe. It is falling behind other fields in the higher education system: it has a relatively smaller impact compared to the others.

Apparently, the higher education field faces unprecedented challenges due to the potential of AI solutions to change the structure of university administrative services. This paper envisions automated tasks that AI may involve in higher education, but it is difficult to be exhaustive about more complex higher education tasks. Although the application of AI in education has been an impressive

achievement, it is dwarfed by the application of AI algorithms in other fields. Because education and learning are still fundamentally a social experience, and the most powerful supercomputers can hardly detect human irony and humor, it only makes various attempts based on algorithms that would be simplified to improvised solutions then. Therefore, people must acknowledge technological limitations and recognize that artificial intelligence cannot replace teachers now or in the future, as it only offers possibilities for improving educational quality. Higher education as a profound transformation's heart that faces enormous opportunities and risks. The true potential of technology lies in its appropriate use to expand human capabilities and give a platform to enhance teaching, learning and researching possibilities. A careful examination and analysis from a scholarly perspective are expected at this crucial crossroads.

In the field of education, AI is still a sleeping giant. The key question is whether the goal of developing technology is faculty replacement by automated media nor whether it should facilitate basic education for both teachers and students at the same time. At present, artificial intelligence will not pose a threat to human society. But it has not always been. The above scientific and technological ethics issues need further in-depth discussion by future generations.

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