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Artificial Intelligence and its Implications in Education

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Abstract

In the past years, computer hardware, software and online service have managed to bring changes and reforms to classrooms and teaching methods. But the true disruption of education is yet to arrive using Artificial Intelligence (AI). Artificial Intelligence has proven its role as a game changing factor in number of fields, causing transformations unimaginable in the past. Using Artificial Intelligence (AI), expert systems can be designed to interact with the world through capabilities like visual perception, speech recognition and intelligent behavior that we would think of as essentially human.

This paper is aimed to discuss role of artificial intelligence in education sector including its market size, impact of AI in education, case studies of current presence of AI in education (smart content, intelligent tutoring systems, virtual facilitators and learning environments etc) with an eye towards improving learning and life outcomes for all. Issues and challenges will be discussed towards the end of the paper.

Keywords: *Artificial Intelligence, AIeD, Education*

1.0 Introduction

When first hearing of “Artificial Intelligence (AI)”, there is some movie images that pop into your mind like Star Wars and Robot where the robots in the movie developed the capacity to think like humans, to feel and to take action on their own. The concept of AI can be hard to understand, especially when trying to think about how it can be applied to education as well as many other sectors of society. In December 2015, the Getting Smart *AskAboutAI* research began and over these two years, they have identified over 100 applications of AI to life in areas such as recreation, transportation, education, healthcare and gaming to name just a few. The campaign focused on AI in regard to three objectives - employment, ethics and education. How can AI be beneficial for different industries, what are some of the uses, what are the benefits and risks associated with it, and of greater personal interest, what are the possibilities for AI in education.

According to Getting Smart’s *AskAboutAI* report, the notion behind AI is that machines can exhibit human intelligence. The concept of *machine learning* started in 1956 and is when algorithms are used to interpret data and take some action or to complete a task. AI, at its base, is computer code that displays some form of intelligence, learning, and problem solving in what has been referred to as a super intelligence. It is the development of computers that can complete

tasks which normally require human intelligence; however, it learns on its own and continues to improve on past iterations. AI becomes smarter, knowledge grows, and it expands the realm of possibilities for society.

Knowingly or unknowingly, we are using some AI applications / tools commonly in our daily life. Some of the everyday common uses of AI are:

- **Communication:** Spam filters, powered by AI, streamline the amount of spam appearing in your inbox. As email senders (real or automated) become more careful with selecting words which have not been flagged previously, the filters need to adapt and continue to learn based on words that the user also flags. There is an added component of machine learning in this, in that through the algorithms already in place by the email provider, additional filters are then created.
- **Travel:** If you have taken a ride using Uber, you have experienced Machine Learning, which is used to predict rider demand and to calculate ETA(Estimated Time of Arrival). The airline industry uses AI, since autopilot qualifies as AI, where it is estimated that “human steered” flight time is only seven minutes of actual flight length.
- **Social networking:** When we use Facebook to share photos, the artificial intelligence is able to detect faces in the image and suggest a name to tag the person. Facebook has continued to add new features as part of its AI Initiative, to generate a more personalized and interactive user experience. Some social media sites, such as Twitter, generate lists of accounts to follow, chats to join, and news feeds of interest based on an analysis of user input and data. Even Google with its cards can provide a variety of personal recommendations based on your search history.
- **Online Shopping:** One that comes to mind quickly is Amazon, and how it suggests items you may be interested in, as a result of your prior searches and order history. Systems are in place to protect consumers against fraud, with alerts being sent almost simultaneously to an attempted transaction that is not recognized as a typical purchase or located in a non-home base location. All of this done through AI, which is used for identifying fraudulent transactions.
- **Education:** Teachers and students have a wide range of tools available, ranging from Google Searches, in which alternate search terms are instantly suggested, citation generators, plagiarism checkers, and even Siri has become a popular tool for searches. An astounding amount of information generated instantly, far more advanced from thirty years ago and society’s reliance on card catalogs, calculators and books.

Looking at these common uses in everyday life makes it easier to think about some ways that Artificial Intelligence can transform classrooms. The technology has numerous applications that are changing the way we learn, making education more accessible to students with computers or smart devices if they’re unable to make it to class. Students aren’t the only ones who benefit as AI is also helping to automate and speed up administrative tasks, helping organizations reduce the

time spent on tedious tasks and increasing the amount of time spent on each individual student. The market size of AI in education sector is discussed in the next section.

2.0 Market Size

As per the survey of report of ResearchAnd Markets.com, the Global Artificial Intelligence in Education Market is forecast to grow from USD 537.3 Million in 2018 to USD 3,683.5 Million by 2023, at a Compound Annual Growth Rate (CAGR) of 47% during the forecast period. With the expected growth of AI in education, the next section shows the impacts of AI in education.

2.0 Implications of AI in Education

The increasing adoption of the AI technology for various applications in the education sector and growing need for multilingual translators integrated with the AI technology are expected to drive the growth of the AI in education market.

Artificial Intelligence is no longer just contained in science fiction films. It is going to be part of our everyday lives and in our classrooms. As we use tools like Siri and Amazon's Alexa, we are just beginning to see the possibilities of AI in education. Few more impacts are listed below:

3.1 Administrative Tasks Automation

AI has great potential in automating and expediting administrative tasks for both organizations and professors. Grading homework, evaluating essays and offering value to student responses is where educators spend the most time. AI can already automate the grading process in multiple choice tests in order to allow educators to spend more time with students one-on-one, but the technology may soon be able to do more than this. Software developers are creating new ways to grade written responses and essays as well. The admission process is also set to benefit with AI. Admissions processes can also be streamlined and improved, reducing the workload for high volume admissions offices. Automating the process of paperwork and support for students with common admissions questions via chatbot and interactive website materials can improve the process for both administrators and future students.

3.2 Smart Content

The concept of smart content is a hot topic now as robots can create digital content with the same degree of grammatical prowess as their human counterparts, and this technology has finally reached the classroom. AI can help digitize textbooks or create customizable learning digital interfaces that apply to students of all age ranges and grades. One such system called Cram101 uses AI to condense the content in textbooks into a more digestible study guide with chapter summaries, practice tests and flashcards. Another platform called Netex Learning allows lecturers and professors to design a digital curriculum and content across a variety of devices, including video, audio and an online assistant. Virtual content such as digital lectures and video conferences are also a reality now thanks to AI.

3.3 Smart Tutors and Personalization

AI can do more than condense a lecture into flashcards and smart study guides as it can also tutor a student based on the difficulties they're having with class material. In the past, students had a limited window of time in which they could see their professors, meaning office hours or hoping they answer their emails. There are now smart tutoring systems such as Carnegie Learning that use data from specific students in order to give them feedback and work with them directly. While this AI application is still in its early stages, it will soon be able to work as a full-fledged digital professor that helps a student with their educational needs in just about any area of need. Also, these platforms will soon be able to adapt to a wide variety of learning styles in order to help every educator and student.

3.4 Virtual Lectures and Learning Environment

Virtual Lectures and LearnEven may replace a lecturer with a robot. Well, not entirely, but there are already virtual human guides and facilitators that can think, act and react with humans by using gesture recognition technology in a natural way, responding both verbal and nonverbal cues. A more digital learning environment is also becoming a reality with institutions such as the University of Southern California (USC) Institute for Creative Technologies developing smart virtual environments and platforms. The organization uses AI, 3-D gaming and computer animation to create real virtual characters and social interactions. With the rise of augmented and virtual reality, and the benefits of bringing these into the classroom for students to have a more immersive learning experience and to see places and explore things that otherwise they would not, AI can be a tremendous benefit for this. Through AI, resources could be found instantly based on student responses, or for the entire classroom to experience. Capabilities such as these are not something that will be limited by the time and place of the classroom setting. AI could show students what they want to explore, find ways to bring the content to life instantly.

3.5 Teachers' Support

In addition to helping with grading, AI will also provide support for teachers in other ways. Some of the routine task can be managed by AI, as well as communication with students. For example, one college professor successfully used an AI Chatbot to communicate with students as a teaching assistant all semester without students knowing they were not talking to a human.

3.6 Students' Communication

Students and teachers will be able to communicate instantly with one another as well as to connect with other forms of AI around the world. Students instantly paired with peers, helping each student to expand their own personal learning networks, with personalized and more authentic connections that will meet the students' interests and needs at any given moment. Think of the benefits for being able to converse with AI or a virtual peer, who has been located based on an assessment of student needs and error analyses.

3.7 Catering to the Needs of Variety of Students

In addition to acting as a personalized learning companion, AI will also be able to help students with special needs by adapting materials to lead them to success. For instance, studies are already showing positive results for AI teaching ASD students' social skills.

3.8 Allow Teachers to Act as Learning Motivators

As AI takes on more of a teaching role by providing students with basic information, it will change the role of teachers in the classroom. Teachers will move into the role of classroom facilitator or learning motivator. Google Assistant, Apple Siri or Amazon Alexa and getting it to answer some of the questions that come up in a lesson would be a fairly simple task for many computing teachers, but to get them on-side, we need to talk far more about the role of machine-learning and far less about the dawn of the robots

3.9 Provide Personalized Help

AI will also provide personalized tutoring for students outside of the classroom. When students need to reinforce skills or master ideas before an assessment, AI will be able to provide students with the additional tools they need for success. In the future, visual and dynamic learning channels outside the classroom will become not only more prevalent but capable of supporting a range of learning styles, all while addressing common questions and concerns students have that cannot be readily addressed by teachers, TAs, tutors or parents.

The one-size-fits-all nature of compulsory education will almost certainly change as AI becomes more prevalent. Students in Massive Open Online Courses (MOOCs), online learning classes and blended class experiences will be able to benefit from customized, individualized learning paths in ways that until recently would not have been possible.

3.10 Dynamic Scheduling and Predictive Analysis

By using predictive computing, AI can learn students' habits and propose the most efficient study schedule for them. This is a benefit for the customer service agent, medical intern, or anyone who does a repetitive or laborious tasks; a machine won't get bored, tired or need a break and should the machine encounter a problem or question out of its programming a human will be contacted to step in.

4.0 Case Studies of AI in Education

Artificial Intelligence's digital and dynamic nature offers opportunities for student engagement that cannot be found in often out-dated textbooks or in the fixed environment of the typical four-walled classroom.

We have provided some case studies in which AI is being pioneered and applied in education. Some of the applications are still in a relatively "primitive" stage in terms of envisioned long-term objectives. Out of those provided, intelligent tutoring systems (ITS) seem to have made the most

progress over the last 20 years, as one of the original concepts for applications of AI in education. All have the potential to help shape a next generation of more personalized learning and responsive teaching.

4.1 Smart Content

“Smart content” creation, from digitized guides of textbooks to customizable learning digital interfaces, are being introduced at all levels, from elementary to post-secondary to corporate environments.

Content Technologies Inc., an AI development company specializing in automation of business processes and intelligent instruction design, has created a suite of smart content services for secondary education and beyond. **Cram101** uses AI to help disseminate and breakdown textbook content into digestible “smart” study guide that includes chapter summaries, true-false and multiple choice practice tests, and flashcards. **JustTheFacts101** has a similar, though more streamlined purpose like highlighting and creating text and chapter-specific summaries, which are then archived into a digital collection and made available on Amazon.

Other companies are creating smart digital content platforms, complete with content delivery, practice exercises, and real-time feedback and assessment. **Netex Learning**, allows educators to design digital curriculum and content across devices, integrating rich media like video and audio, as well as self- or online-instructor assessment. It also provides a personalized learning cloud platform designed for the modern workplace, in which employers can design customizable learning systems with apps, gamification and simulations, virtual courses, self assessments, video conferencing etc.. Learning platforms for the modern workplace are designed to allow employees to master additional skills and receive continuous and automated feedback, and when used strategically have the potential to help improve performance and increase production.

4.2 Intelligent Tutoring Systems

Intelligent tutoring systems (ITS) have made much progress since their early counterparts. Carnegie Learning’s **Mika** Software, uses cognitive science and AI technologies to provide personalized tutoring and real-time feedback for post-secondary education students, particularly incoming college freshman who would otherwise need remedial courses. Carnegie states the cost of such remedial learning as costing colleges \$6.7 billion annually, with only a 33% success rate for math courses. ITS provides the potential for students to more conveniently access flexible and more personalized modes of learning on an ongoing basis.

Pearson, in collaboration with University College London Knowledge Lab, notes that today’s model-based adaptive systems are also increasingly transparent, allowing educators to understand how a system arrived at a next-step decision and rendering them more effective tools for classroom teaching. The **iTalk2Learn**, a system engineered and tested by Carnegie Mellon University to assess its effects on young students learning fractions, applied a learner model that explicitly included information about an individual’s mathematics knowledge, cognitive needs, emotional state, as well as feedback received and the students’ responses in turn.

4.3 Virtual Facilitators and Learning Environments

While it seems obvious that no one in education is eager for virtual humans to come and replace educators, the idea of creating virtual human guides and facilitators for use in a variety of educational and therapeutic environments is a promising area of development. Though not yet a reality, the ultimate goal in this field is to create virtual human-like characters who can think, act, react, and interact in a natural way, responding to and using both verbal and nonverbal communication.

The University Of Southern California Institute for Creative Technologies is a pioneer in creating smart virtual environments and applications that draw on AI, 3-D gaming, and computer animation to develop authentic virtual characters and realistic social interactions. USC researchers have a number of ongoing projects in the space that hint at applications to come over the next two decades.



Fig 1 : SimCoach Prototype (Source: University of Southern California Institute for Creating Technologies Prototype Page)

Captivating Virtual Instruction for Training (CVIT) is a distributed learning strategy that aims to integrate live classroom methods with best-fit virtual technologies—including virtual facilitators, augmented reality, intelligent tutor, and others—in remote learning and training programs. As AI advances in this education domain, it seems there is more evidence to support the idea that both intelligent systems and humans are needed to manage different aspects of students' academic and social competencies. AI will likely not replace but will serve as an invaluable extension of the human expert, helping teachers to more effectively meet the diverse needs of many students simultaneously.

From facial recognition in the classroom to computers marking essays, China is wholeheartedly deploying new technologies into its education system. A recent report has revealed a high school in Eastern China is testing a new facial recognition system designed to analyze the engagement of students in a class room, in real-time.

An “**Intelligent classroom behavior management system**”, scans the room every 30 seconds logging both the behavior of the students and their facial expressions. The system can identify seven moods, including happy, sad, afraid and angry, by simply analyzing a student's face. A camera, perched atop the blackboard at the front of the classroom, also tracks six types of behavior: reading, writing, hand raising, standing up, listening to the teacher, and leaning on the desk.

In an even more striking and widespread implementation of AI into the education system, a recent report from the South China Morning Post (**SCMP**) claimed one in four Chinese schools were experimenting with computer software to grade essays. The machine-learning software has allegedly been in development for nearly a decade using deep learning algorithms to constantly learn and improve its ability to understand and evaluate a student's work. It is currently estimated that 60,000 schools are testing the technology and it can reportedly offer the same grade as a human marker up to 92 percent of the time.

Automated marking systems are not an entirely new idea. While computer-assisted marking software has been around for almost as long as computers, it has only been in the last decade or two that computers have begun to be used for marking more abstract student work, such as argumentative essay writing. In China these systems are implemented with degrees of scale that are unprecedented anywhere else in the world.

China is currently training its **neural network grading system** in a central server that compiles the work of millions of students. As well as promising a potential way to take out the variations attributed by human subjectivity in marking, this system undoubtedly offers the central government a remarkable ability to track the progress of all students in the country, in real time.

And this frighteningly comprehensive monitoring of its education system could inevitably be synced up with the country's oncoming **social credit system** due for full activation by 2020. This proposed system will assign each citizen with a social credit score that will determine a person's ability to travel overseas, get a home loan, or even access the internet.

5.0 Issues and Challenges

As we all know, there are pros and cons associated with every technology — and AI is no exception to this rule. The following are some of the issues and challenges:

- The AI project development environment is quite different. Most of the time, development is about identifying data sources and then gathering content, cleansing it and curating it. Such an approach requires different skills and mindsets, as well as different methodologies. In addition, AI-powered intellectual systems have to be trained in a particular domain.
- The slow digitization rate is affecting the adoption of the AI technology in the emerging economies, as the deployment of AI-enabled solutions require IT infrastructures to generate accurate results. This factor may restrain the growth of the AI in education market.
- To train machine learning algorithms one needs massive and clean data sets, with minimum biases.
- One needs also to keep in mind data privacy issues when it comes to harvesting personal data, particularly in light of the General Data Protection Regulation that is coming in effect in 2018.
- By 2018, Gartner predicts that 20% of all business content will be produced by machines. While there is evidence that AI is capable of creating certain kinds of content that is virtually indistinguishable from human content in terms of clarity and accuracy, machine produced content is substantially more boring and less pleasant to read according to one study.

- It's easy – and fun – to envision a complex collection of AI-driven components collaborating to create fully automated, perfectly personalized customer experiences. But that system will be prone to frequent failures as one or another component finds itself facing conditions it wasn't trained to handle.
- It is almost impossible to predict ROI.
- When combining the cost of installation, maintenance and repair, it's clear that AI is expensive. Only the well-funded schools will find themselves in a position to benefit from AI.

6.0 Conclusion

Artificial intelligence is the most intriguing of technological advancements of our time. From creating advanced data-collecting algorithms to providing detailed and customized student feedback, AI shines as the most competent AI can quickly interpret a student's needs and design an appropriate assessment. It can show students mastery, repeat lessons as needed and quickly design a personalized learning plan for each student. AI could provide teachers with a virtual teaching assistant. But more than just teachers and students, it can be a way to support parents by involving them in the learning environment of students and providing them with the information they need to help their students be successful when they're not in the classroom. The future likely holds a lot of possibilities for AI. This paper highlighted the Potential impacts of AI in education, some worldwide case-studies, issues and challenges associated.

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