# Transforming Classroom Learning through Artificial Intelligence

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*Abstract*: *Artificial Intelligence (AI) is designing machines which can act like human beings. The machines are designed in such a way that can perform all functions which a human being can perform. The machines are characterized by all cognitive and affective functions possessed by human beings. AI finds extensive application in diverse fields and education is not an exception. With the rapid advancement of Information and Communication Technology (ICT), AI based tools can be adopted in education system. The present paper explores and explicates the application of AI based tools in education particularly focusing on teaching, learning, pedagogy and learning assessment.*

*Keywords*: *Artificial Intelligence, Pedagogy, Learning, Teaching, Data Mining.*

## I. INTRODUCTION

Artificial Intelligence (AI) is the fabrication of human intelligence into machines and empowerment of machines with higher level of computations which resembles human cognitive system. With the higher level of intelligence, the machines emulate all cognitive functions such as attention, perception, learning, reasoning, comprehension, decision making etc. In this present era when everything is getting digitalized, the heaps of generated data needs to be mined which acts as an input to AI models, resulting in taking appropriate actions. These actions can help eliminate most of the shortfalls which at present is faced by different sectors of Indian Economy.

Education being one of the core sectors of the Indian Economy plays a significant role in growth and development of the nation. As per National Strategy for Artificial Intelligence report (2018) school education in India has shown substantial progress with increase in Gross Enrollment Ratio (GER) to 97% at elementary level and 80% at secondary level. In such a scenario, it is pertinent to build education system that provide high quality learning opportunities. Moreover, as the entire world is becoming global [1] and competitive, education has to play a

vital role in creating future generations to become global leaders. To meet this goal, the nature of teaching has to be redefined. The traditional way of imparting education will not serve the purpose rather a contemporary approach should be adopted which should be more learner-centric as well as which should focus more on developing the higher cognitive abilities of the learner. With the advancement of latest Information and Communication and Technologies (ICT), novel ways of imparting education may be adopted. The initial efforts have been already made in this direction by Ministry of Human Resource Development (MHRD), GoI by envisaging a centrally sponsored scheme- National Mission on Education through Information and Communication Technologies (NMEICT) to leverage the potential of ICT in teaching and learning process for the benefit of learners particularly in higher education. Thus, for making best use of the latest technologies, Artificial Intelligence can play an important role in transforming the education process. The present paper has identified key areas in education where AI based tools can be applied successfully. These areas are: Teaching learning process, Designing instructional strategies and learning outcome assessment and analysis.

## II. APPLICATION OF AI IN EDUCATION

### A. Teaching learning process

Psychologists defined learning as relatively permanent change in behavior as a result of practice or experience. Teaching can be defined as identifying pupil's needs, experiences, feelings and creating a right environment to the learners to learn new things. Teaching may involve explaining a phenomenon, giving information, questioning, listening, demonstrating a skill or process and facilitating learning activities (note taking, discussion, assignment writing, simulations and practice. Teachers should act as a facilitator and encourage students to act upon the information provided to them rather than just an information disseminator. By applying AI in teaching learning process, teaching can be made more effective. With the use of Intelligent Tutoring System (ITS) personalized learning may be created which will cater to different needs of the students.

Since at elementary level a classroom comprises of heterogenous group of students, a single teacher cannot focus on developmental needs of each and every student. Usually a teacher adopts a generalized pedagogy for teaching everyone. ITS on the other hand can take into account each and every students' developmental needs and provide customized teaching accordingly. ITS modules can be developed for teaching basic subjects like English, Maths, General science, Hindi and Social science. Each module would comprise of learning materials followed by questions of increasing difficulty level. A student can proceed to next level only if he/she successfully completes the previous level. Regular feedback will be also provided by the "Models" once the student completes the assignments. This individual interface of each student with customized modules will lead to effective learning. Besides this, Artificial Intelligence (AI) can be applied in higher education too. Through AI students' Intelligence Quotient (IQ) as well as personality can be mapped. Data from various psychometric tests such as 16 Personality Factor, Myers Briggs Type Inventory, Big Five Personality Factor etc. can be fed into AI tools. This would help in identifying students of different personalities and proper career guidance can be provided to them. It would also help teachers in managing students of different personality types. Feldman and his colleagues [2] in their study on detection of perception style of engineering students trained Naives Bayes classifier- a Machine learning tool to identify the perception style of students. Prior training Naives Bayes classifier, the researchers tried to identify the perception style of students' learning through games. Results revealed 85% accuracy of games in detecting the perception style of students. Many other studies have also proved the efficacy of various ML techniques in detecting students' learning style such as artificial neural nertwork [3] [4], Bayesian network [5] [6] [7], decision trees[8] [9][10], genetic algorithm[11] [12]) and rule based methods [13].

## B. Instructional tools and techniques

For effective learning to occur, teaching aids also play a vital role apart from teaching strategies. For example by making use of different experiential techniques [14] such as role play, simulations, games, case studies etc., learners not only acquires the knowledge but can also reflect upon it, thereby leading to more effective learning. With the advancement of Information and Communication Technology (ICT) the nature of learning environment has also changed. Nowadays, mobile learning, cyber synchronous learning, social learning, ubiquitous learning has emerged in education landscape. In such a scenario, new teaching tools and techniques are required to support these above-mentioned learning. Tobias and his colleagues [15] have found game-based learning leads to enhancement of cognitive processes and multi-tasking skills of the learners. Further game-based learning also leads to enhanced

self-efficacy and knowledge retention [16]. AI can be used in designing interactive pedagogic tools. AI based instructional tools can be particularly useful in acquisition of procedural knowledge. By intelligent virtual reality students can learn the required skill in the simulated environment as well as well as interact with the instructor. This would be especially helpful to engineering students in learning their engineering concepts. Thus, the current problem of skill gap faced by India can be curtailed to a larger extent. Educational cobots and smart classrooms using sensors and Internet of Things (IoT) are the recent application of AI in instructional strategies to make the teaching learning process more engaging and effective [17]. An educational cobot is a robot designed to assist teachers' in delivery of instructions [18] [19]. Through educational cobots classroom teaching can be made more student centeric as the robot can pay attention to diverse needs of heterogeneous student groups and provide tailored teaching which is difficult for a teacher. They can also make the Intelligent Learning Environment (ILE) more effective by attending students who require extra help as well as solve students' queries and doubts [17]. Further, humanoid robots have been found to be more effective as students can closely relate and connect with the robots having human appearance [20] [21] [22] [23] [24]. AI can also be used for creating smart classrooms that support students, teachers and educational cobots too. High definition cameras combined with facial recognition technologies may capture the emotional state of the learners. These videos may be analyzed and through data mining, features of effective classroom space can be identified. Predictive models can be build which would identify effective classroom and ineffective classroom. This would be very helpful for monitoring classroom teaching as well as can be used for training novice teachers [16]. Another technological innovation is the use of wearable badges which can detect affective tone as well as emotions of the wearers. This would be very helpful in classroom management particularly when the students are involved in any group activity. The teacher can get alerts of the vocal tone which is not involved in the task. Teachers can also detect which group requires attention. Over a period of time such badges may generate data which can be mined and patterns of group work can be formulated. This would be very helpful in monitoring as well as assessing any group/collaborative activity by the teacher [16].

### C. Learning outcome assessment and analysis

With the advancement of data analytics, AI can play a vital role in learning assessment too. Through learning analytics students score can be captured as well as further analyzed to detect the student's behavioral patterns as well as predict future performance. This would help in identifying the 'weak students', 'extraordinary students' as well as probable 'dropouts'. Timely requisite interventions would be implemented to each category of these students. It would be very helpful to curtail the dropout ratio and increasing the retention rates particularly at elementary and secondary level. In a study conducted by Kotsiantis and his colleagues [25], the researchers used existing Machine Learning (ML) techniques to predict students' performance in a distance learning system. Latest ML techniques such as Decision Trees, Artificial Neural Network, Naïve Bayes Algorithm, Instance Based Learning Algorthim, Logistic Regression, and Support Vector Machines were compared to find out the best ML techniques for prediction of student performance based on their background data. Results revealed Naïve Bayes to be the best algorithm having 72.48% prediction accuracy followed by Logistic Regression having 72.32%, Artificial Neural Network having 72.26% and Support Vector Machines having 72.17% prediction accuracy. In a similar kind of study [26], researchers predicted students' academic performance by making use of Association Rule Mining Algorithm. Various attributes of students were taken such as percentage of marks in graduation, percentage of attendance, assignment marks and unit test performance. Important rules were generated to measure the correlation with students' attributes and final exam performance. Results revealed students' final exam performance is dependent on unit test, assignment marks, percentage of attendance and marks in graduation. Thus, by application of this algorithm weak students can be early detected in the beginning of the semester, and appropriate interventions can be provided to them to improve their performance. Besides, predicting students' performance, AI based tools can also be used in mapping students' learning trajectory. ASSISTments (an AI based tool) can be used to assess students' current state of knowledge through standardized tools, followed by individualized support system is provided as required. [24]. Thus, through big data and learning analytics the data of learners can be analyzed and effective learning patterns can be identified thereby resulting in development of, learning models which can provide interventions as well projecting the career trajectory of the learners.

## III. RESULTS AND DISCUSSION

Teaching methods across the globe have become more structured to give better, more streamlined results. A study states that by 2021, the application of AI in education and learning will increase by 47.5%. Beyond academics, it can also streamline students' career choices. The relationship between educators and students is changing, where educators have become more approachable and much better at understanding their students' perspectives. Artificial intelligence is causing digital disruption in different industries. It is making its presence felt in the education industry changing traditional and conventional teaching methods. AI applications for education are being developed for different stakeholders such as mentors, trainers, teachers, educational institutions.

- By 2025, the global AI market is expected to be almost $60 billion; in 2016 it was $1.4 billion
- Global GDP will grow by $15.7 trillion by 2030 thanks to AI
- AI can increase business productivity by 40%
- Businesses with more than 100,000 employees are more likely to have a strategy that implements AI.

## IV. CONCLUSION

The present paper has come out with plethora of opportunities where AI can be successfully used. Adopting AI in education will lead to huge transformation in Indian education system. But availing these technologies requires significant amount of participation and full involvement of each and every stakeholder of the education system. For example, requisite training should be provided to teachers who are going to use AI based tools in their classrooms. Policy makers have to draft new policies with regard to teaching, learning and assessment which can encourage the use of AI. Requisite infrastructure should be developed in schools, colleges, institutes which can support AI based tools. The curriculum needs to be revised too. Thus, for incorporating AI in education the entire education environment needs to be transformed. Though application of AI in education is in initial stage in India, with the fuller participation of all the stakeholders, in the coming years there would be significant change in Indian Education landscape which will lead to high quality learning.

## REFERENCES

1. Friedman, T. L. (2005). The world is flat: A brief history of the twenty-first century. New York: Farrar, Straus and Giroux.
2. Feldman,J., Monteserin,A., Amandi, A. (2014). Detecting students' perception style by using games Computers & Education 71 (2014) 14–22.
3. Kolekar, S., Sanjeevi, S., & Bormane, D. (Dec 2010). Learning style recognition using artificial neural network for adaptive user interface in e-learning. In Computational intelligence and computing research (ICCIC), 2010 IEEE International conference on (pp. 1–5).

4. Villaverde, J., Godoy, D., & Amandi, A. (2006). Learning styles' recognition in e-learning environments with feed-forward neural networks. Journal of Computer Assisted Learning, 22(3), 197–206.

5. García, P., Amandi, A., Schiaffino, S. N., & Campo, M. R. (2007). Evaluating Bayesian networks' precision for detecting students' learning styles. Computers & Education, 49(3),794–808.

6. García, P., Schiaffino, S. N., & Amandi, A. (2008). An enhanced Bayesian model to detect students learning styles in web-based courses. Journal of Computer Assisted Learning, 24(4), 305–315.

7. Cha, H. J., Kim, Y. S., Park, S. H., Yoon, T. B., Jung, Y. M., & Lee, J. H. (2006, June). Learning styles diagnosis based on user interface behaviors for the customization of learning interfaces in an intelligent tutoring system. In International Conference on Intelligent Tutoring Systems (pp. 513-524). Springer, Berlin, Heidelberg..

8. Crockett, K., Latham, A., Mclean, D., Bandar, Z., & O'Shea, J. (2011). On predicting learning styles in conversational intelligent tutoring systems using fuzzy classification trees. In IEEE International conference on fuzzy systems (pp. 2481–2488).

9. Özpolat, E., & Akar, G. B. (2009). Automatic detection of learning styles for an e-learning system. Computers & Education, 53(2), 355–367.

10. Chang, Y.-C., Kao, W.-Y., Chu, C.-P., & Chiu, C.-H. (2009). A learning style classification mechanism for e-learning. Computers & Education, 53(2), 273–285.

11. Yannibelli, V., Godoy, D., & Amandi, A. (2006). A genetic algorithm approach to recognise students' learning styles. Interactive Learning Environments, 14(1), 55–78

12. Graf, S., & Kinshuk. (2010). Using cognitive traits for improving the detection of learning styles. In Proceedings of the 2010 Workshops on database and expert systems applications. DEXA '10 (pp. 74–78). Washington, DC, USA: IEEE Computer Society.

13. Graf, S., Kinshuk, & Liu, T.-C. (2009). Supporting teachers in identifying students' learning styles in learning management systems: an automatic student modelling approach. Educational Technology and Society, 12(4), 3–14.

14. Kolb, D. A., Boyatzis, R. E., & Mainemelis, C. (2001). Experiential learning theory: Previous research and new directions. Perspectives on thinking, learning, and cognitive styles, 1(8), 227-247

15. Tobias, S., Fletcher, J. D., & Wind, A. P. (2014). Game-based learning. In In Handbook of research on educational communications and technology (pp. 485–503). New York: Springer

16. Sitzmann, T. (2011). A Meta-analytic examination of the instructional effectiveness of computer-based simulation games. Personnel Psychology, 64(2), 489–528

17. Timms, M.J. (2016). Letting Artificial Intelligence in Education Out of the Box: Educational Cobots and Smart Classrooms. International Journal Artificial Intelligence Education 26:701–712.

18. Green, S.A, Billinghurst, M., Chen X.C. and Chase, J.G. (2008). Human-Robot Collaboration: A Literature Review and Augmented Reality Approach in Design. International Journal of Advanced Robotic Systems, Vol. 5, No. 1 ISSN 1729-806, pp. 1–18.

19. Krach, S., Hegel, F., Wrede, B., Sagerer, G., Binkofski, F., and Kircher, T. (2008). Can Machines Think? Interaction and Perspective Taking with Robots investigated via fMRI. PloS ONE 3 (7), 2579.

20. Kiesler, S., Powers, A., Fussell, S.R., and Torrey, C. (2008). Anthropomorphic interactions with a robot and robot-like agent. Social Cognition, Vol. 26, No. 2, 2008, pp. 169–181.

21. Oshima, J., Oshima, R., & Miyake, N. (2012). Collaborative reading Comprehension with communication robots as learning partners. International conference of the learning sciences, July 2012, Sydney, Australia. Volume 2. Short Papers.

22. Kennedy, J., Baxter, P., and Belpaeme, T. (2015). Comparing robot embodiments in a guided discovery learning interaction with children. International Journal of Social Robotics, 7(2), 293–308.

23. Oshima, J., Oshima, R., & Miyake, N. (2012). Collaborative reading Comprehension with communication robots as learning partners. International conference of the learning sciences, July 2012, Sydney, Australia. Volume 2. Short Papers

24. Heffernan, N. T. & Heffernan, C. L. (2014). The ASSISTments ecosystem: Building a platform that brings scientists and teachers together for minimally invasive research on human learning and teaching. International Journal of Artificial Intelligence in Education, 24(4), 470–497

25. Kotsiantis,S., Pierrakeas,C. and Pintelas, P. (2004). Predicting students' performance in distance learning using machine learning techniques. Applied Artificial Intelligence, 18:411.

26. Borkar, S., & Rajeswari, K. (2013). Predicting Students Academic Performance Using Education Data Mining. International Journal of Computer Science and Mobile Computing. Vol. 2, Issue. 7, July 2013, pg.273 – 279.