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Effective Way to Improve Flipped Classroom Learning

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Abstract: **Now- a- days E-Learning is the popular learning source for the learners. The personalization in E-learning systems has been the subject of many recent research efforts. In E-learning, learner needs to create his/her own interest. Once the learners/students were classified based on their interest and learning style, it is very easy to create interest in the students by supplying personalized material for individual student. The students can utilize their time effectively once if they watch short videos regarding the topic to be discussed by the tutor in the next session in which we call this process as flipped class room. In flipped classroom learning, the type of material that is made available to the students is similar to all types of learners. In this paper we are introducing 'Blended Flipped classroom learning', which includes the classification of learners/students by using MultiLayer Perception (MLP), which depending on performed activity of the learners with three parameters such as learning rate, environmental affectability of learners and rote learning.. Based on these classified learners, tutors will prepare the videos and made available to the students. Personalization of short videos and flipping the classroom will definitely improve the learning.**

Key Words: **E-learning, Learning rate, Environmental affectability, rote learning, flipped class room teaching, Blended flipped classroom teaching.**

I. INTRODUCTION

Traditional teaching utilize the long established technique of on-campus class room meetings for delivering course information and facilitating student conversation and debate. Traditional learning environments are more structured than distance learning programs and provide face-to-face contact with students and professors. Traditional lecture method encourages one-way communication; therefore, the lecturer must make a conscious effort to become aware of student problems and student understanding of content without verbal feedback.

Much focus on Presentation, less time left for practice: Since a teacher has to deliver a fixed number of concepts within a limited time [1]. Practice is left for the student to do as homework.

A. E-Learning

Distance learning, sometimes called e-learning, is a formalized teaching and learning system specifically designed to be carried out remotely by using electronic communication. Distance learning is less expensive to support, it offers opportunities in situations where traditional education has difficulty operating. Students with scheduling or distance problems can benefit, because distance education can be more flexible in terms of time and can be delivered virtually anywhere.

1. Advantages of E-learning:

a. Convenience: One of the key advantages of choosing e-learning over classroom learning is convenience [2]. Students can learn at home, in the library or on vacation. This prevents students from having to stick to a schedule and allows them to carefully manage the pace of their own learning experience.

b. Time comfort: Students can attend for the classes in free time, comfort for their works. This E-learning is mostly useful for students who want to do distance education. In E-learning, learner needs to create own interest, no control on learner and there is no open discussion among the tutor and learners/students. So, Flipped classroom learning came to existence.

B. Flipped classroom learning

Provide an opportunity for students to gain first exposure to class. The mechanism used for first exposure can vary from simple textbook reading to lecture videos to distribute [3]. These short videos can be created by tutors and shared through you tube or their own institutional websites. Students can analyze these videos, acquire knowledge, some unfathomable topics can be clear in-class session by the tutor.

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1. Advantages of flipped classroom teaching:

a. Opens own pace: Flipped classroom learning opens own pace for the students' means students can think them and applies acquired knowledge in their own pace with the help of a tutor.

b. Engaging way to share content: Teachers can share so many different kinds of content. Learning is not restricted to a white board or textbook. Instead, students can be directed to any website, mobile application or other kind of content. And students can share the knowledge with their class members when the open discussion starts.

- A flipped classroom allows students to have more time for collaborating with other students.
- Sick days will no longer interrupt a student ability to learn.
- Students can view videos at their convenient time. They can pause, replay the videos.

The structure of this paper is as follows: after introduction in the second section classification of learners/students into low, medium and high are described. Preparing videos based on the classification in section three. Finally, in the section four evaluation results of our proposed method are represented.

II. LEARNERS CLASSIFICATION ACCORDING TO THREE PARAMETERS

A. Classification of Learner using learning rate

In this method learners are given some online exercises. Based on the results from the questionnaire style given to them and the time taken for each learner to complete exercise we can calculate the learning rate with the help of learning rate formula. From the errors of learners in the given exercise and the time taken by the learners to complete the exercise, we can calculate the overall probability of learners committing mistakes in that exercise. We will obtain the recommended probability of mistakes and time of completion from the expert of the course. Using the Learners Rate formula (1), and the observed recordings, we can calculate the "Learning Rate" of each learner.

$$\Delta LR = LR_A - LR_P = \frac{N - M_A}{T} - \frac{1 - \bar{M}_P}{\bar{T}_P} \quad (1)$$

That ΔLR is difference between learner's rate and predicted rate. $LR_p$is the predicted rate and LR_A is learner's rate. N is the number of exercises in this session, M_A is the number of mistakes in this session, T is time of this session, $\bar{M}_P$is average of predicted mistake probability for exercises of this session, and $\bar{T}_P$ is mean of predicted time taken to complete the exercises in this session

If $\Delta V > \alpha$, $\alpha > 0$, learners rate is high. If $\alpha \leq \Delta V \leq \beta$ learners rate is normal and if V>β, he/she belongs to low rate learners class. The values of α *and* β are determined by teacher of course regarding to educational content. This result is perfectly valid when we encounter with a session in which$\sum CE_s \geq \tau$. The value of τ is determined by psychology and agronomy experts. Increasing the no. of sessions will need to more precise result.

B. Learners Class Computation According to Environmental Affectability

Environmental Affectability is the factors which exercise impact on learners from outside environment like location, ambience and convenience. Generally, learning environment has some impact on learners. The degree of effect of the environment varies from learner to learner. For detecting various causes of 'effects on learning' on a learner in contrast to environmental changes, the system is designed to ask some questions to learners about their environment. Some of the sample environmental effect related questions are:

- Is temperature appropriate?
- Is your chair comfortable?
- Is your desk comfortable?
- Is the lightness of room enough for study?

For each question, the learner needs to select a value between 1 and 3 indicating his/her affectedness to the environment. The response 1 implies that they are not comfortable, the response 2 implies that they are comfortable but not satisfied completely, and the response 3 implies that they are wholly satisfied. We compute learner's environmental affectability by means of (3).

$$\text{ENF} = \frac{\sum_{i=1}^{4} ES_{1i}}{\sum_{i=1}^{4} ES_{2i}} X \frac{\bar{T}_1 - \bar{T}_{PS1}}{\bar{T}_2 - \bar{T}_{PS2}} X \frac{\bar{F}_1 - \bar{F}_{PS1}}{\bar{F}_2 - \bar{F}_{PS2}} \quad (3)$$

That ENF is the Environmental Factor. $\sum_{i=1}^{4} ES_{1i}$ is the satisfaction degree for session by most satisfaction degree. $\sum_{i=1}^{4} ES_{2i}$is the satisfaction degree for session by least satisfaction degree. $\bar{T}_1$and $\bar{T}_2$ are average times of doing exercises by learner, $\bar{T}_{PS1}$and $\bar{T}_{PS2}$ are average of predicted time, $\bar{F}_1$ and $\bar{F}_2$ are average of mistakes for learner, $\bar{F}_{PS1}$ and $\bar{F}_{PS2}$ are average of predicted mistake probability related to sessions 1 and 2.and $\bar{T}_2$are average times of doing exercises by learner, $\bar{T}_{PS1}$ and $\bar{T}_{PS2}$are average of predicted time, $\bar{F}_1$ and $\bar{F}_2$ are average of mistakes for learner, $\bar{F}_{PS1}$ and $\bar{F}_{PS2}$ are average of predicted mistake probability related to sessions 1 and 2. If ENF≥θ, 3/4≤θ ≤1, he/she belongs to class by low affectability. If σ ≤ENF<θ, 1 2≤σ <3/4 , system will detect that his/her affectability is medium. If ENF<σ , the learner belongs to high effectible class. θ and σ are determined by an expert and the teacher of the course according to Pedagogical content.

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C. Calculating Rote Learning

Rote learning is a learning technique which focuses on memorization. The major practice mixed up in rote learning is learning by repetition by which students commit information to memory in a highly structured way. The idea is that one will be able to quickly recall the meaning of the content the more one repeats it. Rote methods are routinely used when quick memorization is required, such as learning one's lines in a play or memorizing a telephone number. Rote learning is widely used in the mastery of foundational knowledge. By definition, rote learning eschews comprehension, so by itself it is an ineffective tool in mastering any complex subject at an advanced level.

Rote learning is sometimes disparaged with the derogative terms parrot fashion, regurgitation, cramming, or mugging because one who engages in rote learning may give the wrong impression of having understood what they have written or said. It is strongly discouraged by many new curriculum standards. For example, science and mathematics standards in the United States specifically emphasize the importance of deep understanding over the mere recall of facts, which is seen to be less important, although advocates of traditional education have criticized the new American standards as slighting learning basic facts and elementary arithmetic, and replacing content with process-based skills. In some instances of learning of math and science, rote methods are used by students, for example to memorize formulas etc. But, there is greater understanding if students commit a formula to memory through practical exercises that use the formula rather than through rote repetition of the formula. Newer standards often recommend that students derive formulas themselves to achieve the best understandings. It is show that, students who learn with understanding are able to transfer their knowledge to tasks requiring problem-solving with greater success than those who learn only by rote.

D. Work Bench used for Classification of Learners

In work bench we have processed this data on all compatible classifiers present in WEKA and the values like Kappa statistics, Mean Absolute Error and Root Mean Squared Error are noted. We have compared the values to identify the outperforming classifiers which will produce accurate results compatibility with our data.

1. Kappa statistic: Kappa result varies between 0 to 1 intervals. Higher the value of Kappa means stronger the agreement/ bonding. If Kappa = 1, then there is perfect agreement. If Kappa = 0, then there is no agreement. If values of Kappa statics are varying in the range of 0.40 to 0.59 considered as moderate, 0.60 to 0.79 considered as substantial, and above 0.80 considered as outstanding [23].
2. Mean Absolute Error (MAE): Mean absolute error can be defined as sum of absolute errors divided by number of predictions. It measures set of predicted value to actual value i.e. how close a predicted model to actual model. A minimum value of MAE suggests that prediction and accuracy of the model is better.

3. Root Mean Square Error (RMSE): Root mean square error is defined as square root of sum of squares error divided number of predictions. It measures the differences between values predicted by a model and the values actually observed. Small value of RMSE means better accuracy of the model.

Compare results of WEKA Classifiers w .r. t Kappa Statistics, MAE and RMSE

S.no	Algorithm	Kappa Statistics	MAE	RMSE
1	MLP	0.9547	0.067	0.1612
2	SMO	0.866	0.2484	0.3166
3	Random Forest	0.8649	0.1196	0.2593
4	IB1	0.8187	0.0784	0.2801
5	N Bayes	0.773	0.1445	0.325
6	Simple Logistic	0.6779	0.1814	0.3078
7	ADABOOST	0.7736	0.151	0.2771
8	ASC	0.7766	0.137	0.3074
9	BAGGING	0.7748	0.1946	0.2935
10	CVR	0.8177	0.191	0.2691

E. MultiLayer Perception (MLP)

MultiLayer Perception (MLP) is a feed forward neural network with one or more layers between input and output layer. The first layer is the input layer, which does not perform any computational task. Then there are one or more hidden (intermediate) layers and an output layer, all composed by computational nodes. There are no connections between nodes in the same layer, neither there are connections between nodes on non-adjacent layers. The non-computational nodes in the input layer use an identity function, while the computation nodes in the intermediate and the output layers use a sigmoid function. Feed forward means that data flows in one direction from input to output layer (forward) i.e. the input is processed and relayed from one layer to the next, until the final result has been computed.

This process represents the feed forward scheme. This type of network is trained with the back propagation learning algorithm. One of the most popular techniques to train the hidden neurons is error back propagation, whereby the error of output units is propagated back to yield estimates of how much a given hidden unit contributed to the output error.MLPs are widely used for pattern classification,

recognition, prediction and approximation. MultiLayer Perceptron can solve problems which are not linearly separable.

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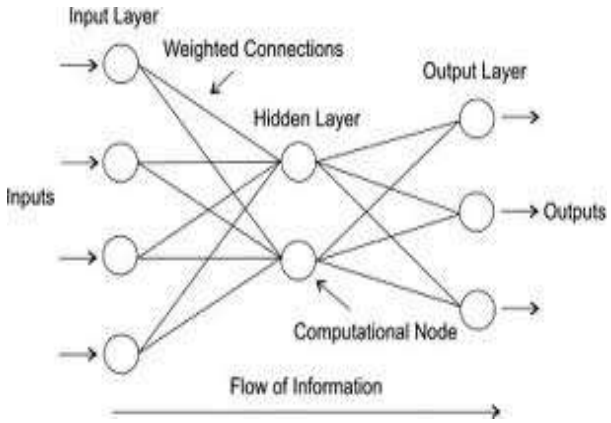


Neural networks are applicable in virtually every situation in which a relationship between the predictor variables (independents, inputs) and predicted variables (dependents, outputs) exists, even when that relationship is very complex and not easy to articulate in the usual terms of "correlations" or "differences between groups."

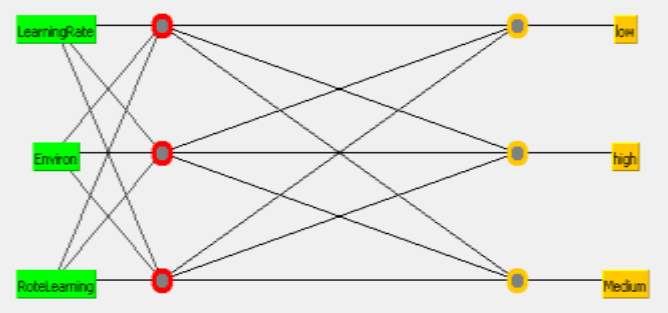
1. Model Building & Sample Experiment: The scrutiny process consists of four steps. These steps imply the usage of the WEKA Explorer application. The first step is to prepare a training dataset from the data collected from learners based on the three parameters chosen for this paper. This is in the shape of an ***arff*** file where all experiences of users are placed. The second step is to feed the training dataset to WEKA. The third step is to select the MLP module in WEKA and choose the proper features. Once the test options are selected, the results are obtained. The final step is to have an understanding and usage of the results.

The input dataset is represented by an arff file. The features from the arff file are:
@RELATION students
@ATTRIBUTE Learning rate NUMERIC
@ATTRIBUTE Environ affect NUMERIC
@ATTRIBUTE Rote learning NUMERIC
@ATTRIBUTE class {low, medium, high}

Each attribute is self-evident and is computed for each student from the activity logs. The last attribute represents the class where each student is placed in the input dataset. The *class* attribute has three values: *low*, *medium* and *high*.

Each line in the data section represents a student. The first line represents a student Learning rate i.e. we will record the number of mistakes committed and the time taken by the learners to complete the exercise based on the questionnaire style, and the second one represents the environmental affectability i.e. For detecting causes of a learner's effect on learning in contrast to environmental changes, system should ask learner some questions about his/her environment.

The third one is rote learning, it is based on the reproduction of results of a student. We classify the students as intelligent(s) when they are able to effectively apply the concepts given for learning. If a student knows the concepts, but unable to apply them, is classified as a 'rote' learner.



Based on the above 3 attributes, we have collected 34 instances of test data. Running the Multi Layer Perception (MLP) algorithm has been performed on this test data.

III. PREPARATION OF VIDEOS ACCORDING TO CLASSIFICATION

According to the learners classification we have three types of learners; high, medium, and low. High learners are intelligent, they can ugrasp the topic with brief explanation, Medium learners are average, they need explanation with examples and low learners are below average they want explanation with more alternative examples. Tutors can prepare videos according to above types of learners.

IV. EVALUATION RESULTS OF OUR BLENDED FLIPPED CLASSROOM MODEL

As it mentioned above, our purpose is detecting different classes of learners for preparing the videos according to learner class. We have identified the three types of learners', high, medium, and low. Let us consider we have 300 learners, we are sharing videos to them. After sharing videos, we have prepared survey form to collect qualitative feedback from the learners.

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The following questions were designed for that purpose:

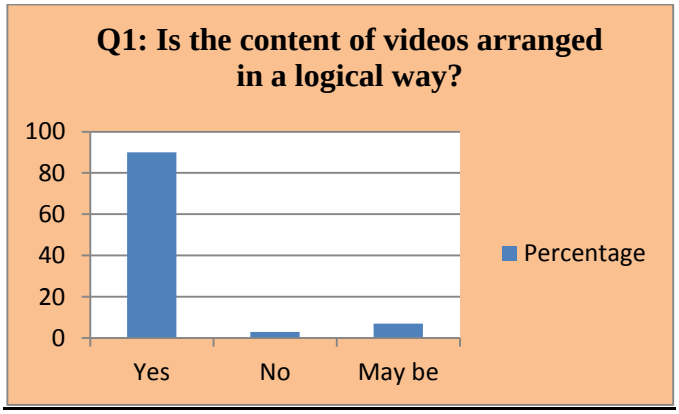
S.No	Questions
1	Is the content of videos arranged in a logical way?
2	Are these videos helpful to improve application knowledge?

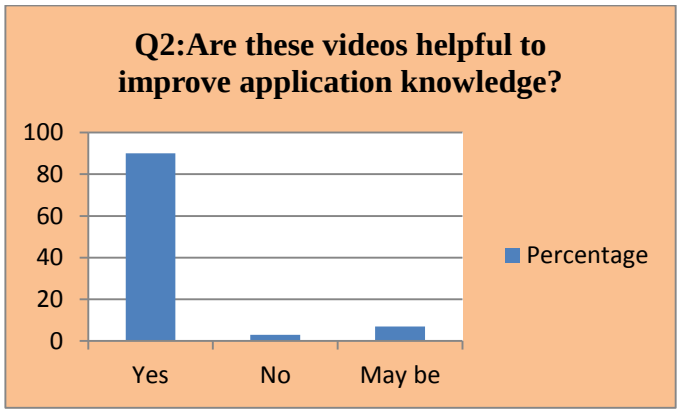
A. Results

Total number of learners: 300

Question number	Appropriate (Yes)	Not Appropriate (No)	Can't Say (May be)
Q1	85%	10%	5%
Q2	90%	3%	7%

We have conducted survey on 300 learners, for Q1 we get feedback as 85% appropriate, 5% are may be and 10% not appropriate, for Q2 we get feedback as 90% appropriate, 7% are may be and 3% not appropriate.





V. CONCLUSION

In this paper we are using three parameters for classification of learners/students by using MLP classifier. From the learner's performed activity we gather data as an input for our classification. The MLP classifier results are very promising and it is able to accurately classify the learners. Accurate classification of learners helps in designing a good e-learning environment/system. It also helps in delivering the appropriate content to the learners. Once an acceptable accuracy is obtained, the videos are prepared and shared to the learners to participate in flipped classroom more interactively. Finally we are using questionnaire for feedback. 90% results are in positive way. So, the blended flipped classroom learning is more effective and improves application knowledge. In future work more and more precise classification methods can be applied for classification of learners.

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