

Integration of Artificial Intelligence Technologies in Teaching and Learning in Higher Education

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Abstract In the future, technology will influence the learning experience in many ways. To improve teaching and learning process and to deliver quality education, there are numerous promising technologies for higher education like Artificial Intelligence (AI), cloud computing, Internet of Things and others. However, the application of AI and other similar technologies in education are still in their infant stages especially in developing countries. Currently, various educational organizations are realizing the significance of introducing technologies into their daily teaching methods. Instantly, many higher educations will have AI involved into their regular activities. This is because of the high capability of AI in reasoning and learning, understanding of student's feeling and complex decision-making, visual perception, speech recognition and language translation, etc. It deals with the use of technology to make devices behave like human beings. With the support of AI, higher educations can enhance learning outcomes by providing more wealthy learning experiences, improved operational efficiency, and by gaining real-time, practicable insight into student performance. The purpose of this study is to illustrate integration of AI to advance teaching and learning and design AI based higher education teaching and learning implementation framework. AI have promises to change radically the way higher education work, and enhance student learning in many disciplines. If there is sincere preparedness to ensure widespread and successful implementation of AI, it has huge role for higher educational institutions. To pursue the full benefits and realize the influence of AI, higher education needs further efforts. Therefore, this paper presents a study about the integration of AI on higher education, the current issues in higher education and the current state of AI. Finally, based on the concepts analysed and the current state of AI technologies, AI based higher education teaching and learning implementation framework is developed which affects the future education.

Keywords Teaching-Learning, Higher Education, AI, AI-Based Education, Implementation Framework

1. Introduction

Now a day, advancement of technologies and unlimited expectation of students (the necessary skills to find jobs that pay them enough) from higher education enforces higher education institution's to support teaching and learning process with advanced technologies. So, the integration of an innovative educational technology in order to enhance quality education must be the responsibility of higher education. For this purpose, there are a number of educational technologies which includes cloud technologies, mobile technologies, virtual reality and classroom, audio and video, artificial intelligence (AI) and others (Wikipedia) (Fulton, 2019).

AI mainly deals with the use of technology to make devices behave like human beings. It is the ability of computers to act as human to do tasks. In this context,

computers and other machines with algorithms and methods to pretend human insight and judgment making practices to positively complete activities related to teaching and learning can be referred as AI (Murphy, 2019). Normally, there are four basic concepts in the definition of artificial intelligence as described in (John Paul Mueller, 2018). (1) acting humanly: that means computers acts like a human, (2) thinking humanly: that means to perform tasks that require intelligence to succeed which relies on introspection, psychological testing and brain imaging, (3) thinking rationally: that means how humans think using some standard and (4) acting rationally: that means how humans act in given situations under specific constraints.

AI have promises to change radically the way higher education work, and enhance student learning in many disciplines and at any level (Schroeder, 2019). If there is sincere preparedness to ensure widespread and successful implementation of AI by top management, lecturers and students, it has huge role for higher educational institutions. To pursue the full benefits and realize the influence of AI systems and technologies, higher education needs further efforts. Therefore, this paper presents a study about the

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integration of AI on higher education. Furthermore, this paper presents the current issues in higher education, the current state of AI and its challenge in higher education. Also, based on the concepts analysed and the current state of AI technologies, AI based higher education teaching and learning implementation framework is developed which affects the future education.

2. Overview on Area of AI Applications

In the present technological era, AI is applicable almost in all areas which is highly attached with many science disciplines from agriculture, health and education to space exploitation, astronomy and mineral prediction. Here below, the application of AI in agriculture and health are discussed to show the application of AI in other fields as initial topic to examine its application in education. Additionally, the major application areas or sectors of AI are shown in figure 1. In this regard, AI is contributing a great role in the modern agriculture to manage soil, crop, diseases and weeds (Eli-Chukwu, 2019). This is to monitor soil and crop as well as to predict weather, productivity and diseases control (Faggella, 2020) which aims to create smart agriculture. In the agriculture sector, AI is used in image recognition and perception, to maximize output using chatbot for farmers (Tanha Talaviya, 2020). AI contributes a great role in healthcare area for health monitoring, diseases diagnosis, drug development, digital consultation, personalized treatment, medical data processing and managing (Amisha, 2019). Even, in the time of Covid-19, AI is used for early detection and diagnosis of the infection, monitoring the treatment, contact tracing of the individuals, projection of cases and mortality, development of drugs and vaccines,

prevention of the disease as well as reducing the workload of healthcare workers (Raju Vaishya, 2020). Generally, AI is used in healthcare industries to make a better and faster diagnosis than humans. AI can help doctors with diagnoses and can inform when patients are worsening so that medical help can reach to the patient before hospitalization (Javatpoint). AI is also highly used in information searching by content recommendation based on users past experience. In this regard YouTube, Google and Facebook are very known in recommending contents for the users' by integrating AI algorithms in their systems. AI is also used in space exploitation in analysing and deriving the meaning of humongous amounts of data that cannot be analysed through human intelligence, to identify the geological makeup and historical significance of a planet, etc. (Gupta, 2019).

In the future, there may AI based robot managers in the work place in which employees are reporting to the robot. This is because of many works in industries are replaced by intelligent machines or robots. In the robotics scenario, Sophia may be the smartest in the world which communicates with people by maintaining eye contact, by following faces and even by recognizing individuals. Overall, the main goal of AI is just to improve human life as a whole by filling the present gaps of the available technologies.

Therefore, the power of AI (multi-domain problem solving ability) to solve impossible to think and complicated problems in different areas makes us inspired to forward our insight of AI in teaching and learning environment. In addition, because of lack of quality education and students' skill gaps in their professions are the main obstacles for economic growth of one country, we consider that the issues can be resolved by applying AI into educational environment.



Figure 1. Major Application areas of AI (Javatpoint)

3. Limitation of the Study

Although this study was conducted to illustrate the use of artificial intelligence to improve teaching and learning process in higher education and to deliver quality education, implementation and testing was not done. This is because of lack of required tools and resources (AI laboratory) to implement the proposed framework for proof of concept purpose.

4. Discussion

In this section, emerging issues in higher education, current state of AI, education and AI as well as AI based teaching learning implementation framework in higher education are discussed.

4.1. Emerging Issues in Higher Education

In higher education, the current teaching and learning process have many unresolved problems and issues such as global competition, student's lack of skill, the high cost of establishing and maintaining physical laboratory and smart rooms, shortage of technologists, lack of real time assistant of individual student, adapting new form of knowledge, lack of creativity or the capacity to learn and a lifelong readiness to face new things and adjust learned expectations accordingly and others (Kerr, 2017).

For the points specified above, AI will have encouraging effect on teaching and learning in higher education, it will be engaging or relevant enough if applicable in higher education. AI will be used as a portfolio to assess and guide each individual students which is not practical in today's higher education system, because a single lecturer can't work with every student at once.

Once again, AI will play a significant role for students by making technologies that reads their mind during study and learning so that it regulates the teaching learning environment based on the student's preferences. Here, the future AI technologies together with the concepts of cloud computing, IoT and 5G technology will be able to create lessons, self-check activities, evaluation and decision making, and refreshments with their devices to adjust the specific student's needs, particularly where a student may be inspired to do things or discouraged, and give immediate feedback.

4.2. Current State of AI

AI has a major potential and already started to improve the human life in different ways. Together with the Internet and cloud computing, AI changes the way we experience the world and has the potential to be a new engine for economic growth (P. AGHION, 2017) (ITUTrends, 2018) (Jahanzaib Shabbir, 2015) (B. M. Lake, 2017). The Internet is key for the technology behind AI and is the main platform for its deployment; including significant new means of interacting with the network.

Due to the collection of Big Data and the expansion of the Internet of Things (IoT), AI based applications are so far working in healthcare diagnostics, targeted treatment, transportation, public safety, service robots, education and entertainment, etc. with this, AI is already implemented and used in different areas for different purposes which includes the following (InternetSociety, 2017).

Email filtering: Email services use artificial intelligence to filter incoming emails. Users can train their spam filters by marking emails as spam.

Personalization: Online services use artificial intelligence to personalize your experience. Services, like Amazon or Netflix, learn from your previous purchases and the purchases of other users in order to recommend relevant content for you.

Fraud detection: Banks use artificial intelligence to determine if there is strange activity on your account. Unexpected activity, such as foreign transactions, could be flagged by the algorithm.

Speech recognition: Applications use artificial intelligence to optimize speech recognition functions. Examples include intelligent personal assistants, e.g. Amazon's Alexa or Apple's Siri.

4.3. Education and AI

While innovations are ongoing, no single application has come out on top. AI can be used to find gaps in the learnings of the student and provide real-time solutions. The technology can also identify areas where teachers are outnumbered by students and create optimized learning programs that impact the largest number of students (Khera, 2019). Teaching with technologies has becomes everywhere in almost every teaching and learning environments. We can take smart class rooms, computers, laptops, cell phones which are integrated in to teaching as a technological enablers (Maud Chassignol, 2018) (Hutchins, 2017).

The AI technology tracks student progress, assesses their skill, identifies knowledge gaps and offers personal study recommendations and feedback. Also AI technology gives teachers access to resources and reduces the time spent in planning, grading and managing project (Schroeder, 2019).

Currently, there are several technological and educational powerhouses that will contribute to the growth of AI which commit substantial resources and personnel to develop digital platforms that use AI (Wiley, n.d.).

With this, there are a number of promising opportunities in higher education that rises together with artificial intelligence (Lynch, 2018) (Maud Chassignola, 2018) (Mehrnaz Fahimirad, 2018) (André, 2017).

4.3.1. Simulated Learning Environment and Lecturers

AI have the ability to change where students learn, who teaches them, and how they acquire basic skills (Verma, 2018). AI could offer students a way to experiment and learn in a relatively free virtual environment especially when AI tutors offer solutions for improvements. So the students can

practice and discuss with any academic topics as much as they want and understand.

4.3.2. The Accumulation of Smart Content

In AI, smart learning content creation, from digitized guides of textbooks to customizable learning digital interfaces are possible. This is also used to design a digital curriculum and content across a variety of devices, including video, audio, and an online assistant (Sudarshan, 2018).

4.3.3. Intelligent Tutoring Systems (ITS) and Online Learning

Artificial Intelligence (AI) makes it possible for machines to learn from experience, adjust to new inputs, and perform human-like tasks. It can do more than condense a lecture into flashcards and smart study guides as it can also teach a student based on the difficulties they are having with class material. In the earlier time, students had a limited window of time in which they could see their lecturers, meaning office hours or hoping they answer their emails (Utermohlen, 2018) (Kulik, 2016). However, Artificial Intelligence will solve the problem by being with the students every time when they need assistant with no tired. Also, based on students' preference, revision of knowledge when they are just about to forget it is an effective educational and technological solution with AI. One of the best hopeful application of AI in education is that of adaptive learning. Adaptive learning is assumed that artificial intelligence in universities can track the improvement of each individual student and either adjust the course or inform the lecturers about the material that a given student has trouble in understanding. The ITS provide step by step tutorials, individualized for each student, through topics in well-defined structured manner (Wayne Holmes, 2019). Typically, the ITS is based on interactive technologies like

natural language processing systems (Ocaña-Fernandez, 2019).

4.3.4. The Automation of Administrative Tasks

AI has numerous applications that are changing the way we learn, making education more accessible to students with computers or smart devices if they are 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 (Utermohlen, 2018).

4.3.5. Universal Access for all Students

AI-powered learning system makes classrooms accessible to all, including those in another country. This can be highly helpful to those students who are unable to attend school due to an illness or want to study a different course from the one available in their school (Desk, 2019) (Marr, 2019).

4.3.6. Collaboration of AI and Lecturers

The fundamental focus of AI in higher education is to grasp the best qualities of electronic devices and lecturers where they work together for the best outcome for students (Marr, 2019).

4.4. AI Based Teaching Learning Implementation Framework in Higher Education

To implement AI based teaching and learning process in higher education, it should be based on the existing knowledge of computer technology and the future development of AI technologies.

By comprising these considerations, we proposed the following AI based teaching learning implementation framework in higher education.

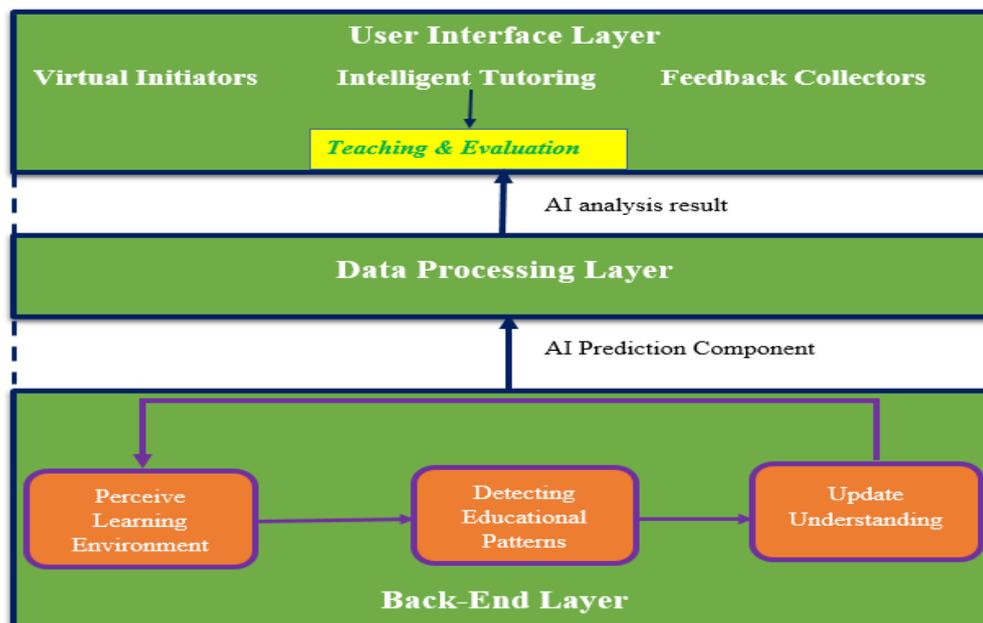


Figure 2. AI based educational implementation framework

4.4.1. The Back End Layer

This is the main AI layer which consists of multiple iteration of the three processes: Understanding the learning environment, detecting educational patterns, updating understanding and generating output or prediction component to the data processing layer.

As shown above, there is perception of the learning environment to provide tutoring for the learners. Here, there is detection of patterns specific to education to get understanding about the learners request and to update its knowledge related to specific topic to generate prediction components for data processing layer. If the back end didn't understand the request from the learning environment and educational patterns, the processes will be repeated until it gets and understands the correct information to send for data processing layer. In this layer, to perform such processes, there will be different AI algorithms and applications.

4.4.2. Data Processing Layer

After having AI prediction component from AI back end layer, we need to add user-friendly layers to support various user input data and to create an attractive format for AI results. The first step is to process the input data, then add component that will support the learning requirements and user's workflows by formatting the input data to feed AI component (file format mapping, input data size reduction, etc.) and parsing user settings to enable different behaviours. Finally, after prediction is performed and output is produced, post-processing the output to provide a user-friendly version of the results is required. It can be anything from computing some quantity of interest, to formatting text, to transforming an output file to a user supported file format. All of these pre and post processing parts will require software development. It will certainly be using standard software development: scripting or compiled code.

4.4.3. The User Interface (UI) Layer

"No AI without UI", in the AI systems, there is need of user interfaces that collect actual input and past data from student behaviour that can be used to model the learner (Tuomi, 2018). In this study the UI layer contains interfaces to interact with AI system for educators and learners. So AI without User interface is not possible. This is because any service is accessed by the user interface. It contains three sub components as a User interface:

Virtual initiators: it is highly useful in the educational domain to assist students by answering their requests quickly and accurately (Ajuzieogu, 2019). Also it is used to provide directional information and other advising for students.

Feedback collector: is AI based User interface to collect and evaluate students' feelings, ideas and assessments iteratively. This is because of student evaluation in learning is the most valuable source of information for improving quality of education. For this purpose the User interface with the integration of modern technologies like chatbot and teacherbot can be used to collect the students' feelings via

dialog interface. Also the concept of NLP, ML and DP could apply for evaluating and updating understanding.

Intelligent tutoring: is AI based User interface to provide actual tutoring for students. Here, there will be gap identification by identifying student's preference and understanding will be performed and finally evaluation of students learning using different ways like by chatbot application will be done for improvement. This is with perception of the learning environment, detecting learning patterns and modifying understanding to decide what content is preferable for whom. And then evaluation will be done after providing the tutor and there may be again learning environment observation process to improve the tutoring based on the evaluation result.

Generally, the AI user interface layer may be an API if the user of AI analysis result is a third party software like MOOCs, A desktop application if AI analysis result has to be installed on the user computer or web application if AI analysis result has to be available online. So it is used to interact with AI components to perform a prediction and access to the results of AI analysis. This can be by generating a document report of the AI analysis results or accessing a GUI that would display the computed results.

5. Conclusions

In this study, the issues of integrating AI in to teaching and learning process in higher education have been explored from the teaching and learning viewpoint. The study also looked at AI based teaching and learning implementation framework which contains AI backend layer, Data processing layer and User Interface layer. In the idea of education and AI, there are a number of promising opportunities like simulation of learning environment and lecturers, intelligent tutoring system, accumulation of smart content, automation of basic tasks and others. With this, it is possible to tackle educational challenges using AI by supporting knowledge and skill development to personalize learning and individualize feedback, for repetition, exercise and practice, assessing and monitoring student progress. For students, it is possible to find out the points that they are forgotten and can be easily suggested them to revise it with the integration of AI algorithm and applications in the teaching and learning process. Hence with a few revision, the students can be sure about the information that could be stored in their memory for long period of time. So higher education could be focus on integration of artificial intelligence in education to improve the teaching and learning process and to produce man power with expected skill and knowledge.

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