Learner Level and Preference Prediction of E-Learners for E-Learning Recommender Systems

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ABSTRACT. From the large sources of learning content available for e-learning, e-learning system has to identify the appropriate learning content for the close needs of the learner. The recommendation system is the tool to address such competence. Identifying learner levels and thereby identifying the appropriate learning content can be possible only if the learning content is prepared using a proven instructional strategy which covers various learnerlevels. Therefore in this proposed method, the learning content is prepared using the David Merrill's First principles of instructional strategy, a problem-based approach that has four phases of instruction namely Activation, Demonstration, Application and Integration. These four phases are used to predict the Learner Level for three different media types of content that are Text, Video and Audio and rating is arrived at. Naïve Bayes Classifier assumes that the presence of a particular feature in a class is unrelated to the presence of any other feature. The learners' rating is been used to predict the Learner Preferences as what type of content they like. To identify the learners' level, the learner rating and the instructional phases which they prefer most are used. Same classifier is used to identify the level as well as preferences of the learner. To estimate the predictive accuracy, k-fold cross validation technique is used. The experimental results show that the proposed classifier yields a maximum accuracy 0.9794 and a maximum kappa statistic of 0.9687 for learning Level and Preference respectively.

Keywords:E-Learning, Learning content, Naive Bayes, David Merrill, Learner Preference, Learner Level, k-fold cross validation.

1 Introduction

E-Learning is facilitated through electronic devices either standalone or over a network, using intranet, extranet and the internet. The explosion of learning resources in the World Wide Web is increasing in greater volumes. Learners are facing difficulties in choosing learning resources that are suitable and relevant to their learning needs due to information overload from the web. Accessing the right learning content for the learners is the main problem in any E-learning System.

There are educational taxonomies that are better suiting for classroom teaching and learning followed by evaluation. However, those taxonomies may not be the suitable one for e-learning which differs from classroom teaching and learning in principle. E-learning system demand a specific instructional design approach that ensemble the features required for addressing the above mentioned competence. David Merrill's First Principles of Instruction (FPI) is the instructional approach that is problem-centered, object-oriented, in addition to a proven suitable for e-learning.

One of the most important applications of recommender systems in learning environments is material recommendation. Recommendation Systems use opinions of users to help individuals identify material and content of interest from a possibly overwhelming set of choices more effectively [6]. By using material recommender systems in learning environments, personalization and information overload are addressed. Recommender systems can overcome the information overload by filtering out irrelevant learning resources and can bring in personalization support by recommending relevant resources to the learners according to their personalized preferences.

Learning Resources to all learners are same although different learners need different information according to their level of knowledge and learner preferences. Learner's learning level will affect the way they learn with the help of Text, Video, or Audio support. Some learners like textual form of content, some prefer to analyze visual form of content and few want to hear the audio content (preferable blind learners). For identifying the Learner's learning level and Learning Preferences, Learner log data can be more contributing.

Classifying the content for different levels of learner and identifying the preference of media by the learners are the most crucial elements of e-learning system that can lead to a successful e-learning system. Naïve Bayes classifier is the one that works with the concepts of probability. Hence, the proposed system adopts Naïve Bayes classifier to group the learners based on their level and their media preferences.

2 Review of Literature

E-learning is used to enhance knowledge and performance in the internet. The quick evolution of computer and Internet technologies has made E-Learning come to be significant learning process. The learner's needs for audiovisual aid and instructional material in e-learning has improved recently and such content has been contained within to attract a learner's consideration and interests[2].

The main purposes of recommendation systems contain analyzing user data and extracting useful information for further predictions. A recommender system is a part of software that helps users to identify the most interesting and relevant learning content from a large number of contents. Recommender systems may be based on collaborative filtering (by user ratings), content-based filtering (by keywords), and hybrid filtering (by both collaborative and content-based filtering). Recommendation system that would recommend a learning task to a learner based on the tasks already done by the learner and theirsuccesses, and based on tasks [10]. The authors have worked on a

Recommender system for the readers of books. These Recommendation Systems are to help the users, by presenting him the learning objects that one would be more interested in, based on their known preferences. The ratings devised are as No useful, poor, useful, very useful and No value, poor value, valuable, very valuable [9].
Learner needs multimedia learning contents in the form of video, audio, images, text, etc. as a learning material in E-learning. Use of multimedia-based teaching material enhances learners' learning and increases productivity. It is therefore important for the content developers, not only understand the concepts behind the development of multimedia but to also have a good grasp of how to implement some of the processes involved with courseware production [8].

Learner needs audiovisual aid learning contents in the form of video, audio, text, etc. as a learning material in E-learning. Recommendation system can produce produce item recommendations from a huge collection of items based on users' preferences. The degree of preference is measured by a rating score. Using rating score, learning preferences may be predicted as the learner prefers text content or audiovisual content [11].
E-learning system delivers the learning content to all learners in the same way. On the other hand different learners require different learning material according to their level of knowledge. The instructional strategy which is David Merrill's First Principles of Instruction (FPI) approach can be used for identifying the level of the learner [1, 3]. FPI approach which has four phases of instruction that are Activation, Demonstration, Application and Integration (ADAI) [5].

Activation remembers the previous knowledge or understanding and create learning situation for the new problem. Demonstration expresses a model of the skill required for the new problem. Application applies the skills obtained to the new problem. Integration provides the capabilities and to show the acquired skill to another new situation [7]. Any learning content can be categorized to those four phases. The four phases can be considered as the learning levels of the learners.

3 Proposed Work

The above literature pointed out the issues in the E-learning Recommendation Systemsuch as Content to be prepared with the use of an Instructional strategy to suitdifferent levels oflearners and the learner preferences to be devised using the learners rating. The proposed systemarchitecture is presented in Fig 1.

In Fig 1, the Learner has to understand the learning content and rate each of thecontent in the rating scale 1 to 5 for Poor, Below Average, Average, Good and Very Goodrespectively. The content is of three different media types namely text, video and audio for eachof the four phases of instruction namely Activation, Demonstration, Application and Integration.The four phases are considered as four learning levels of the learners.

The proposed method uses Naïve Bayes Classifier for predicting the learner level as wellas learner preferences. For the dataset, the learner has to rate the learning content according totheir preferences, i.e. some prefer the textual form of content, some-

one prefer the video form andsome others prefer audio form of content; thus their rating of the content is according to themedia preference. Similarly for the learner level, some want to be at activation level; some wantsdemonstration; some want application and some want integration; thus, their rating is accordingto the level of learning they stand in.

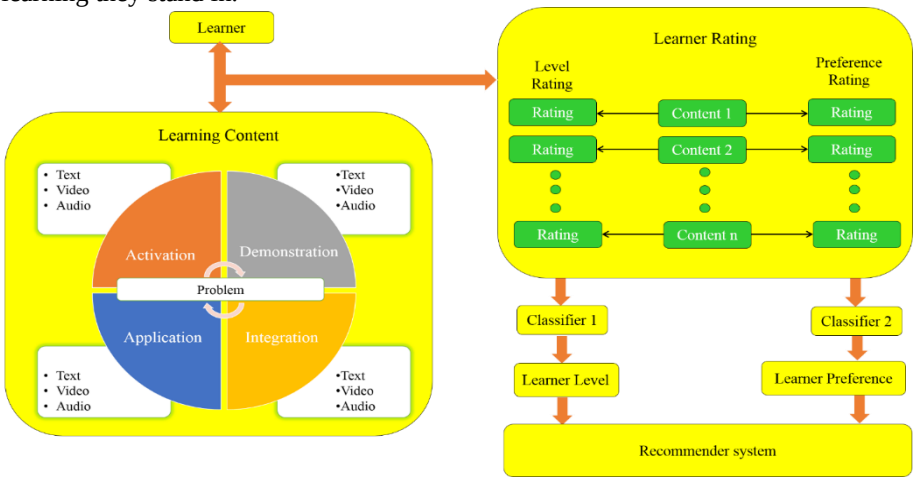

Fig. 1. Proposed System Architecture

Based on the rating for Level and Preference given by the learners, classifiers areconstructed using Naïve Bayesian classification. These two classifiers for level and prefe-rencecan predict the learner level and the learning content media type which will be taken as input bythe recommender system. The recommender system can make use of these prediction to decideon the right leaning content and learning material for the right learner.

4Results and Discussion

The learning content is developed for 10 different topics. The content for each of the four different phases/levels and for each phase, three different media types. In this Experiment, 15 students from PG level (including three blind students) have been observed to rate the Learning content.

The experimental results are observed for two different parameters namely Level and Preference. To estimate the accuracy of the classifier-1 for learning level and classifier-2 for learning preference, cross-fold validation method is used. As cross-fold validation is suitable when sufficient data are available, this proposed work fixes this method. The fold parameters considered is 2, 5, 7 and 10. The maximum fold considered 10 is found to be adequate and accurate [4].

The cross-validation method has been executed at different resampling levels at 2, 5, 7, 10. As shown in Table 1 the minimum Accuracy in the false category is 0.8211 for 7-fold and maximum 0.8288 for 2-fold whereas in the True category 0.9261 for 2-

fold as minimum and the maximum is 0.9794 for 10-fold. The Kappa level for false category minimum 0.7260 for 7-fold and maximum 0.7384 for 2-fold and True level category minimum 0.8857 for 2-fold and maximum 0.9687 for 7-fold as well as 10-fold. It is understood that Higher the Kappa, higher the true positives and false negatives and thus higher accuracy. The results show that the kappa achieved is 0.9687 and hence the classifier accuracy is highly acceptable.

Table 1. Evaluation Measures of Learning Preference

Cross-fold Parameter	Kernel	Accuracy	Kappa
F=2	False	0.8288	0.7384
	True	0.9261	0.8857
F=5	False	0.8238	0.7303
	True	0.9511	0.9247
F=7	False	0.8211	0.7260
	True	0.9794	0.9687
F=10	False	0.8222	0.7277
	True	0.9794	0.9687

Table 2. Evaluation Measures of Learner Level

Cross-fold Parameter	Kernel	Accuracy	Kappa
F=2	False	0.8216	0.7417
	True	0.9174	0.8743
F=5	False	0.8257	0.7389
	True	0.9576	0.9189
F=7	False	0.8289	0.7461
	True	0.9636	0.9671
F=10	False	0.8291	0.7476
	True	0.9636	0.9671

Similar to Preference classifier, Table 2 show that the minimum Accuracy in the false category is 0.8216 and the maximum is 0.8291 whereas in the True category 0.9174 is minimum and the maximum is 0.9636. The Kappa level for false category minimum is 0.7389 and maximum is 0.7476 while for True level category minimum is 0.8743 and maximum is 0.9671. The results indicate that the overall predictive accuracy is highly acceptable.

5Conclusion

Learning depends mostly on Learner and the Learning Content i.e. learner's learning Level and the learner Preference over the form of content media. To know of the level of the learner and to understand the type of learning of material required are the two major task of any recommender system. This work has addressed on deciding these two parameters of e-learning system. Using classification and prediction, the preference of the learning content for the respective level of learner can be predicted. Naïve Bayes classification is used with k-fold cross validation technique. The identified learner level and preference can help any recommender system to decide on the learning content (simple-to-complex or lower-to-higher) to be offered with the respective learning material type such as Text or audio or video. Therefore, this work when further refined with some more specific parameters such as the nature of problem/topic, dynamic behavior of the learner and more would be more needy.

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References

1. B. K. Poornima et al., “Efficient content retrieval in E-learning system using semantic web ontology” Advances in computer science and information technology (ACSIT), ISSN: 2393-9915, vol. 2, no. 6, pp. 503-507, April-June 2015.
2. B. K. Poornima et al., “Text preprocessing on extracted text from audio/ video using R”, International Journal of Computational Intelligence and Informatics, Vol. 6,March 2017.
3. B. K. Poornima, et al., “Personalization of Learning Objects in E-learning System using David Merrill’s approach with Web 3.0”, International Journal of Applied Engineering Research (IJAER),Volume 10, Number 85, pp.318-324. 2015.
4. Gupta G.K, “Introduction to Data Mining with Case Studies”, Prentice-Hall Of India Pvt. Limited, 2006.
5. Merrill, M. D., “First principles of instruction: a synthesis”. Trends and Issues in Instructional Design and Technology,2nd Edition, pp.62-71, 2007.
6. MojtabaSalehi , Mohammad Pourzaferani , Seyed Amir Razavi, ” Hybrid attribute-based recommender system for learning material using genetic algorithm and a multidimensional information model”, Elsevier, Egyptian Informatics Journal, vol. 14,pp. 67–78, 2007.
7. Nirmala K., Pushpa M., “Feature based Text Classification using Application Term Set”, International Journal of Computer Applications,Volume 52– No.10, pp.0975 – 8887, 2012.
8. Parlakkilic and Karslioglu “Rapid multimedia content development in medical education”, Journal of Contemporary Medical Education, J Contemp Med Edu, vol. 1(4): pp.245-251, 2013.
9. R.G. Crespo et al., ” Recommendation System based on user interaction data applied to intelligent electronic books” Elsevier, Human Behavior, vol. 27, pp. 1445–1449, 2011.

10. ReemaSikka, AmitaDhankhar, ChaaviRana, “A Survey Paper on E-Learning Recommender System”, International Journal of Computer Applications (0975 – 888), Volume 47– No.9, June 2012.
11. Ying Liu, JiajunYanga, “Improving Ranking-based Recommendation by Social Information and Negative Similarity”, Information Technology and Quantitative Management (ITQM 2015), Procedia Computer Science, vol. 55, pp. 732 – 740, 2012.