

# Enhancing E-Learning Through Artificial Intelligence: A Research perspective

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## Abstract

In the modern educational system, e-learning is crucial. Learning behaviour and interest are the main focuses of personalized learning systems, which also adapt the curriculum to the skills and foundational knowledge of their students. The personalized learning system is a customizable teaching methodology that meets the particular needs of students. Personalized learning maximizes each learner's needs. For an efficient education system, personalized learning system is vital to understand learners and build a strategy that caters to the specific learning needs and interests of students. An intelligent tutor system is a system that monitors the learner's performance and provides tailored tutoring. Computer-based learning, digital collaboration, web-based learning, and virtual classrooms are all examples of e-learning applications. Artificial intelligence-based e-learning is contingent upon a multitude of aspects, including but not limited to the learner's interest, aptitude, skill, hobbies, perception, attitude, and emotions. Organizations are in great need of AI-based e-learning systems to give corporate training to their staff members depending on their preferred methods of learning and the demands of the company. Personalized learning systems require the identification of learning styles and the prediction of domain knowledge.

**Keywords:** Artificial Intelligence, E-Learning System, Artificial Neural Network, Fuzzy Rule Based System Domain Knowledge Prediction

## 1. Introduction

One dynamic element in the learning environment is artificial intelligence-based e-learning. To give the optimal learning experience, it is essential to identify learners' learning behaviours and design a personalized e-learning system. Artificial Intelligence contingent upon a multitude of aspects, including but not limited to the learner's interest, aptitude, skill, hobbies, perception, attitude, and emotions. a good education system must first understand its pupils. Modern teaching methodologies, curriculum design, training, performance evaluation of students, and teaching instrument creation can all be automated with artificial intelligence. One of the main challenges in today's academic environment is creating a personalized environment.

## 2. Reviews of the Literature

Learning is a dynamic process impacted by the learner's interests, emotions, prior domain knowledge, and aptitude for the subject matter. Audio, video, presentations, text, discussion forums, webinars, and other forms of e-learning content are available online. E-learning materials help students acquire information and skills that are appropriate for their requirements. The personalized e-learning technique is learner-centric, which helps to give students with the correct learning path.[1]. Neural networks, evolutionary algorithms, clustering, fuzzy logic, inductive learning, and visualisation are important ways for optimizing e-learning and determining students' educational aptitude and competence. According to the study, data mining approaches can be utilized to classify students' learning outcomes and solve e-learning problems[2]. Researchers claim that ANN-based personalised e-learning systems are an effective approach for students to study at their own pace[3]. Back propagation ANN is used to categorize learning objects according on concepts. The multilayer perceptron network is trained using a standard back propagation technique. The Conjugate Gradient Approach use the output Weight Optimisation (OWO) technique to select the best learning path for the given learner. According to studies, ANN can select learning resources and paths for students based on their learning expectations [4]. The Apriori approach is used to determine the link between learners' knowledge and the difficulty level of the learning object [5].AI-based e-learning is an innovative educational strategy that uses AI technologies to provide students with a personalized learning experience. It has the potential to transform education by offering pupils a more engaging and effective learning environment [6]. AI-based e-learning is a sort of e-learning that makes use of artificial intelligence technologies to provide students with a tailored and interactive learning experience. The purpose of AI-based learning is to employ AI algorithms to assess student behaviour and deliver personalized feedback in order to enhance their learning experience [7].AI systems can assess student behaviour and deliver personalized feedback to help students improve their learning. This can result in higher student engagement and better learning outcomes [10][9]. Students can interact with virtual teachers and receive personalized feedback in real time by leveraging AI technologies such as natural language processing and computer vision [8][10].For improved analysis, research has to pay greater attention to the unique characteristics of each learner. A customized collaborative e-learning environment requires data mining algorithms and relevant AI approaches [11]. AI can simulate emotion well enough to produce a more engaging experience [12]. Using the dataset, this model is utilized to forecast the marking and scoring patterns of students. R. Shivannathan (2017) investigates the efficacy of e-learning techniques in teaching mathematics to learners who progress slowly. The researcher claims that for slow learners, e-learning is a more effective teaching tool than traditional classroom methods. V. Kavitha, Resham Lohani (2018) goes into detail about how artificial intelligence may improve e-learning's virtual learning environment. AI supports the individualized learning experience by assisting in the identification of learners' cognitive behaviors. In order to assess student profiles and learning activities, Padmaja Appalla et al. (2018) suggested a cloud-based database is utilized to keep track of each learner's actions, amount of knowledge attained, and so forth. When compared to a knowledge-based recommendation system, the fuzzy model provides superior results, making the suggested method appropriate for a range of learning materials, including text, audio, video, and pdf . According to Sankar Pariserum et al. (2019), implementing fuzzy logic

is crucial when creating an online learning system since it may recommend relevant online resources and boost students' interest in the platform.

### **3. Artificial Intelligence**

Various techniques such as machine learning, deep learning, heuristic searching, rule-based systems etc., are the foundation of artificial intelligence. A computer equipped with general intelligence and the ability to think and function like a human being is known as strong artificial intelligence. It can use this intelligence to solve any problem. Artificial intelligence has several applications.

#### **3.1 Artificial Intelligence & Education**

With a personalized approach for each student, artificial intelligence tools contribute to the transformation of learning. Artificial Intelligence is a crucial tool for automating a wide range of multidisciplinary departments. In order to provide individualized education based on each learner's needs, artificial intelligence stores and analyzes vast amounts of learner data. When it comes to understanding each learner's unique skills and interests, artificial intelligence can bridge the knowledge gaps in subject areas where teachers lack specific expertise. A branch of machine learning is called deep learning. Artificial Neural Network analysis of brain function is facilitated by machine learning algorithms.

### **4. Fuzzy System**

A mathematical method that provides output ranges between 0 and 1 is called a fuzzy system. In order to produce actual output, fuzzy logic operates at the level of input possibilities. Data that is noisy, distorted, and imprecise can be processed by a fuzzy logic-based system. It provides a fresh, simple method without getting too complicated. Fuzzy logic is simple to use and comprehend since it is grounded in human communication and a quantitative approach seen in everyday language.

#### **4.1 fuzzy Rule based System**

Several IF-THEN rules are stored by Rule Base according to working memory. Another name for it is a knowledge base. The selection of acceptable rules is done through the usage of conflict resolution policies. Rule-based systems are created using data mining techniques such as association and clustering, together with conflict resolution principles including data ordering, specificity, and refractoriness. The procedure is iterative and doesn't stop until the desired outcomes are achieved.

### **5. Synthetic Neural Network**

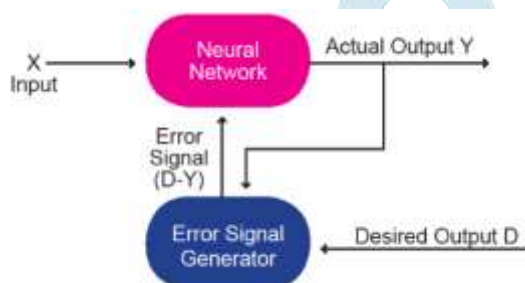
A biological nervous system-inspired information processing model, including the functioning of the human brain, is known as an artificial neural network. By experience or example, an artificial neural network can pick up new skills. A neural network can function without any specialized computation or explicit programming. Real-time issue solving is facilitated by artificial neural networks because of their parallel architecture and fast response times. The innovative structure of the information processing system of ANN is its key component.

## 5.1 Types of Learning through Artificial Neural Network

An ANN is data-driven. To learn or train a neural network is to modify its parameters in order to cause it to respond to a stimulus in a way that produces the desired outcome [5]. Three categories are used to group the learning strategies.

### 5.1.1 Supervised Learning

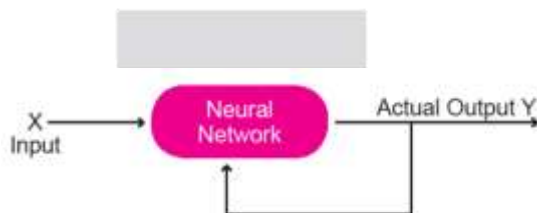
The training data that matches the intended/desired output vector with the actual output vector is what the neural network uses to learn. The network generates an error signal if the two output values differ from one another. We refer to this kind of approach as supervised learning. Fig. 1 illustrates how supervised learning methods operate.



**Fig.1 Supervised Machine Learning**

### 5.1.2 Unsupervised Machine Learning

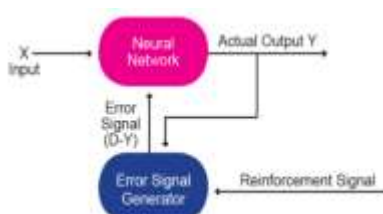
This method is known as unsupervised learning since it is used in ANNs to group similar-type input vectors without the need for training data to identify which pattern the output data belongs to. In order to create a cluster, the process network organizes and accepts input patterns during training. A new class is formed if the pattern class cannot be discovered. The neural network provides an output response for every new input in order to determine which class's output pattern. Figure 2 below illustrates how unsupervised learning methods operate.



**Fig.2 Unsupervised Machine Learning**

### 5.1.3. Reinforcement Learning

Reinforcement learning is the process of learning based on critical information when there is insufficient or critical information available to predict the outcome. Making weight adjustments is important if you want to receive negative feedback later on. Figure 3 below illustrates how reinforcement learning operates.



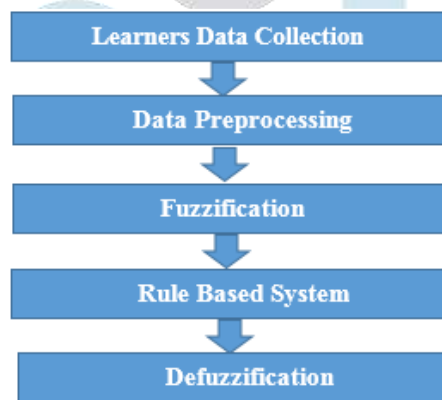
**Fig.3 Reinforcement Learning**

## 6. Analysis of Learning Behaviour.

In today's educational system, analysing learning behaviour is a critical task. Many elements contribute to learning behaviour analysis, including the learner's interest, skill, hobbies, perception, attitude, aptitude, and emotions. It is a constantly changing aspect of the learning environment. Analysis of learning behaviour aids in the selection of teaching methods based on the needs and interests of the learner. To create a personalized e-learning system, it is critical to identify learners' learning behaviours in order to give the optimum learning experience. This study develops a fuzzy method for analyzing learner behavior. The system's performance is assessed using an artificial neural network.

### 6.1. Fuzzified Rule Based System for Learners Behaviour Analysis

Each learner has a different learning style. Accurately predicting the learner's exact behavior is difficult because learning is a dynamic process. To solve this imprecise issue, a fuzzy rule-based system is made to identify the learner's learning behaviour. An examination of learner behavior using a Fuzzified Rule-Based System is demonstrated.



**Fig 4. Proposed Fuzzified Rule Based System**

## 7. The study's objectives

Online resources for e-learning are readily available for students to choose the right ones to meet their learning objectives.

1. Understand the present state of AI / ML applications on e-learning systems.
2. Examine the benefits and problems of incorporating adaptive learning algorithms into e-learning systems.
3. Evaluate the impact of AI / ML-powered adaptive learning on student engagement, retention, and performance.
4. Make recommendations for educational technologists and stakeholders on how to effectively use AI/ML for adaptive learning.

## 8. Research Methodology

To give students a customized online learning experience, the researcher created a system. To analyze and forecast data, artificial intelligence methods are employed.

## 8.1 Data Collection

The following techniques are used to gather data:

**a. Primary Data:** Using the Moodle online web portal, students' behaviour, skill, ability, interest, and prior knowledge are all recorded.

**b. Secondary Data:** Research journals, thesis, e-resources, reference books, and other sources are used to gather information about artificial intelligence approaches, machine learning algorithms, and the operation of current e-learning systems.

## 9. Tools for Data Analysis

**a. MATLAB Software:** MATHWORKS created the multi-paradigm environment known as MATLAB Software for statistical and numerical calculation. A variety of functions for data analysis, computation, and visualization through interactive 2D/3D graphs and charts are available in MATLAB. A nice user interface of MATLAB enables the creation of a genetic algorithm, fuzzy systems, artificial intelligence algorithms like ANN, and a variety of data mining approaches.

### b. R Software:

Scientific research and statistical computation can be conducted using the open-source R software environment.

Implementing machine learning algorithms, data mining, statistical computation, and numerical methods is made easier using the packages and functions offered by the CARN library. Data visualization using various plotting approaches is possible with R software.

## 10. Data Analysis and Processing Techniques

1. Prepare a dataset to record the learner's learning behaviour, learning styles, and domain knowledge.
2. Diagnostic assessment for predicting the analytical and logical abilities of the learner
3. Use proper data mining and AI approaches to construct an e-learning system.
4. Designing a customized e-learning system with several dimensions.
5. Create an interactive personalized e-learning system that recommends relevant e-learning material and the optimum learning path based on the learners' ability and learning needs.

## 11. Conclusion

Personalized e-learning powered by artificial intelligence will assist students in learning depending on their aptitude, interest, and other factors. The technology offers the learner an optimal learning path based on their learning style and amount of subject expertise. This work describes a method for using artificial intelligence techniques to create a personalized e-learning system. The learner's four primary learning styles—auditory, reading, visual, and kinesthetic—must be taken into consideration while creating a customized e-learning system. Further research involves determining which e-learning technique will work best for a particular learner group by using big data analytic technologies.

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