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Analysis of NNBP Model for SNE Learning Process

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***Abstract*- Learning process are attained the maturity of applying contemporary algorithms and models for the modern teaching learning process in the entire subjects. The education system adopts the technology to support learners to access the content and evaluation system. The sophisticated models provides the online teaching using multimedia content for learning process but the learning models are involved in the enhancement of learning. The learning models are involved to evaluate the learner's performance dependences on the learning related factors. This research papers provide the continuation of the previous constructed neural network back propagation model to optimise the BPNN for effective learning process. This covers the memory model which determines learner's internal attributes process weight and its influences.**

Keywords- Special Need Education, Education Data Mining, Neural network

I. INTRODUCTION

The data mining techniques are applicable to all domains according to the need of applications. The data mining technology phases are majorly having pre-process analysis and pattern generation. The data mining technology is attempted to integrate the learning system of challenging learners and their cognitive behavior using predict approach. The data mining technology is support to determine the unknown values from available values. The predictive approach is used to identify the relationship of challenging learner's performance and their cognitive load using Neural network approach and its optimized based on back propagation algorithm.

II. SCOPE

The research work is aimed to determine the cognitive behavioral and educational performance of special need learners using data mining techniques such as classification techniques and back propagation algorithm. The learning behavior of the Special Need Education (SNE) learners and their cognitive performance based classification attempted to determine the feature pattern of similar SNE groups. The research work studies the process of SNE learners in the different environmental learning process and observes their behavior to simulate the process of learning and their behavior.

The predictive mining has been put in operation in the SNE educational sector for the learners' behavior, learning tool adaptation and the implementation and matching of the pedagogy for the targeted learners. Data mining process is adopted for determining the pattern for special need learners with the learning objectives. Learners and the type of learning objective and its achievements are determined in the specific attributes and the patterns are been presented in the process-able knowledge.

III. DATA MINING TECHNIQUES FOR EDUCATIONAL PERFORMANCE

Children with special need education includes those who are physically handicapped, moderately or severely learning disabled, blind and partially sighted, deaf and partially hearing, and any child who, for some or other reasons requires additional educational provision. The special education for these children is interpreted and perceived, as much as possible, as "additional" rather than as "different". It proclaims that computers used to help children [1, 14] with SNE in the following ways.

The Special Need learner's behavior is observed by the researchers to visualize effectiveness in learning process. The data representation and analysis techniques are meeting the goals of the mining objectives. According to Gartner Group [15] defines data mining as "the process of discovering meaningful new correlation, patterns and trends by shifting through large amount of data stored in repositories and by using pattern recognition technologies as well as statistical and mathematical techniques". Rubenking [34] explains, "Data mining is the process of automatically extracting useful information and relationships from immense quantities of data. In its purest form, data mining doesn't involve looking for specific information. Rather than starting from a question or hypothesis, data mining simply finds patterns that are already present in the data". Han and Kamber [45] define data mining as the process of discovering 'hidden images', patterns and knowledge within large amount of data and making predictions for outcomes or behaviours. The researchers have explored to determined

the cognitive load impact of academic performance applications of data mining in education. The authors had gone through the survey of the literature to understand the importance of data mining in education. The researcher had tried to analyze its importance from Indian education perspective which has not been explored in [9, 25-27, 37, 32, 35].

The worldwide educational system has improved especially on higher education system discussed in [26]. The technological adaptation and the e-learning approach as comes out as an outcome. A model for knowledge sharing process using data mining in higher educational system [9]. Waiyamai [42] recommends the use of data mining in education can help improve the quality of graduate students through pattern generation. Barros and Verdejo [3] analyzed the student interaction process and applied to improve collaboration. Delmater and Handcock [10] place stress on underlying predictive modelling which is a mixture of mathematics, computer science and domain expertise. Ranjan and Malik [32] proposed a framework for effective educational process using data mining techniques to uncover the hidden trends and patterns and making accuracy based predictions through higher level of analytical sophistication in students counselling process. Talavera and Gaudioso [39] proposed to shape the analysis problem as data mining task. Ma et al [27] visualized that the education domain offers many interesting and challenging applications for data mining.

The Ministry of Education, Singapore carried out the research to target the right student using data mining techniques. Association rule approach used to select the remedial program students instead of traditional approach. [23]. The mining objective is to recommend to learners activities, resources and learning tasks that would favour and improve their learning, suggest good learning experiences for the students, suggest path pruning and shortening or simply links to follow, based on the tasks already done by the learner and their successes, and on tasks made by other similar learners, etc. [17,13,24,40,44]. Although the educational data mining is a very recent research area there is an important number of contributions published in journals, international congress, specific workshops and some ongoing books [33] that show it is one new promising area. Some of the most promising work line is the use of e-learning recommendation agents [24, 44]. These recommender agents sees what a student is doing and recommends actions (activities, shortcuts, contents, etc.) they think would be beneficial to the student. Recommender agents can also be integrated in evolving e-learning systems in which materials are automatically found on the web and integrated into the system [40]. In this way, they help educators to detect which parts of existing materials from heterogeneous sources as the Internet are the best to use for composing new courses.

Besides recommenders try to integrate the domain knowledge and ontologies, combining web mining and semantic web in semantic web mining [28]. Semantic web mining is a successful integration of ontological knowledge at every stage of the knowledge discovery process [4]. Educational data mining is a young research area and it is necessary more specialized and oriented work educational domain in order to obtain a similar application success level to other areas, such as medical data mining, mining e-commerce data, etc.

IV. DATA MINING TECHNIQUES FOR SNE

Spanish National University for Distance Education (UNED) initiated research for Special Need Educational learners to participate and learns through web portal. Virtual communities have been identified as one of the most valuable applications in the Internet. One of their main features is that they do not limit participants to particular locations. This research present an accessible collaborative platform and learning management system that allows building accessible virtual communities so that students (with and without special needs) can organize themselves in communities of interest and promote dynamics in learning. A virtual community built upon this platform for members of the Spanish National University for Distance Education (UNED) interested in accessibility issues (directly or indirectly) [30].

Final made the study through Institute of Mathematics and Informatics and come to the conclusion that in the Special Need Education is to increase sufficient amount of resources from teachers and a restructuring of the education system. Technologies used in special education in Finland can roughly be divided into four main categories; assistive technologies, communication technologies, and learning software [11].

Michigan State University (MSU) developed online educational system Project the Learning Online Network with Computer-Assisted Personalized Approach (LON-CAPA) to predicate the student's performance. They design, implement, and evaluate a series of pattern classifiers and compare their performance on an online course dataset. A combination of multiple classifiers leads to a significant improvement in classification performance. This method may be of considerable usefulness in identifying students at risk early, especially in very large classes, and allow the instructor to provide appropriate advising in a timely manner[5].

The Education Data Mining (EDM) approaches are carried various researchers to determine the performances and learning factors [31, 33, 38, 41]. Data mining practitioner point of view, references are organized according to the type of modelling techniques used, which include: Neural Networks, Genetic Algorithms, Clustering and Visualization Methods, Fuzzy Logic, Intelligent agents, and Inductive Reasoning, amongst others.

From the same point of view, the information is organized according to the type of Data Mining problem dealt with: clustering, classification, prediction, etc. [6, 8, 20-22, 36, 43]. Finally, from the standpoint of the e-learning practitioner, provide taxonomy of e-learning problems to which Data Mining techniques have been applied.

Student Academic Performance Monitoring and Evaluation Using Data Mining Techniques work recommends student learning process must be evaluated and integrated into any future performance monitoring prototype. DMT has a potential in performance monitoring of school and other levels education offering historical perspectives of students' performances. The results may both complement and supplement territory education performance monitoring and assessment implementations [12].

As per the analysis of Educational data mining process address the issues on course design, content delivery and the result analysis process. The mining data set which processed are provide the learners point view with the external dataset. From the study the following issues are identified.

V. SNE – BACK PROPAGATION NEURAL NETWORK MODEL

Special Need Educational Learners academic performance and their cognitive load scaling method provide information about the relationship of SNE learner and their cognitive influence relations. The internal process between the cognitive load and the impact on the academic performance are not measureable. Therefore the neural network model is adopted to determine the weight based process of producing academic performance and level of influence by each factor through the process.

Neural Networks are analytic techniques modeled after the (hypothesized) processes of learning's in the cognitive system and the neurological functions of the brain and capable of predicting new observations (on specific variables) from other observations (on the same or other variables) after executing a process of so-called learning from existing data. Neural Networks is one of the Data Mining techniques to determine and optimize the factors. It describes the model of neural network approach and conventional model for the SNE learner's performance.

In 1985, Moore and a panel of technology and special education experts had identified expert system could help in screening, diagnosis, and placement issues in special education [29]. Hofmeister and Ferrara developed a series of expert system prototypes, one of which was used to address the classification of students as learning disabilities. They concluded that a need for similar technology exists in special education and that it was possible to develop practical expert system with the tools and research and development resources available at that time [18]. A preliminary finding by Hofmeister et al [19] also indicated that expert systems can perform as well as humans in specific areas. Geiman and Nolte proposed an expert system for the diagnosis of students with disabilities, which revealed quite positive results [16]. Baer et al designed an expert system to assist educators to reduce bias in the process of referring students with suspected disabilities. However, field test of such system showed that it had no statistically significant impact on the percentage of students referred for special education, or the ratio of students placed to students assessed. In addition, variables predicting referral for special education assessment were not consistent [46].

VI. BACK PROPAGATION MODEL FOR SNE LEARING PERFORMANCE ANALYSIS

Multilayer perceptron l & BP (Back-propagation) model Standard multilayer perceptron (MLP) architecture consists more than 2 layers; A MLP can have any number of layers, units per layer, network inputs, and network outputs such as fig 1.1models. This network has 3 Layers; first layer is called input layer and last layer is called output layer; in between first and last layers which are called hidden layers. Finally, this network has three network inputs, one network output and hidden layer network.

This model is the most popular in the supervised learning architecture because of the weight error correct rules. It is considered a generalization of the delta rule for nonlinear activation functions and multilayer networks. In a back-propagation neural network, the learning algorithm has two phases. First, a training input pattern is presented to the network input layer. All external observation attributes are considered for the input. I1 to I10 represents the input variable which presents the score of the each exercise which carried out different memory learning process such as long term, short term, working, instant, responsive, process, recollect, reference, instruction and action memory. The cognitive loads are treated as process neuron of hidden layer. The H1 to H6 presents the mental, physical, temporal, performance, effort and frustration cognitive loads.

According to the observed values, the neural network process is made. The student exercise values are presented 5, 7, 10, 7, 10, 6, 8, 10, 10 and 8. The process values weightage is presented as a matrix.

Initially Assigned Input to Hidden layer values are

TABLE I. INITIAL ASSIGNMENT I-> H

0.1159	0.7452	0.7667	0.3303	0.5616	0.0683
0.6439	0.4698	0.0191	0.2963	0.8009	0.6156
0.2143	0.5475	0.2102	0.3169	0.1742	0.4353
0.9549	0.5177	0.1248	0.0150	0.7018	0.2846
0.4923	0.1257	0.9708	0.0489	0.7574	0.9536
0.0792	0.3202	0.8221	0.3629	0.9702	0.0913
0.1030	0.4678	0.0615	0.0294	0.1558	0.3777
0.6844	0.4638	0.3015	0.5345	0.3129	0.2956
0.8698	0.8769	0.1957	0.9274	0.4688	0.0399
0.1469	0.6540	0.3309	0.5981	0.0100	0.3490

Initially Assigned Hidden layer to Output values are

TABLE II. INITIAL ASSIGNMENT H-> O

0.9532	0.4718
0.0451	0.0943
0.1912	0.4462
0.5433	0.1154
0.6347	0.8885
0.8214	0.0804

From the initial values, each level obtained output is recalculated and assigned as a input and reduced the error level. Initially the output is estimated for 81 for the learning cognitive and 95 for the learning performance. The initial assigned neuron process produced 96 for the cognitive load and 89 for the learner performance. While obtaining this process, -62.048 errors are produced. The iterative process implemented and obtained the final value in zero level error. The final weight-age values are presented below.

Final Input to Hidden layer values are

TABLE III. OBTAINED WEIGHT I-> H

0.2318	1.4905	1.5335	0.6605	1.1232	0.1366
1.2879	0.9397	0.0382	0.5926	1.6019	1.2313
0.4286	1.095	0.4204	0.6338	0.3484	0.8705
1.9099	1.0355	0.2495	0.03	1.4036	0.5692
0.9846	0.2514	1.9416	0.0979	1.5147	1.9072
0.1583	0.6403	1.6442	0.7259	1.9405	0.1825
0.206	0.9356	0.1229	0.0587	0.3116	0.7554
1.3687	0.9276	0.603	1.069	0.6258	0.5912
1.7397	1.7538	0.3913	1.8548	0.9375	0.0799
0.2938	1.308	0.6618	1.1962	0.02	0.698

Final Hidden to output layer values are

TABLE IV. OBTAINED WEIGHT H->O

0.9532	0.5718
0.0451	0.0943
0.1912	0.4462
0.5433	0.2154
0.6347	0.8885
0.8214	0.1804

While processing the network model, the high value of mental effort is influenced at the maximum level of 95.32 percentages and least level of physical at 4.51 percentages.

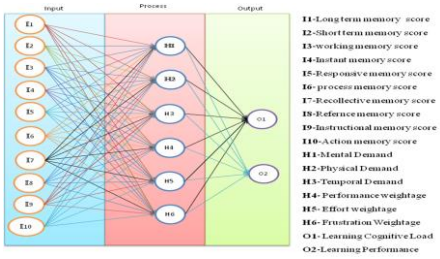

Figure 1: Neural network model

The advantage of this model is less number of iteration and better performance compare with standard back-propagation model. To evaluate this algorithm, the MATLAB coding designed and executed. Some cases of classification data and different setting of network factors (e.g. hidden layer number and nodes, number of classification and iteration). The learning performance is inclined to performance factor of the cognitive load to obtain as expected result. The entire model is presented according to the load along with the learning performance with the controlled weight.

The load is differ one with another according to the different learning process. Mental, physical, temporal, effort, frustration is less while performance is high. The learning process and its corresponding variation is presented as a graph. From the calculated and fetched academic values of particular students variation and its relation is separated and tabulated below

TABLE V. CALCULATION

	Observed		TH 0.01	TH 0.02	TH 0.03	TH 0.04	TH 0.05	TH 0.06	TH 0.07	TH 0.08	TH 0.09	TH 0.10
APE_1	72.50	50.00	66	62	67	73	87	67	60	59	59	58
CL_1	72.50	50.00	64	67	59	54	50	66	72	82	73	80

TABLE VI. CALCULATION

	Observed		TH 0.01	TH 0.02	TH 0.03	TH 0.04	TH 0.05	TH 0.06	TH 0.07	TH 0.08	TH 0.09	TH 0.10
APE_2	73.75	48.40	68	83	68	61	63	65	64	63	65	61
CL_2	73.75	48.40	65	57	66	68	64	66	71	66	73	70

The threshold value produced different academic performance and cognitive load optimized value as per the average weight and the calculated error value .The range of threshold value and its corresponding APE and CL presented as a chart below

As per the derived result the cognitive load and academic performance of the indirectly proportionate one with another. However the influencing factors are determined from the frequency table. The frequency table of first SNE learner generated and presented below

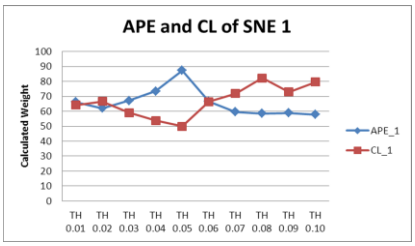

Figure 2: APE and CL of SNE1

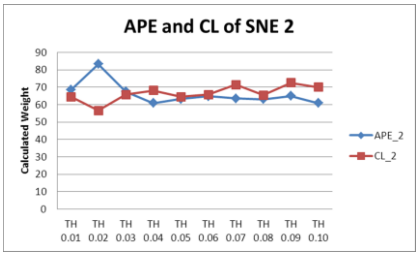

Figure 3: APE and CL of SNE2

TABLE VII. CALCULATION

	MD	PD	TD	PER	EFF	FRUST
Long	1	0	1	1	0	2
Short	1	0	1	2	1	2
Working	0	4	2	0	4	2
Instant	1	1	1	1	1	0
Responsive	0	0	1	2	0	0
Process	1	1	1	1	1	1
Recollect	0	0	1	1	1	1
Reference	5	2	1	0	2	0
Instructional	1	1	0	2	0	1
Action	0	1	1	0	0	1

As per the frequency table, mental demand is decided by reference memory. The mental demand fifty percentage of demand is dominated by the reference memory. The physical demand is influenced by working memory process. The temporal memory is dominated and produced the optimum based on working memory. The performance weight is determined according to responsive and instructional memory activities. The effort is controlled by working memory activities and frustration based on long term, short term and working memory actives. This occurrence table values are differ one with another.

VII. CONCLUSION

The result analysis chapter provides the cognitive relationship of academic performance of special need learns as per this school, gender and the socio economic attributes. The basic analysis unable to provide the weight of individual memory related activities with the demand and weights of the influencing factors. Therefore the back propagation neural network model which described in the previous chapter executed and its results are presented. As per the observed result the academic performance and the cognitive loads are indirect proportionate one with another. The working memory and reference memory are influenced the learners' performance. The back propagation neural network feed forward concepts, iterative process and optimization techniques are discussed. The Back propagation model supported for dynamic as well as with the unknown input values. The optimized maximum value is determined and presented as part of the result. The frequent occurrence of the cognitive load and the corresponding mode is calculated and maximum levels of influence factors are presented.

REFERENCES

[1] F.Newell, A.Carmichael, P.Gregor and N.Alm, "Information technology for cognitive support," In the Human-Computer Interaction Handbook, pp. 464-481, 2002.

[2] S.Yesha, T.Mustafa ,A.Sattar and J.Khan, "Data Mining Model for Higher Education System," European Journal of Scientific Research, 43(1), pp. 24-29, 2010.

[3] B. Barros, and M. F. Verdejo, "Analyzing Student Interaction Processes In Order To Improve Collaboration: The Degree Approach," International Journal of Artificial Intelligence in Education, 11(1), pp. 221-241, 2000.

[4] K.Becker, M.Vanzin, & D. D. A. Ruiz, "Ontology-based ltering mechanisms for web usage patterns retrieval," In 6th International conference on e-commerce and web technologies, pp. 267-277, 2005.

[5] Behrouz Minaei-Bidgoli , Deborah A. Kashy , Gerd Kortemeyer, William F., Punch Predicting Student Performance: An Application Of Data Mining Methods With The Educational Web- Based System LON-CAPA,33rd ASEE/IEEE Frontiers in Education Conference, November 5-8, Boulder, CO, 2003.

[6] G. Biswas, K. Leelawong, K.Belynne, K.Viswanath, "Developing Learning by Teaching Environments that Support Self-Regulated Learning," In: The 7th International Conference on Intelligent Tutoring Systems. Maceió, Brazil, 2004.

[7] J .D. Bransford, A. L. Brown, & R. R. Cocking, "How people learn: Brain, mind, experience, and school," Expanded Edition. Washington, DC: National Academy Press, 2000.

[8] F. Castro, A .Vellido, A .Nebot, J Minguillón, "Finding Relevant Features to Characterize Student Behavior on an e-Learning System. In: Hamid," R.A. (ed.): Proceedings of the International Conference on Frontiers in Education: Computer Science and Computer Engineering, FECS'05, pp. 210-216, 2005.

[9] N. Delavari, M. R. Beikzadeh, and S. K. Amnuaisuk, "Application of Enhanced Analysis Model for Data Mining Processes in Higher Educational System," Proceedings of ITHET 6th Annual International Conference, Juan Dolio, Dominican Republic, 2005.

[10] R. Delmater, and M. Handcock, "Data Mining Explained: A Manager's Guide to Customer- Centric Business Intelligence," Digital Press, Boston, 2001.

[11] Eija karna-lin, Kaisa pihlainen-bednarik., "Technology in Finnish Special Education – Toward Inclusion and Harmonized School Days Informatics in Education," 2007, 6(1), pp. 103–114, 2007.

[12] N. O. Emmanuel, "Student Academic Performance Monitoring and Evaluation Using Data Mining Techniques," Fourth Congress of Electronics, Robotics and Automotive Mechanics IEEE Computer Society, 2009.

[13] R. Farzan, "Adaptive socio-recommender system for opencorpus e-learning," In Doctoral consortium of the third international conference on adaptive hypermedia and adaptive web-based systems, 2004.

[14] S. Garner, "COLORS for Programming: A system to support the Learning of Programming," Proceedings of Informing science, pp. 533-541, 2004.

[15] Gartner Group., "Magic Quadrant for Customer Data Mining," Retrieved 18 September 2008 from http://dml.cs.byu.edu/~cgc/docs/mldm_tools/Reading/Gartner2Q07.pdf. 2007.

[16] R. M. Geiman, and W. L. Nolte, "An Expert System for Learning Disability Diagnosis," Proceedings of the IEEE Conference on System Engineering, pp. 363-366, 1990.

[17] J. Heraud, L. France, & A. Mille, "Pixed: an it's that guides students with the help of learners' interaction log," In International conference on intelligent tutoring systems (workshop analyzing student– tutor interaction logs to improve educational outcomes), Maceio, pp. 57–64, 2004.

[18] A. M. Hofmeister, and J. M. Ferrara., "Artificial Intelligence Applications in Special Education: How Feasible? Final Report," Logan, Utah State U, 1986.

[19] A. M. Hofmeister, and M. Margaret Lubke., "Expert Systems: Implications for the Diagnosis and Treatment of Learning Disabilities, Learning Disability Quarterly," 11(3) pp. 287-291, 1988.

[20] G J Hwang, G.J., Hsiao, C.L., Tseng, C.R., "A Computer-Assisted Approach to Diagnosing Student Learning Problems in Science Courses," Journal of Information Science and Engineering, 19, pp. 229-248, 2003.

[21] Y. Hwang-Wu, C. B. Chang, G. J. Chen, "The Relationship of Learning Traits, Motivation and Performance-Learning Response Dynamics," Computers & Education, 42 pp. 267-287, 2004.

[22] K. P. Jantke, G. Grieser, S. Lange, "Adaptation to the Learners Needs and Desires by Induction and Negotiation of Hypotheses," In: Auer, M.E., Auer U. (eds.): International Conference on Interactive Computer Aided Learning, ICL 2004. Villach, Austria, 2004.

[23] B. Liu, Y. Ma, C. K. Wong, and P. Yu,"Target selection via scoring using association rules," IBM Research Report 21697, March Yorktown Heights, NY, 2000.

[24] J. Lu, "Personalized e-learning material recommender system," In International conference on information technology for application, pp.374–379, 2004.

[25] J. Luan, "Data Mining Applications in Higher Education," A chapter in the upcoming New Directions for Institutional Research, 1st Ed., Josse-Bass, San Francisco, 2001.

[26] J. Luan, 'Data Mining and Its Applications in Higher Education' in A. Serban and J. Luan (eds.) "Knowledge Management: Building a Competitive Advantage fir Higher Education," New Directions for Institutional Research, No. 113. San Francisco, CA: Jossey Bass, 2002.

[27] Y. Ma, B Liu, C. K. Wong, P. S. Yu, S. M. Lee, "Targeting the right students using data mining," Proceedings of the sixth ACM SIGKDD international conference on Knowledge discovery and data mining, Boston, pp 457-464, 2000.

[28] P. Markellou, I.Mousourouli, S.Spiros, & A.Tsakalidis, "Using semantic web mining technologies for personalized e-learning experiences," In Proceedings of the web-based education, pp. 461–826, 2005.

[29] G. B. Moore, Robotics., "Artificial Intelligence, Computer Simulation: Future Applications in Special Education," COSMOS Corp., Washington, DC, 1985.

[30] F. Paas, "Cognitive Load measurement as a Means to Advance Cognitive Load Theory," Educational Psychologist, 38(1), pp 63-71, 2003.

[31] M. Pechenizkiy, T. Calders, E. Vasilyeva, P. De Bra, "Mining the student assessment data: Lessons drawn from a small scale case study," In Proc. of the 1st Int. Conf. on Educational Data Mining (EDM'08), pp. 187-191, 2008.

[32] J. Ranjan, "Impact of Information Technology in Academia," International Journal of Education Management, 22(5), pp .442-455, 2008.

[33] C. Romero, S. Ventura, P. G. Espejo, C. Hervas, " Data mining algorithms to classify students," In Proc. of the 1st Int. Conf. on Educational Data Mining (EDM'08), pp. 187-191, 2008.

[34] N Rubenking, 'Hidden Messages', PC Magazine, May 22, 2001. Retrieved 25 October 2008 from : http://www.pcmag.com/ article2/0,2817,8637,00.asp , 2001.

[35] P. Sargenti, W. Lightfoot, and M. Kehal, "Diffusion of Knowledge in and through Higher Education Organizations," Issues in Information Systems, 3(2), pp 3-8, 2006.

[36] J. Sheard, J. Ceddia, G. Hurst, "Inferring Student Learning Behaviour from Website Interactions: A Usage Analysis," Education and Information Technologies 8(3), pp. 245-266, 2003.

[37] K. Shyamala and S. P. Rajagopalan "Data Mining Model for a better Higher Educational System," Information Technology Journal, 5(3), pp 560-564, 2006.

[38] S. J. Vandamme, J. P. Meskens, N. "Determination of factors influencing the achievement of the first-year university students using data mining methods," In Proc. of the Workshop on Educational Data Mining at ITS'06, p. 37-44, 2006.

[39] L Talavera, and E Gaudioso, "Mining Student Data to Characterize Similar Behavior Groups In Unstructured Collaboration Spaces," presented at Workshop on Artificial Intelligence in Computer Supported Collaborative Learning at European Conference on Artificial Intelligence, Valencia, Spain,pp 17-23, 2004.

[40] T. Tang, & G. McCalla, "Smart recommendation for an evolving e-learning system," International Journal on E-Learning, 4(1),pp.105–129, 2005.

[41] N. Thai Nge, P. Janecek, P Haddawy, "A comparative analysis of techniques for predicting academic performance,". In Proc. of 37th Conf. on ASEE/IEEE Frontiers in Education, 2007,

[42] K. Waiyamai, "Improving Quality of Graduate Students by Data Mining," Dept. of Computer Engineering, Faculty of Engineering, Kasetsart University, Bangkok, Thailand, 2003.

[43] Y. Yoo, S. Yoo, C. Lance, J.Hankins, "Student Progress Monitoring Tool Using Tree view.," In: The 37th Technical Symposium on Computer Science Education, SIGCSE'06. ACM Press, Houston, USA pp.373-377, 2006.

[44] O. Zaane, & J. Luo, "Web usage mining for a better webbased learning environment," In Proceedings of conference on advanced technology for education, Banff, Alberta, pp. 60-64, 2001.

[45] J. Han and M. Kamber, "Data Mining Concepts and Techniques," Morgan Kaufmann, pp.4-27.

[46] R. Baer, "An Expert System for Guiding Teachers in Referring Students for Special Education Placement," Logan, Utah State U., Center for Persons with Disabilities, 1991.