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PREDICTING LEARNERS' ATTITUDE AND PREFERNCE IN E-LEARNING USING ARTIFICIAL NEURAL NETWORKS

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Abstract
E-Learning is a web based learning that uses information and communication technology as a platform to facilitate teaching and learning process for e-learners'. The present study felt the need to predict learners' attitude and preference in E-Learning using artificial neural network (ANN) which was specifically designed to analyze non-linear temporal series through multilayer perceptron (MLP). The research was conducted among 125 respondents of Vellalar College for Women (Autonomous), Erode, of self financing wing with the students who have completed minimum of two E-Learning modules and underwent assessment. The study is descriptive in nature and ensures random sampling method for data collection. A well designed questionnaire was prepared and data was collected through Google forms. The tools used for the analysis include descriptive statistics and artificial neural network (ANN) with the statistical package SPSS 16.0. It was found from the classification table that accuracy rate was high, with 82.8% in classifying the e-learners' attitude in recommending E-Learning to others in "yes" and "no" category. The study also recommends future researchers to concentrate on diverse academic perspectives and with more samples.

Key Words: E-Learning, E-learners, Attitude and Preference, Multilayer Perceptron (MLP) and Artificial Neural Networks (ANN)

1. Introduction

In the tech savvy era, E-Learning is gaining popularity due to its network enabled transfer of skills and knowledge. It utilizes the technologies to access educational curriculum outside the traditional classroom. It delivers learning resources to the learners scattered in different geographical region in a short span of time. The courses are delivered online via the internet. It is an interactive mean to communicate with teachers, professors, or other students in class. Broadband and unlimited internet connectivity paves a road to incorporate Learning Management System (LMS) in the educational institutions. Learning enhancement permits greater learner interactivity and promotes learners' efficiency, motivation, cognitive effectiveness, and flexibility in learning style. Interactive learning shifts the focus from a passive, teacher-centered model to active learner-centered model.

2. Artificial Neural Networks (ANN)

An artificial neural network is a computational model based on the structure and functions of biological neural networks. A neural network consists of a set of connected cells called the neurons. The neurons receive impulses from either input cells or other neurons and perform some kind of transformation of the input and transmit the outcome to other neurons or to other cells. The neural networks are built from layers of neurons connected so that one layer receives input from the preceding layer of neurons and

passes the output on to the subsequent layer. The two most widely used NN's are feed forward networks and recurrent networks. In feed forward networks, information flows in one direction along connecting pathways, from the input layer via the hidden layer to the final output layer. There is no feedback loop i.e. the output of any layer does not affect the same or preceding layer. Whereas recurrent networks differ in the sense that there is at least one feedback loop i.e. the output of a neuron is fed back into itself as input. There are two learning methods in neural network which include supervised and unsupervised learning. In supervised learning, every input pattern that is used to train the network is associated with an output pattern, which is the target or the desired pattern. Whereas, unsupervised learning, the target output is not presented to the network. The most popular form of neural network architecture is the multilayer perceptron (MLP) also known as universal approximators and can be used with little prior knowledge of the relationship between inputs and targets.

3. Related Studies

Jan Janusz and Robert Lucka[1] noted that modal analysis indicated that artificial neural network allow for more accurate mapping of the process than multiple regression. Samir Thakkar and Hiren Joshi[2] found that students attitude towards E-Learning is not affected by difference in gender, locality or social category of the student. Nick Z. Zacharis[3] predicted students' academic performance in blended learning using ANN and found that model predicted the performance of students with correct classification rate, CCR, of 98.3%. The result also showed that the most powerful predictors of course outcome were the numbers of messages posted by the students and the contributions they made in team content creation project. Mirza Naveed Shahzad et.al[4]. assessed the determinants and influences on students' career choice through ANN. It was found that educational background playing the most important role in determination of career selection among other variables. . Samir Abou El-Seoud et al.[5] assessed the effect of E-Learning on higher education in Egyptian University. It was revealed that E-Learning module such as Moodle increases the motivation of the under graduate students for the learning process. Meaghan Lister[6] found that there are four main factors while designing E-Learning and on-line courses which include course structure, content presentation, collaboration and interaction and timely feedback.

4. Objective of the Study

1. To predict learners' attitude and preference in E-Learning using Artificial Neural Network (ANN).

5. Research Methodology

This study is systematically and scientifically organized. It describes learners' attitude and preference in E-Learning and hence the study is descriptive in nature. The data required for this study was collected during the academic year 2019-2020. For the present research population comprised of students of Vellalar College for Women (Autonomous), Erode, Tamilnadu of self financing wing, who have completed minimum of two E-Learning modules and underwent assessment. To ensure reliability nearly seventy percentage of the population were considered and the sample size being 125 respondents. In order to obtain primary data from the respondents structured questionnaire were prepared and data was collected through Google forms. The secondary data was collected from all associated sources such as

books, journals and internet web sources. The statistical package used for analysis is IBM Statistics SPSS 16.0 and the tools used include descriptive statistics and artificial neural network (ANN). The table no.1 gives the descriptive statistics of the used data.

Table No. 1Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
Prefer E-Learning system	125	1.00	1.00	2.00	1.1280	.33543	.113	2.254	.217
Future ambition	125	2.00	1.00	3.00	1.5280	.67890	.461	.919	.217
Interest in E-Learning	125	1.00	1.00	2.00	1.2080	.40751	.166	1.456	.217
Courses learnt	125	2.00	1.00	3.00	1.3520	.57159	.327	1.394	.217
Time spend per day	125	2.00	1.00	3.00	1.5120	.61717	.381	.790	.217
Valid N (list wise)	125								

Source: computed

6. Artificial Neural Network

6.1 Variables used to construct ANN

Independent Variables

1. Prefer E-Learning system
2. Future ambition
3. Interest in E-Learning
4. Courses learnt
5. Time spend per day

Independent Variable

1. Recommendation of E-Learning to others

6.2 Stopping Rules used

Maximum steps without a decrease in error : 1

1. Data to use for computing prediction error : Auto
2. Maximum training time : 15 minutes
3. Maximum training epochs : Auto
4. Minimum relative change in training error : 0.0001
5. Minimum relative change in training error ratio : 0.001

6.3 Results of Artificial Neural Network

The data is analyzed to predict learners' attitude and preference in E-Learning using Artificial Neural Network (ANN) which otherwise receive inputs and deliver outputs based on their predefined activation functions. Table no.2 gives information about the datasets used to build the ANN model.

Table No. 2,Case Processing Summary

		N	Percent
Sample	Training	61	48.8%
	Testing	35	28.0%
	Holdout	29	23.2%
Valid		125	100.0%
Excluded		0	
Total		125	

Source: computed

The table no. 3, shows the network information in which number of neurons of every layer and the five independent variables (prefer E-Learning system, future ambition, interest in E-Learning, courses learnt, time spend per day). Automatic architecture selection chose 2 nodes for the hidden layer, while the output layer had 2 nodes to code the dependent variable (recommend E-Learning to others). For the hidden layer the activation function was the hyperbolic tangent and for the output layer it was Softmax function. Cross-entropy was used as error function because of the use of Softmax function.

Table No. 3,Network Information

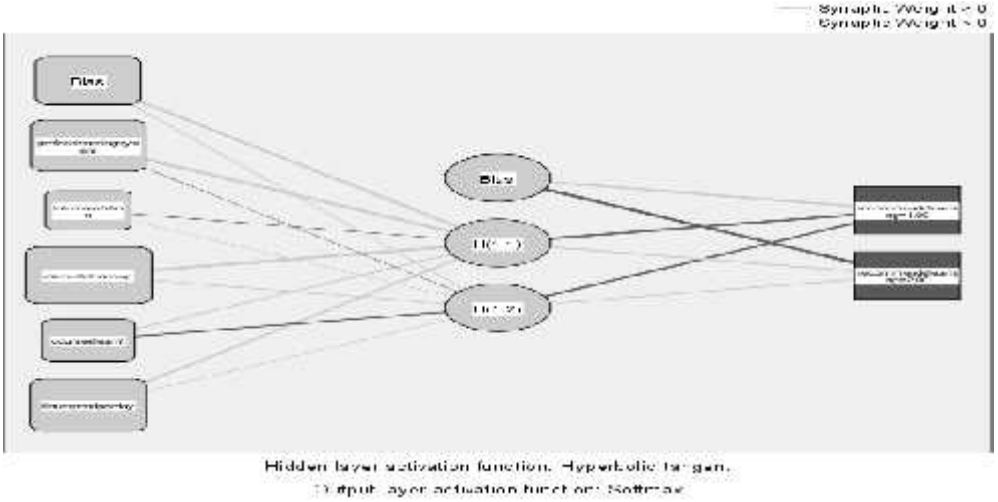
Input Layer	Covariates	1	Prefer E-Learning system
		2	Future ambition
		3	Interest in E-Learning
		4	Courses learnt
		5	Time spend per day
	Number of Units[a]		5
	Rescaling Method for Covariates		Standardized
Hidden Layer(s)	Number of Hidden Layers		1
	Number of Units in Hidden Layer 1[a]		2
	Activation Function		Hyperbolic tangent
Output Layer	Dependent Variables	1	Recommend E-Learning to others
	Number of Units		2
	Activation Function		Softmax
	Error Function		Cross-entropy

Source: computed

a. Excluding the bias unit

The figure 1, shows the network diagram that SPSS used to predict e-learners' attitude, in recommending E-Learning to others (Yes=1, No=2) from 5 independent variables. The diagram shows the 5 input nodes, 2 hidden nodes and 2 output nodes representing recommending E-Learning to others = 1 and recommending E-Learning to others = 2.

Figure – 1,Network Diagram



The table no.4 shows, the model summary in which it provides information related to the results of training, testing and holdout. Cross entropy error is given for both training and testing sample to accelerate the back propagation algorithm and to provide good overall network performance with relatively short stagnation period. The cross entropy error value is relatively small (27.242) in testing which indicates the power of the model to predict the attitude and preference of e-learners'. The cross entropy error is less for the testing sample compared with training data set, meaning that the network model has not overfitted to the training data and has learned to generalize from trend. The percent of incorrect predictions dropped in holdout (17.2%) compared to training (21.3%) and testing (20.0%) based on weights and biases at each stage to ensure accuracy in actual output at every time. Stopping rules used is 1 consecutive step, meaning training epochs will be stopped once the model performance stops improving in holdout validation dataset.

Table No. 4,Model Summary

Training	Cross Entropy Error	27.242
	Percent Incorrect Predictions	21.3%
	Stopping Rule Used	1 consecutive step(s) with no decrease in error[a]
	Training Time	00:00:00.078
Testing	Cross Entropy Error	16.395
	Percent Incorrect Predictions	20.0%
Holdout	Percent Incorrect Predictions	17.2%

Source: computed

Dependent Variable: Recommend e- learning to other

a. Error computations are based on the testing sample.

The table no. 5 displays the synaptic weights between the data of the training dataset (12).

Table No. 5,Parameter Estimates

Predictor		Predicted			
		Hidden Layer 1		Output Layer	
		H(1:1)	H(1:2)	[recommend E-Learning to others Yes =1.00]	[recommend E-Learning to others No = 2.00]
Input Layer	(Bias)	.681	.143		
	Prefer E-Learning system	.935	-.023		
	Future ambition	-.052	.062		
	Interest E-Learning	1.002	.194		
	Courses learnt	.243	-.255		
	Time spend per day	.394	.120		
Hidden Layer 1	(Bias)			.657	-.867
	H(1:1)			-.609	.266
	H(1:2)			-.464	.220

Source: computed

The table no.6 displays a classification table to separate samples into different classes by finding common features between samples of known classes.

Table No. 6Classification Table

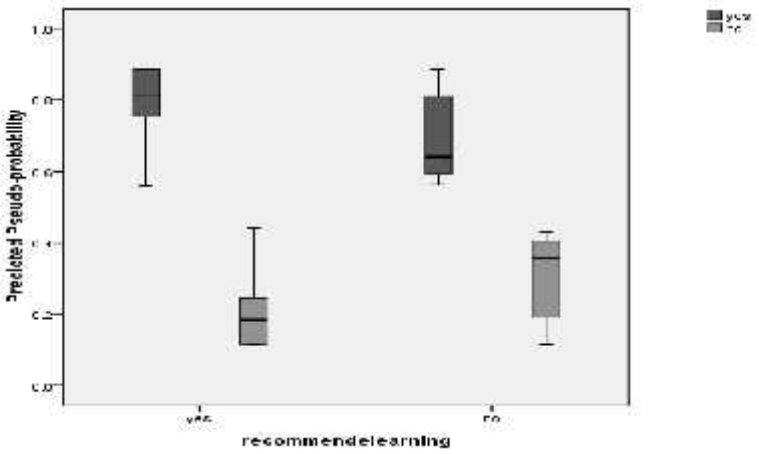
Sample	Observed	Predicted		
		Yes	No	Percent Correct
Training	Yes	48	0	100.0%
	No	13	0	.0%
	Overall Percent	100.0%	.0%	78.7%
Testing	Yes	28	0	100.0%
	No	7	0	.0%
	Overall Percent	100.0%	.0%	80.0%
Holdout	Yes	24	0	100.0%
	No	5	0	.0%
	Overall Percent	100.0%	.0%	82.8%

Source: computed

Dependent Variable: Recommendation of E-Learning to others

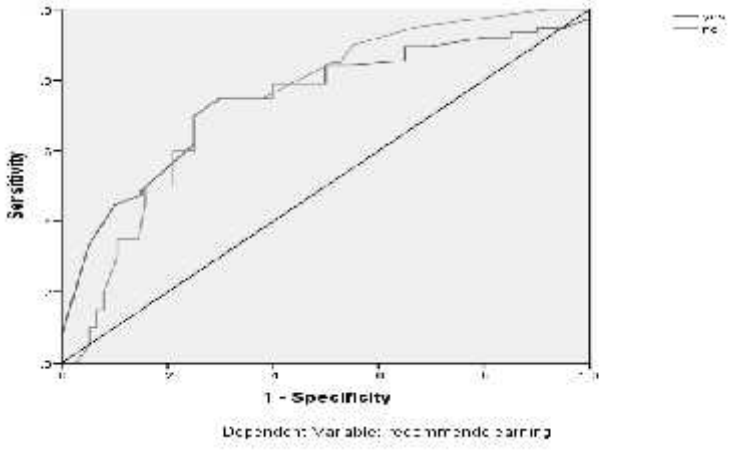
In figure 2, the graphical look of the classification box indicated the predicted pseudo probability of the correctly classified cases of categories “yes” and “no”. The box of the blue colour showed “yes” category and green box showed “no” category. Most of the portion of the left blue box plot was above cut point 0.5 on the Y-axis; it meant that most of the caese was correctly classified and the right green box plot indicated the pseudo-probability of correctly classified cases of the category “no” of the dependent variable. Incorrect classified cases of both categories were shown below the cut point 0.5.

Figure – 2,Predicted –by-observed chart



In figure 3, Receiver Operating Characteristic (ROC) curve shows the relationship between false negative rate (FNR) and false positive rate (FPR) errors. It gives us clear and powerful result as compared to other analysis. ROC curve is a diagram of sensitivity versus specificity that shows the classification performance for all possible cutoffs, in one plot. Sensitivity was the number of positive cases correctly classified and specificity was the number of negative cases incorrectly classified as positive. The two lines in the graph one in blue shows the category “yes” and in green shows the category “no” in the dependant variable. Both lines were on the top left corner near to 1 which was the indication of the best fit of the model.

Figure – 3,ROC Curve



The table no.7 shows area under the ROC curve. Here, the area value shows that, if a student from "yes" category and the students from "no" category are randomly selected, there is 0.749 probability that the model-predicted pseudo-probability for the first student of being in the "yes" category, is higher than the model predicted pseudo- probability for the second student of being in the "yes" category.

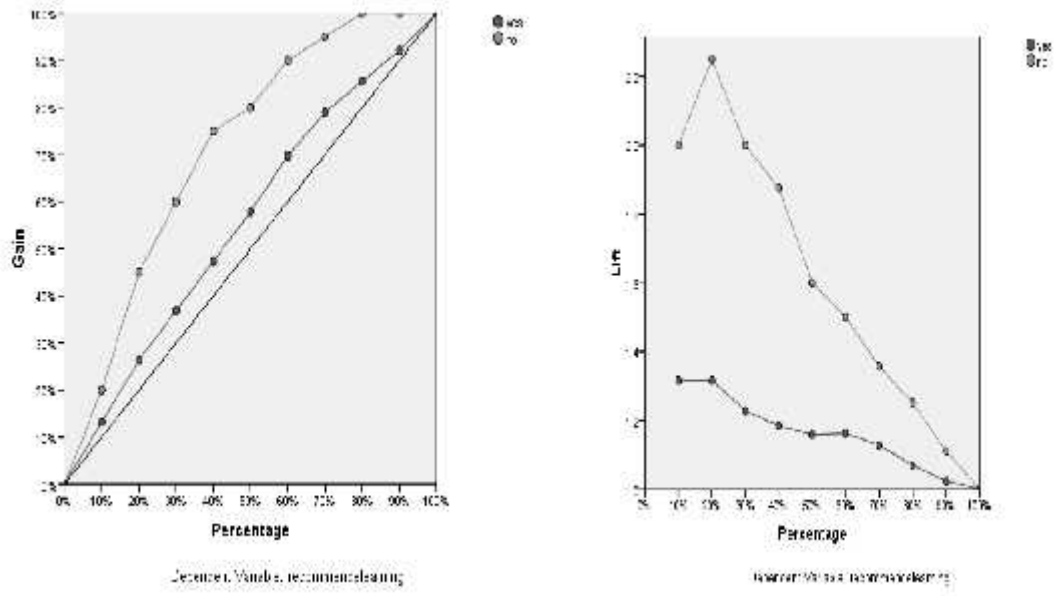
Table No. 7Area under the ROC Curve

		Area
Recommend E-Learning to others	Yes	.749
	No	.749

Source: computed

The figure 4, shows the cumulative gain and lift chart. Lift is a measure of the effectiveness of a predictive model calculated as the ratio between the results obtained with and without the predictive model. Cumulative gains and lift charts are visual aids for measuring model performance. Both charts consist of a lift curve and a baseline. The greater the area between the lift curve and the baseline, the better the model they are.

Figure – 4,Cumulative Gains and Lift Charts



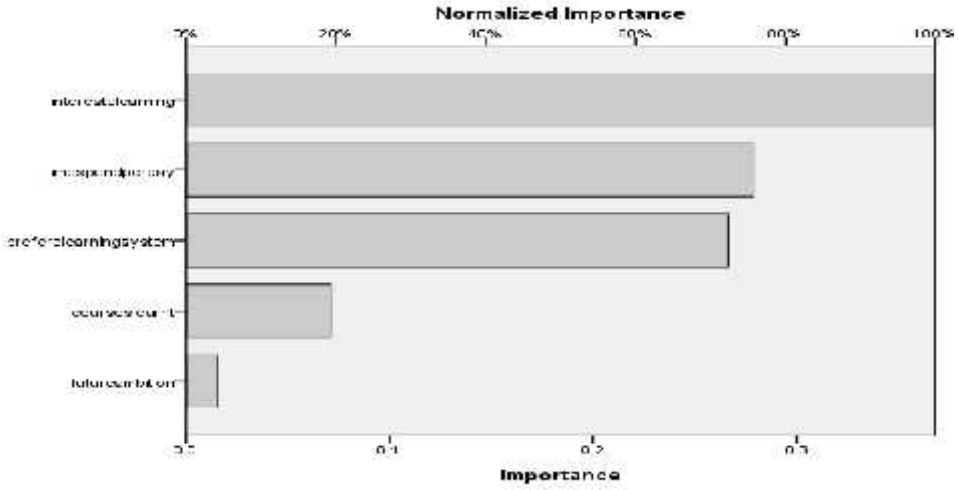
The table no.8 gives the impact of each independent variable in the ANN model in terms of relative and normalized importance. In figure-5, it depicts the importance of the variables, i.e. how sensitive is the model to the change of each input variable.

Table No. 8, Independent Variable Importance

	Importance	Normalized Importance
Prefer E-Learning system	.266	72.4%
Future ambition	.015	4.2%
Interest in E-Learning	.368	100.0%
Courses learnt	.071	19.3%
Time spend per day	.279	75.7%

Source: computed

Figure – 5, Independent Variable Importance Chart



From the figure 5, it is apparent that among the variables related to learners' attitude and preference in E-Learning, interest in E-Learning (100%) is the most important predictor among independent variables followed by time spend per day (75.7%), preference in E-Learning system (72.4%), courses learnt (19.3%) and future ambition (4.2%).

7. Conclusion

The main aim of the study was to measure learners' attitude and preference in E-Learning through Artificial Neural Network (ANN). The result shows that classification accuracy rate was high, with 82.8% in classifying the e-learners' attitude in recommending E-Learning to others in "yes" and "no" category. The result also showed that the most powerful predictor among the independent variables to reveal learners' preference in E-Learning is "interest in E-Learning" and "time spend per day". The study also recommends future researchers to concentrate on diverse academic perspectives and with more samples. This present research can be used as a base to predict students' psychology and

expectations to help the institutions or the board to design the timely academic intervention to bring massive change in academic pursuits.

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