African Journal of Advanced Pure and Applied Sciences (AJAPAS)
Online ISSN: 2957-644X
Volume 4, Issue 1, January - March 2025
Page No: 281-292
Website: https://aaasjournals.com/index.php/ajapas/index
ISI 2024: 0.877 **SJIFactor 2024: 6.752** **معامل التأثير العربي: 1.62**

Enhanced E-learning through Neural Network Based Cloud Data Extraction

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تحسين التعلم الإلكتروني من خلال استخراج البيانات السحابية القائمة على الشبكات العصبية

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Received: November 23, 2024	Accepted: February 10, 2025	Published: February 18, 2025

Abstract:
In light of the aspiration to achieve sustainability in the field of education, especially after the development of artificial intelligence technologies in general and artificial neural network technologies in particular, the process of improving e-learning has become one of the most important strategies for achieving sustainability. This study aims to evaluate the impact of using artificial intelligence techniques and artificial neural networks on improving cloud e-learning by extracting and mining data from the electronic cloud and analyzing it to provide a more efficient and effective educational experience. Through several methodologies, including descriptive methodology to describe the factors influencing the improvement of machine learning through the use of artificial intelligence techniques and the mechanism for using these techniques, quantitative methodology was used in collecting data and analytical scientific methodology to analyze the results of the proposed model, which is a hybrid of convolutional artificial neural networks (CNN) and recursive neural networks (RNN). Through the model, it is possible to extract and analyze user data such as interaction with content and duration of study to extract patterns and behaviors that support improving the learning experience, and personalizing individual learning paths. Predicting the academic performance of students using machine learning techniques. The results showed an improvement in the learning experience of 86% and an improvement in platform performance of 85%. Machine learning indicators, such as accuracy (94%), recall (93%) and f1 score (91%), also indicated the success of the model used in improving.

Keywords: e-learning, data mining, neural networks, precision, recall, F-1-score.

الملخص:
في ظل التطلع إلى تحقيق الاستدامة في مجال التعليم، وخاصة بعد تطور تقنيات الذكاء الاصطناعي بشكل عام وتقنيات الشبكات العصبية الاصطناعية بشكل خاص، أصبحت عملية تحسين التعلم الإلكتروني واحدة من أهم الاستراتيجيات لتحقيق الاستدامة. تهدف هذه الدراسة إلى تقييم تأثير استخدام تقنيات الذكاء الاصطناعي والشبكات العصبية الاصطناعية في تحسين التعلم الإلكتروني السحابى من خلال استخراج واستخراج البيانات من السحابة الإلكترونية وتحليلها لتوفير تجربة تعليمية أكثر كفاءة وفعالية. ومن خلال عدة منهجيات، منها المنهج الوصفي لوصف العوامل المؤثرة في تحسين التعلم الآلي من خلال استخدام تقنيات الذكاء الاصطناعي وآلية استخدام هذه التقنيات، وتم استخدام المنهج الكمي في جمع البيانات والمنهج العلمي التحليلي لتحليل نتائج النموذج المقترح، وهو هجين من الشبكات العصبية الاصطناعية التلافيفية (CNN) والشبكات العصبية التكرارية (RNN). ومن خلال النموذج يمكن استخراج وتحليل بيانات المستخدم مثل التفاعل مع المحتوى ومدة الدراسة لاستخراج الأنماط والسلوكيات التي تدعم تحسين تجربة التعلم وتخصيص مسارات التعلم الفردية. والتنبؤ بالأداء الأكاديمي للطلاب باستخدام تقنيات التعلم الآلي. وأظهرت النتائج تحسنًا في تجربة التعلم بنسبة 86% وتحسنًا في أداء المنصة

بنسبة 85%. كما أشارت مؤشرات التعلم الآلي مثل الدقة (94%) والتذكر (93%) ودرجة (91%) f1 إلى نجاح النموذج المستخدم في التحسين.

الكلمات المفتاحية: التعلم الإلكتروني، استخراج البيانات، الشبكات العصبية، الدقة، الاستدعاء، درجة F-1.

1. Introduction

With the development of computing and programming technologies and the emergence of artificial intelligence, machine learning techniques and data extraction techniques from the electronic cloud have become revolutionary tools in the field of education at any time and in every place, which leads to enhancing reference sustainability, which is the cornerstone of achieving total sustainability with its three axes: economic sustainability, environmental sustainability, and sustainability. Societal sustainability means preserving the rights of current generations without compromising the rights of future generations from economic resources. And environmental [1]. And through what is called Data mining (Data Mining & data extracting), which can be defined as the process of extracting and analyzing data by revealing patterns, relationships, and trends that may be clear or implicit trends that may be hidden. The goal of analyzing this data is to form strategic and effective insights to make a specific decision regarding determining the factors affecting the improvement of the quality of e-learning through data mining in the cloud. Electronic data mining is considered one of the basic tools in the field of science and artificial intelligence and has wide applications, as well as predicting future requirements and aspirations to improve the quality of e-learning through electronic platforms [2].

Through this study, which aims to use data mining techniques in the electronic cloud to improve and analyze the efficiency of e-learning by exploring the challenges associated with data mining and analysis tools and developing effective models for analyzing and extracting data in e-learning, as well as evaluating previous models and improving practical recommendations through A methodology that relies on several methodologies, including the descriptive methodology in describing data and the factors influencing data extraction and analysis from the electronic cloud, as well as the factors influencing the improvement of the e-learning process and methodology. Quantitative data collection, in addition to using scientific and analytical methodology to analyze the results and using comparative methodology to compare the results.

The study is of particular importance because it is an attempt to enhance the development of e-learning through the use of neural network techniques as tools to extract and analyze data and use them to improve e-learning processes and thus increase the efficiency of students, educational institutions and those interested in the data extraction process. It also discussed the challenges facing data mining operations and how to overcome them. It can be briefly described as a reference contribution related to extracting data from...the electronic cloud and its role in improving e-learning processes [3].

Despite the importance of extracting data from the electronic cloud and using it in analysis processes to develop e-learning processes and other developments, there are some challenges and obstacles facing the data extraction process, which are Lack of current capabilities for data mining and data analysis. Data mining and data analysis tools are important tools that enable teachers to understand the behavior of their students, analyze patterns, and discover areas in which they can improve their teaching. Also, the process of data extraction is a relatively complex process and requires specific expertise [4]. However, with the numerous studies related to developing models to overcome these challenges, including this study, hybrid techniques are used to take advantage of the features of each technology and develop models that are more flexible and free of complications.

2. Basic Concepts and Theoretical Background

Data extraction techniques, e-learning techniques, are an example of the development of education as a response to the requirements of time, place, and technology, especially in light of the tremendous development witnessed by computing and artificial intelligence technologies. After data extraction relied on books, references, and written texts, there are now large databases of data that can be consulted when needed. . In this part, we will present the most important basic concepts and theoretical backgrounds of the study so that the reader can form an insightful point of view on the concepts of the study, its objectives, procedures, importance, and the results it reached.

2.1. Basic concepts

2.1.1 The electronic cloud

The electronic cloud or cloud computing (Cloud Computing) is an electronic model through which computer services can be provided over the Internet, where users can access a wide range of computing resources,
applications and content through information stored in a system called the electronic cloud. This system depends on factors such as storage and power. Computing and software services through an Internet connection rather than storing data. They are stored on remote rings in other specialized companies called companies that provide electronic cloud services [5].

2.1.2 Data extraction

Cloud Data Extraction is the process of retrieving data stored on cloud storage platforms such as Google Drive, Dropbox, One Drive, and Amazon S3, then converting it into a format that can be used in data analysis operations,

in addition to backup operations and data transfer operations between different clouds, as well as compiling... Data from multiple sources to create mini databases [6]

Among the most important methods of extracting data from the electronic cloud are the following:

1) Manual downloading, where files are downloaded directly from the user interface of any application, is a suitable method for extracting a small amount of data.
2) Using data mining applications, which are available on most platforms and include and allow interaction with data, but require programming experience.
3) Using machine learning techniques and neural networks to extract data. These techniques include techniques that rely on artificial intelligence to develop models capable of learning. The most famous of these techniques are:
4) Supervised learning: To train models using pre-labeled data, such as ranking students by performance.
5) Unsupervised learning: To discover hidden patterns in data, such as grouping students with similar learning behaviors.
6) Reinforcement learning: To improve systems by interacting with the environment, such as designing educational recommendation systems [7].

2.1.3. Pattern Mining:

Techniques used to discover the relationship between elements and different data, whether this relationship is an implicit relationship or an explicit relationship. These technologies do the following:

1) Association rules: To reveal the correlation between content type and study time.
2) Time series analysis: To track students' progress over time.
3) Detecting anomalous patterns: To identify students who are experiencing difficulties.

2.1.4 Artificial Neural Networks:

These are techniques for tracking artificial intelligence, where the human brain structure is simulated to analyze data and formulate models for future prediction. Neural networks are divided into several types, each type has a specific feature and is used in a specific application. The most famous of these types are the following:

1) Feed-forward networks (FNNs): To solve classification and regression problems.
2) Convolutional Networks (CNNs): They are specialized networks in visual and audio text processing, image processing, and computer vision [8]. Figure 1 shows a model of one of these networks.

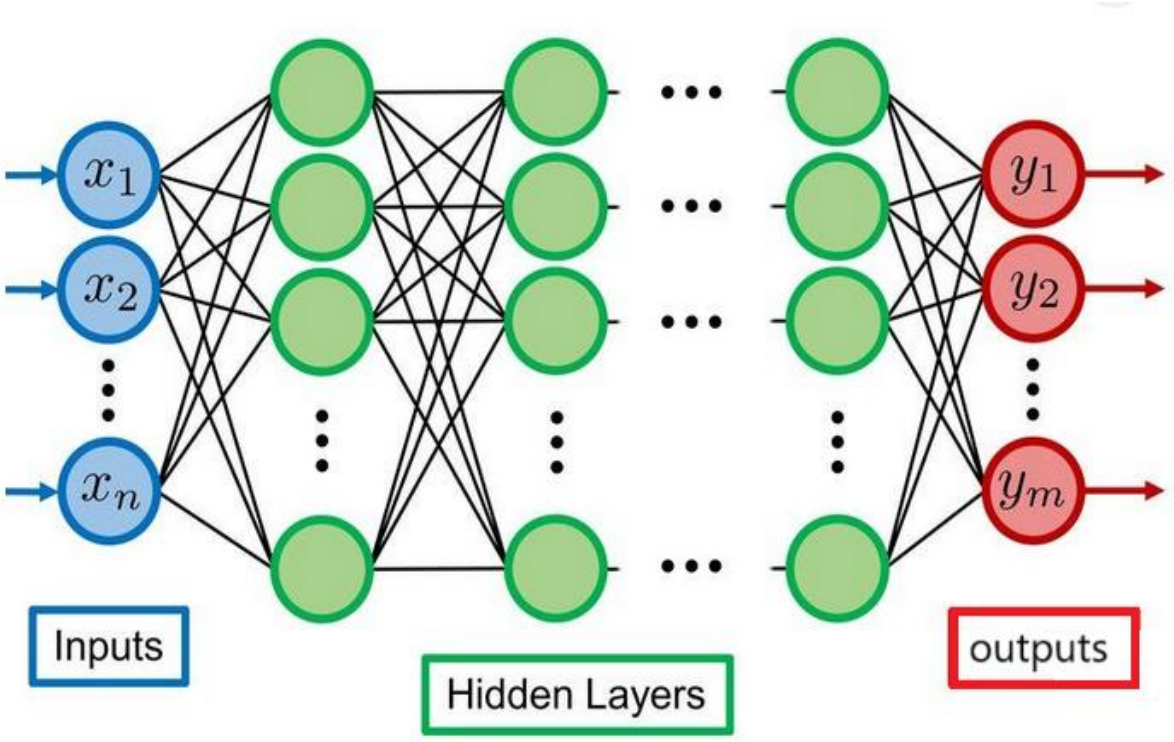

Figure 1: a model of CNN.

3) Recurrent networks (RNNs): They are networks specialized in analyzing data that follows a specific time sequence, as well as recurring textual data. Figure 2 shows a model of this network.

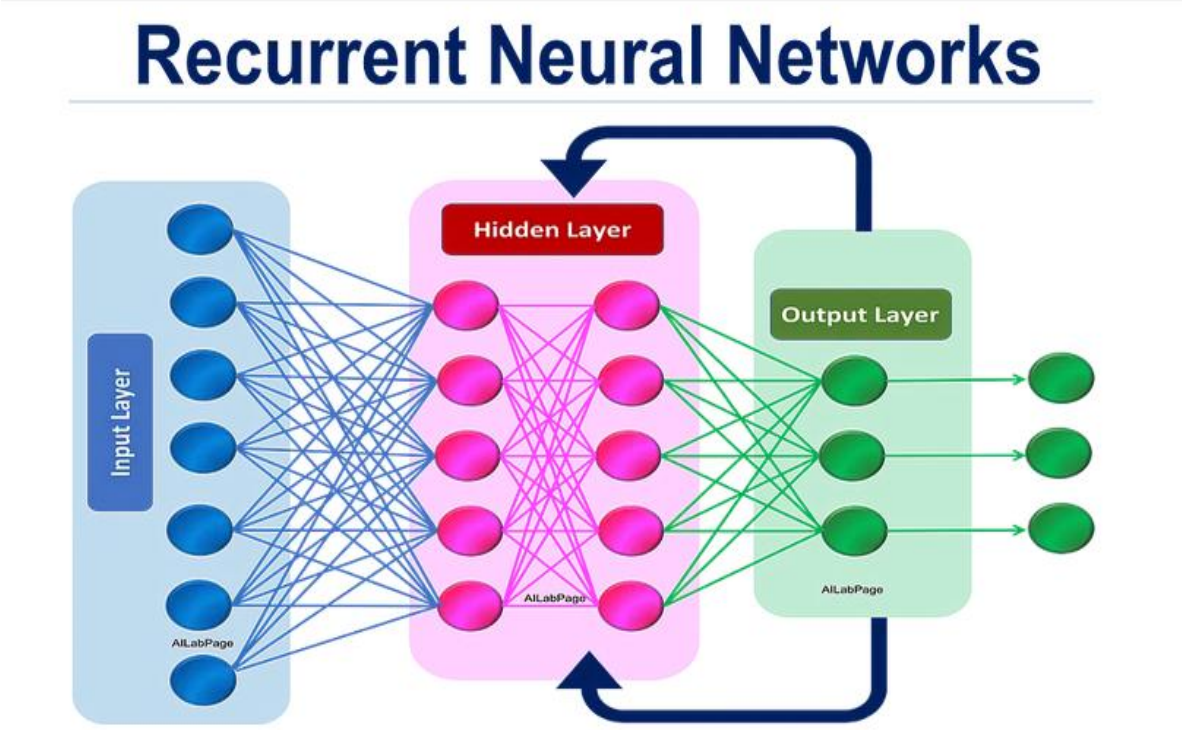

Figure 2: a model of RNN.

4) Long Short-Term Memory Networks (LSTMs): These are networks specifically designed for long sequence processing and natural language processing.[9].
5) Generative Adversarial Networks (GANs): These are networks used to generate data according to the data that was used.
6) Radial Fundamental Function Networks (RBFNs): These are networks whose purpose is to analyze regression tasks and estimate relationships and their direction.
7) Hopfield networks: Wish Networks to recover damaged data and solve data integration problems and anomalous data.

2.1.5 Factors influencing the choice of technology:

There are many factors that affect the nature of choosing the appropriate network for the appropriate application, and the most important of these factors that affect the selection of the network type are the following:

1) Nature of data: Is it text data, audio data, written data, descriptive data, or digital data?
2) Problem type: Is it required to classify, determine the cautious relationship, or generate new data[10]
3) Computational resources: It affects the size of the network and the time required for training and implementation.

2.1.6 Cloud computing.

The term "cloud computing" refers to "a new approach to computing in which dynamically scalable and often virtualized resources are provided as a service over the Internet." Cloud computing is a relatively recent development in information technology.

The cloud can be visualized as a network of large groups of computers linked together. These network computers can be personal computers or network servers located within public or private institutions. When we use a platform that provides cloud computing, we do not need to spend large amounts of money on the hardware or software needed to build or maintain an IT infrastructure for individuals. IT system resources are made available to users as online services. We are required to provide access to a third-party online facility in order to use computing resources such as application software. On the other hand, a fast and reliable Internet connection is essential for cloud-based learning systems). Support for educational systems can be found from a variety of providers, including Google, Amazon, Microsoft, and Yahoo, among others [11].

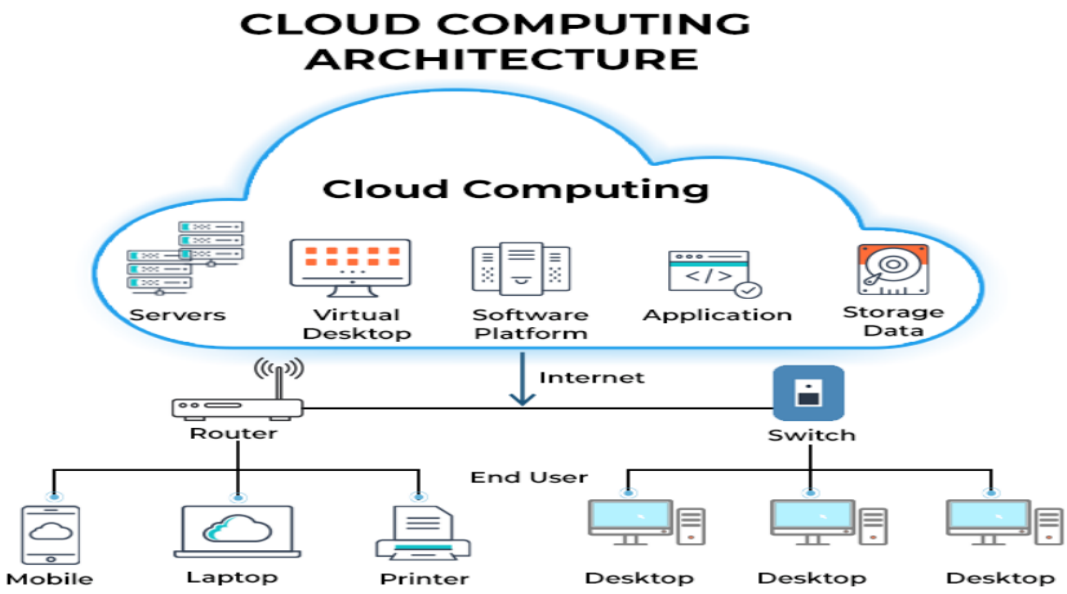

Figure 3: a model of Cloud computing.

2.1.7. Digital Educational Content (ODC)

It is any educational content that is presented in a digital form, whether this content is text data or visual data such as photos, videos, and audio data, in addition to a group of interactive, participatory activities among users of the platform [12].

2.2. Analytical theories

It is a group of theories that have been used or are being used to analyze data, study relationships, and evaluate results. Some of them were used in this study. Among these theories that were used are the following:

1) Communication theories: This is the theory that is concerned with studying the process of communication between the sender and the recipient and helps in understanding how to make this communication flexible and fast.
2) Multimedia theory: It is the theory through which we study how to use different media, whether images, videos, or audio textual data, to improve understanding and retention of information.
3) 3.Technological integration theory: These are the theories through which technology can be integrated into the educational process more effectively and flexibly, and to ensure that this technology supports the goals of the educational process on the one hand and supports the goals and requirements of the learners on the other hand [13].
4) Constructivist theory: It is a theory that focuses on building special knowledge through which one can interact with a special environment through specific experiences. This theory emphasizes the importance of providing data of a certain size and variety that facilitates data extraction processes and also facilitates the discovery and building of close relationships between this data on the one hand and Recipients, on the other hand [14], focus on the learner's role in building
5) Statistical theories and tests are used to analyze quantitative data and descriptive data such as means, standard deviations, and hypothesis testing, in addition to analyzing the extent of validity, suitability, extent of agreement, importance of the data, and extent of variation in the data, such as ANOVA tests, multiple linear regression tests, and T-TEST tests.

3. Methodology

In this part, the applied framework of the study will be presented, in addition to the tools that were used in the study, as well as the procedures for the study. It explains how to collect data related to data extraction techniques and how to use neural network techniques to formulate a model to extract data from the Internet. This section deals with the data processing processes that were applied to the collected data, such as cleaning, initial analysis, and the necessary transformations to ensure data quality. It reviews how to group data based on clustering algorithms used to understand major patterns in the data and combine data mining and data analysis techniques to better understand the data and reveal hidden trends and patterns. There are several criteria by which the quality of the model can be determined, as follows:

- Accuracy: where it is measured new percentages of correct classifications out of total Predictions Through this measure, it is done and determine how good the model is in making correct predictions across all categories [15].
- Predictions: A measure by which a model's ability to accurately predict the future can be determined.[16]
- Recall: A metric by which all relevant positive cases are measured, it calculates the proportion of positive cases that are realistically identified out of all the cases it prefers.[17]
  F1 score: It is a consensus measure between precision and recall, where it provides a balance measure that takes into account both false drivers and false negatives [18]

3.1. The applied framework of the study

The applied framework explains Study procedures and applied stages, starting with defining the goal and formulating the problem, then through collecting and filtering data, then formulating the model mathematically, and ending with recording, analyzing, evaluating and comparing the results. Then drawing conclusions and recommendations. As shown in Figure 4

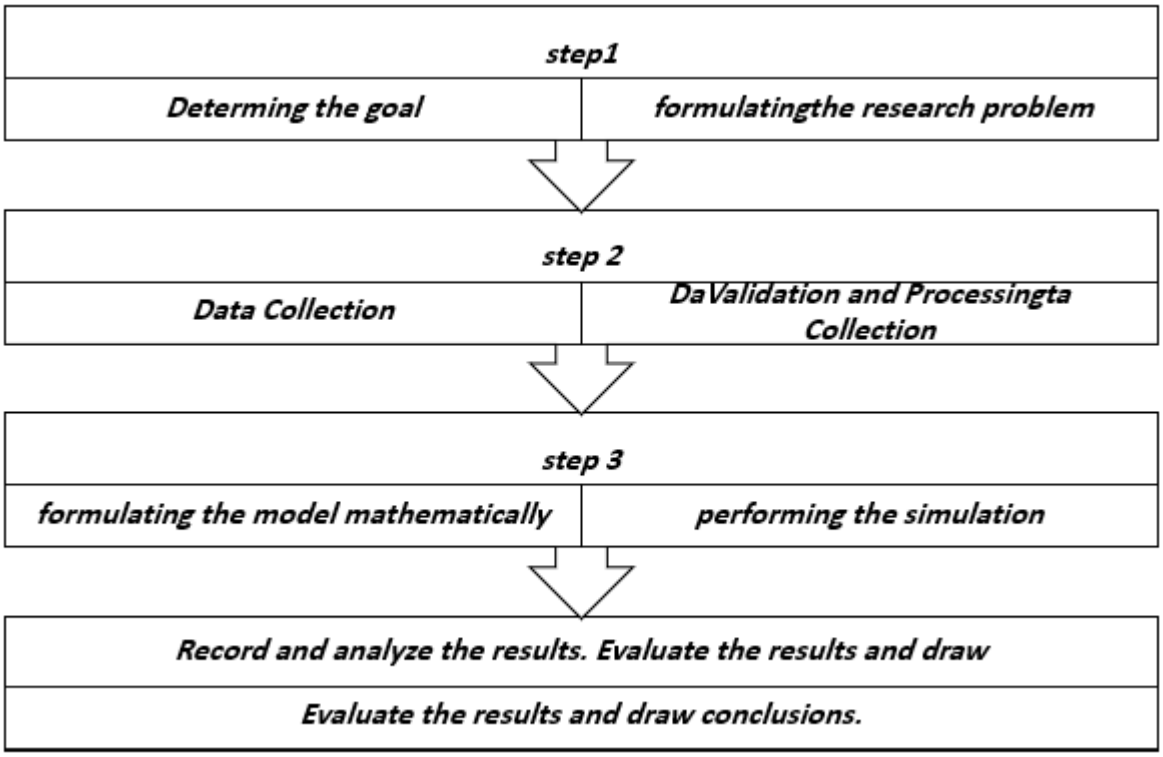

Figure 4: The applied framework of the study (by author)

It explains the applied framework The study has stages of study, starting from defining the goal and formulating the research problem, through collecting data, verifying its validity and processing, then formulating the mathematical model and running the simulation with the artificial neural network, then recording and analyzing the results, then evaluating them and drawing conclusions.

3.2. procedures

This part will explain the study procedures, which are as follows:

1. Determine the goal, which is to formulate models that can extract data from the electronic cloud. These models are formulated using a neural network and used to improve e-learning processes, identify the research problem, and attempt to solve it.

2. Collect data related to the study on the one hand and collect the data that will be entered into the form, whether it is characteristic data or visual data. The sources of data collection are the following:

1) Previous studies
2) Databases and the Internet.
3) Experts and supervisors

3. Formulate the mathematical model.

a. Design of a recurrent neural network

For the basic equation of RNN:

$$h(t) = tanh(Wx(t) + Uh(t-1) + b) Eq1$$

Where:

- h(t): the hidden state at time t
- x(t): the input at time t
- W, U: weight matrices
- b: bias.

1) Input: Vectors representing student data, content, system, and external data.
2) Function: Convert the input data into a suitable representation for the neural network.
   Equation:

$$h(t) = tanh(Wx(t) + Uh(t-1) + b) Eq2$$

   Where:

- h(t): Hidden state at time t
- x(t): Input at time t
- W, U: Weight matrices
- b: Bias
- tan h: Activation function

3) Hidden layers:
   Function: Extract complex features from data.
   Equation:

$$h(t) = f(Wx(t) + Uh(t-1) + b) Eq3$$

   Where:

- f: Activation function (e.g. ReLU, LSTM)

4) Final layer:
   Function: Generate predictions.
   Equation:

$$y(t) = softmax(Vh(t)) Eq4$$

   Where:

- y(t): Output vector (predictions)
- V: Weight matrix
- Soft max: Activation function for probability classification

5) Convolutional neural network design:
   The purpose of using a convolutional network is to deal with visual and audio data. Educational content may be visual content that contains videos or audio texts [15].
   The basic equation for convolution:

$$S(i,j) = (I * K)(i,j) + b\ Eq5$$

   Where:

- S: The resulting feature map
- I: input matrix (image)
- K: filter matrix
- b: bias

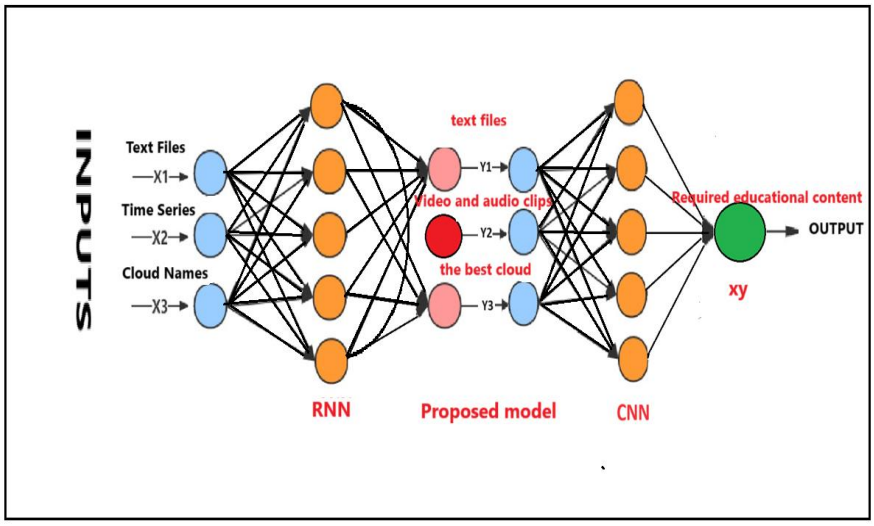

Figure 5: the proposed model, which is a hybrid model of the recursive neural network and the neural network.

The previous figure shows the proposed model, which is a hybrid model between the Recursive Neural Network (CNN) to take advantage of its important features in processing visual data and its effective ability in language processing, and the Recursive Neural Network (RNN), Which is distinguished by its ability to deal with written text data and data of a sequential nature, especially time series? As for the layers, there are five basic layers, which are as follows:

1. The first layer: the input layer of the recursive neural network (RNN). The inputs are as follows:

1) X1: Raw data, which is text, images, videos, digital data, records, questionnaires (Student data: Age, number of study hours, attendance rate).
2) X2: Temporal data Interactive activity data like (The number of posts in the forums, the total number of questions answered by the student, the scopes and types of electronic clouds.
3) X3: Features: Features extracted from data, such as keywords and behavioral patterns.

2. The second layer: It is the hidden layer in the recursive neural network, and it is the layer in which the relationships and the nature of their interconnections are determined and defined.
3. The third layer: It is an output for the recursive neural network and at the same time an input for the convolutional neural network, which is as follows:

1) Y1: It is Classification: Identify the category to which the data belongs (for example: "outstanding student" or "student who needs additional support).
2) Y2: Determine the characteristics of electronic fasteners and choose the best one according to the requirements
3) Y3: Visual data, images, videos, natural language processing, and sentiment analysis

4. The fourth layer: It is a hidden layer of the convolutional neural network in which images, language, classifications, and characteristics are processed.
5. The fifth layer: which is the outputs of the model and includes:

1) XY1: Multiple decision matrix Provides more than one outlet to choose the most appropriate one.
2) XY2: Advanced data analysis Provides smart recommendations to users.
3) XY3: Time series analysis (Predicting future performance).

4. Results and discussion

After obtaining the results of the model and testing the model in terms of accuracy, prediction, and recall, F1-score. These results are tested, their importance, and the extent to which they are revealed through the nova statistical test, determining the p-value, the value of the coefficient of variation, and the linear regression test, and the extent of the relationship between the use of deep learning techniques and improving prediction results by extracting data from the electronic cloud network using neural network techniques and returning machine learning techniques. We will... The following lines will present, analyze and discuss these results.

Table 1: Shows the recall, precision, prediction and f1-score metrics.

p-value	*f*	*Value %*	*Index*
		95	***Accuracy***
		94	***Prediction***
		90	***Recall***
<0.001	***24.3***	***92***	***F1-Score***

The table shows the values of accuracy, prediction, and recall indicatorsf1-score All of them are good results that indicate the success of the model in terms of accuracy, prediction, and recallf1-score. It is clear from the table that the accuracy reached 95%, while recall reached 90%, the prediction rate reached 94%, while the F1-SCORE index reached 92%. Whereas Indicators for evaluating the performance of neural networks [19].

When training and evaluating neural networks, we need a set of indicators that help us measure how well the model is performing. The most important of these indicators is the accuracy index, which is the percentage of correct answers provided by the model compared to the actual correct answers, as well as the recall index, which is the percentage of true positive examples that were correctly classified as positive. As for the prediction index, it will express the training model's expectation of a new value or a new classification. The table also shows the P-ALUE value, which is <0.001. This means that the data is of great importance, as the marginal p-value is 5%, and the variance f has reached 12.3, which is a value. Significant means that the data is statistically significant and fits the model perfectly.

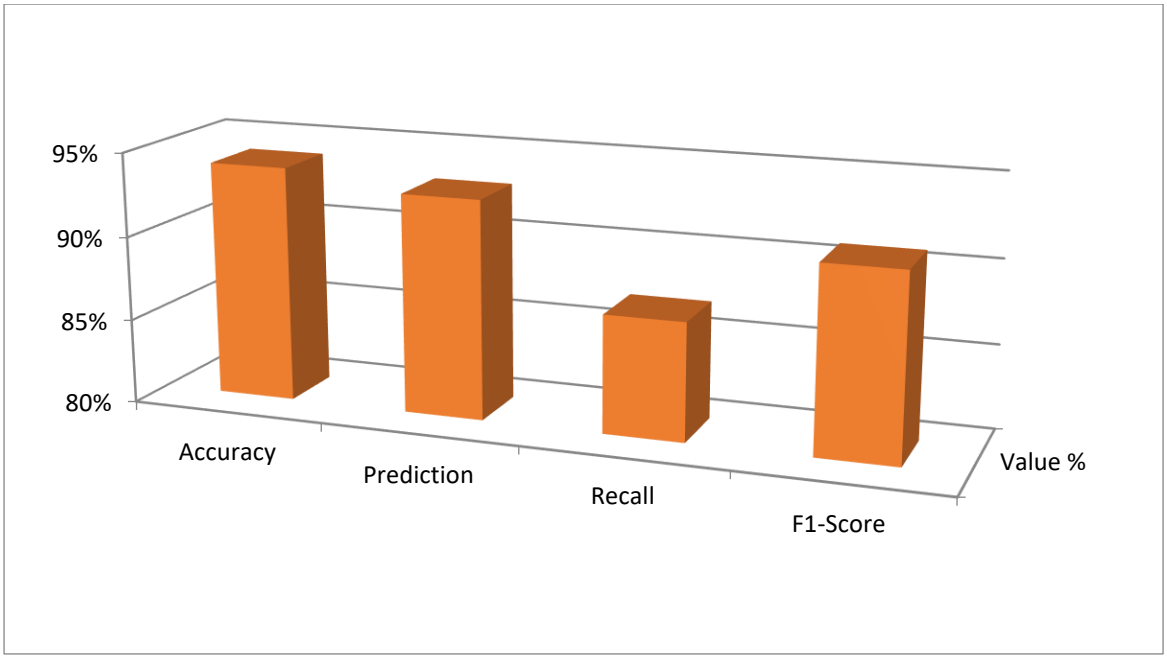

Figure 6: the recall, precision, prediction and f1-score metrics.

The previous figure shows the values of the accuracy, recall, and prediction indicators, 1-F, through the values of the quality of the model used to extract data from the electronic cloud.

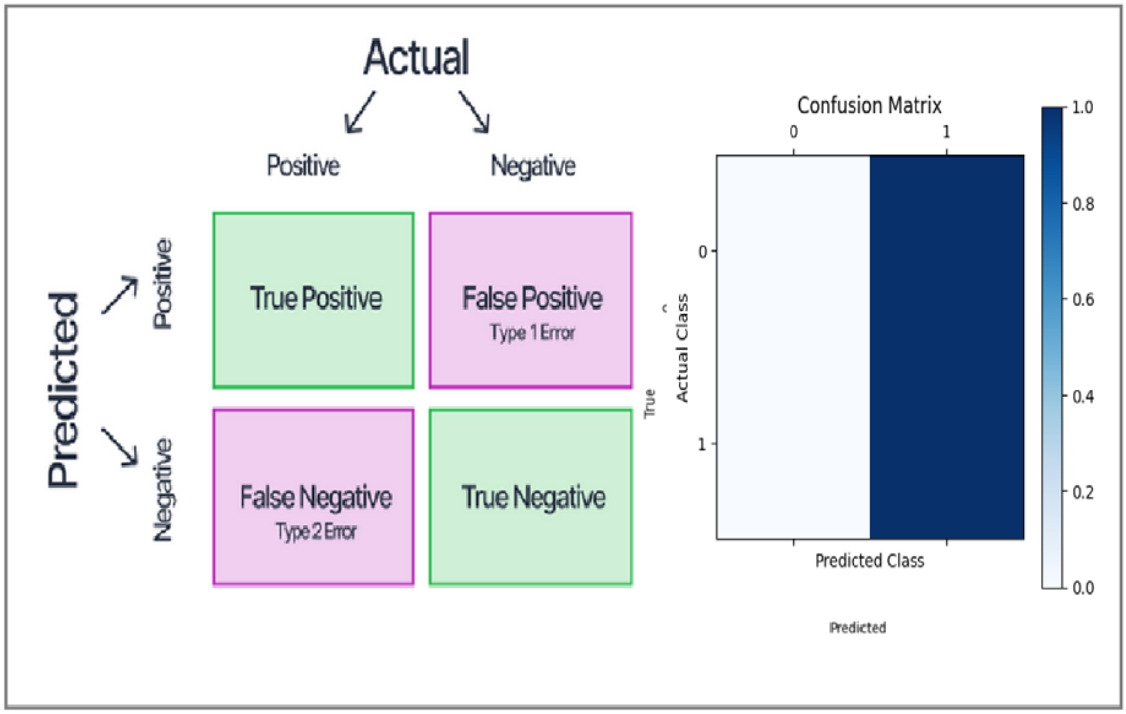

Figure 7: Confusion Matrix analysis is used to determine the accuracy of classifications and predictions.

According to the previous figure, which shows the confusion matrix for the hybrid model of recurrent and neural networks, it is clear from the model that the model was classified according to specific tasks, and that according to these tasks, true positive cases and false positive cases were identified. The true positive cases were more, which means the accuracy of the model, as the positive cases reached Actual and honest case out of the total 80 cases were repeated[20]

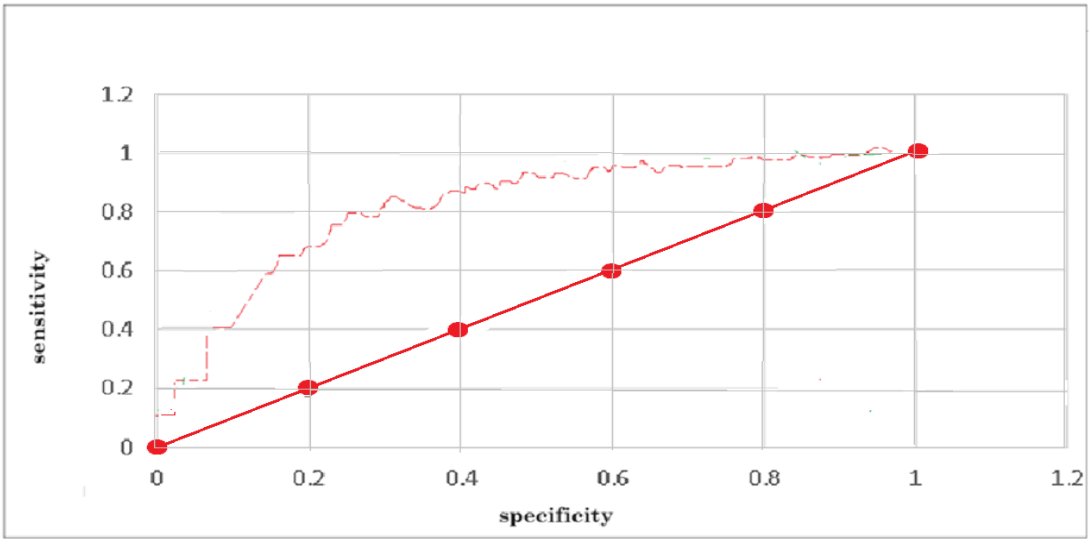

Figure 8: Shows the sensitivity and specificity of the model used.

Sensitivity and specificity analysis is the process of evaluating the performance of a machine-learning model in classifying data. Sensitivity expresses the model's ability to accurately identify positive examples, while Specificity reflects its ability to identify negative examples. The importance of this analysis lies in:

- Performance evaluation: To understand the efficiency of the model in classifying cases.
- Compare models: To choose the best based on the balance between sensitivity and specificity.
- Adjust parameters: To improve performance [21].
- Choose the most appropriate model: Based on case requirements.

The relationship between sensitivity and specificity is competitive, with increasing one decreasing the other, making it difficult to achieve an ideal balance between them.

The previous figure shows the extent to which the model's ability to correctly identify positive cases for prediction and forecasting is already high, reaching a sensitivity of 90% even before the improvements. On the other hand, specificity refers to the model's ability to accurately detect, isolate, and classify negative cases.

where:

- Allergy =TN/(FP+TN)*100
- Privacy= TP/(TP+FN)*100
- accuracy = (TP+TN)/(TP+TN+FP+FN) ∗ 100

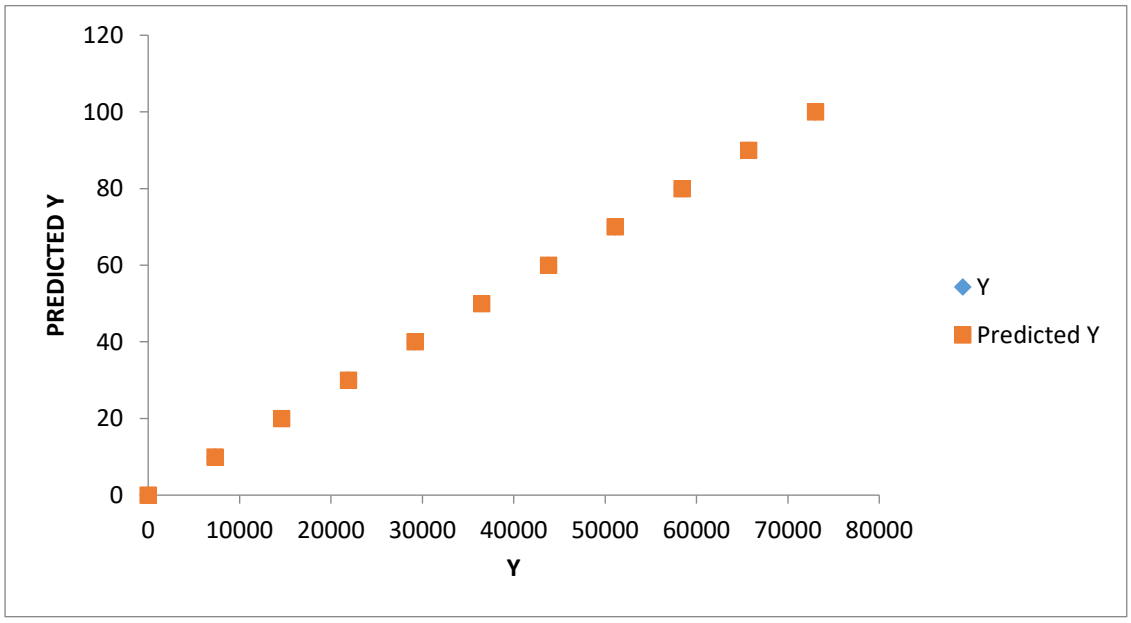

Figure 9: Expected and actual values.

The previous figure is the relationship between the actual values obtained from the model and the expected values, or from the figure it is clear that the relationship is linear and has a strong correlation coefficient, as almost the entire expected y valueslie above the actual y values [22].

5. Conclusions and recommendations

5.1. Conclusions

Among the most important conclusions that were drawn from this study are the following
The most important conclusions reached from this study are the following:
1. Artificial neural network techniques for mining and extracting data through the electronic cloud are considered very important techniques in all applications, including e-learning applications, as by extracting this data it is possible to analyze it and form effective strategic insights in various applications [23].
2. Neural network and machine learning techniques are considered among the most important techniques that can be used to formulate models to extract data from the electronic cloud.
3. By conducting statistical tests and testing accuracy, prediction accuracy, recall, and sensitivity, where the accuracy value reached 95%, the recall value 90%, the prediction value 94%, and the f1-scor value 92%.The sensitivity of the model reached 90%, which means that specificity indicates the strength of the model and its ability to detect negative cases, isolate them, and classify them accurately and analyze the data effectively and flexibly [24].
4. Through statistical tests, it became clear how significant the data was and how much it varied. The P-ALUE value, which is <0.001. This means that the data is highly significant, as the threshold p value is 5%, and the f variance is 12.3 which is a statistically significant value meaning that the data is statistically significant and fits the model perfectly.
5. There were no clear differences between the expected results and the results extracted from the model, which indicates the accuracy and quality of the model.
6.an improvement in the learning experience by 86% and an improvement in the performance of the platform by 85%. Machine learning indicators, such as accuracy (94%), recall (93%), and f1 score (91%), indicated the success of the model used in the improvement.
7. The more massive and diverse the data is, the more effective the proposed model will be. The necessity of processing the data must be taken into account, where anomalous data is eliminated, and the training data must be actual data.

5.2. Recommendations

The most important recommendations that can be made are:
1. It is necessary to make more efforts and research to explore new technologies that will enhance data extraction from the electronic cloud. In order to enhance the performance of the model, it must be constantly monitored and the required improvements and developments made.
2. The necessity of relying on hybrid technologies, where the advantages of each technology are obtained, and thus the results obtained are more accurate. Especially with regard to artificial intelligence (AI) and artificial neural network (ANN) technologies.
3. It is necessary to choose the appropriate neural network techniques for the appropriate applications, as each type of neural network is suitable for the nature of the input data, whether it is written textual data, visual data, or audio data. For example, recursive neural networks are suitable for data with recurring sequences and time series, and neural networks are suitable for visual and audio data.
4. To ensure more accurate results in models, especially hybrid models using neural network techniques, the following must be done:
Conduct accuracy, prediction, F-1SCORE, and recall tests
Use optimization algorithms Strong: like Adam, RMSprop, or LAMB To quickly adjust weights and reduce errors.
To improve results and provide the largest possible amount of actual data to train models.
Take advantage of cloud and distributed computing by distributing the training load across multiple processing units (GPUs/TPUs).

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