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EDULOGIC+ - Knowledge Management through Data Analysis in Education

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***Abstract*—**This paper outlines the application of Knowledge Management (KM) principles in the context of Educational institutions. The paper caters to the needs of the engineering institutions for imparting quality education by delineating the instruction delivery process in a highly structured, controlled and quantified manner. This is done using a software tool EDULOGIC+. The central idea has been based on the engineering education pattern in Indian Universities/ Institutions. The data, contents and results produced over contiguous years build the necessary ground for managing the related accumulated knowledge. Application of KM has been explained using certain examples of data analysis and knowledge extraction.

***Keywords*—**Education software system, information system, knowledge management.

I. Introduction

IN present times, quality is a buzz word and it plays an important role in education. There is a need for education to be delivered in a highly structured and planned manner. Most of the institutions invest significantly in software technologies, without considering how to integrate them effectively into a continuous decision-making processes, and thereby improve the quality of academic instruction. Every academic institution may inherently store, access, and deliver knowledge in some manner. However, the question is what value is added to the services they deliver by the effective use of that knowledge capital [3].

KM in EDULOGIC+ is not about creating a central database that is somehow a complete replica of all that is known by institution. KM is more about embracing a diversity of knowledge sources from faculty, department heads, students, examination department, databases etc. It is, in essence, about what we do best as knowledge workers, what Bill Gates refers as "Thinking Work" [6]. "*KM is the art of creating values by leveraging the intangible assets of knowledge. To be able to do that one has to visualize the whole organization as consisting of nothing but knowledge and knowledge flows"* [7].

In India, the hierarchy of most of the institutions related to engineering is as follows: there is a University Institution which lays down the syllabi structure, rules and guidelines. The evaluation pattern is two-fold: Internal Evaluation by the affiliated College/Institution and External Evaluation by the University. EDULOGIC, a software package designed for achieving quality in education, has been described by authors [1]. In this paper, the design and working of this educational software system have been extended further to incorporate KM.

II. Working Logic Behind the System

The academic requirements of an educational system leading to KM have been realized in a series of phases, described as follows:

Phase -- I: Planning: This phase involves deciding the number of calendar working days, number of classes for each subject, assigning faculty to classes, preparation of timetables, teaching schedules, assignments, lab schedules, tutorials, revisions and other preliminary activities.

Phase – II: Maintenance of Faculty and Student Data: After the commencement of classes, maintenance of attendance details, submissions details, internal marks, practical assessments, faculty and students deadlines planning and control comes into picture.

Phase – III: Performance Data Analysis and Control: Data maintained in phase II needs to be analyzed for individuals (students and teachers), subjects, classes and branches and later for the entire institution. This provides guidelines for re-scheduling and control. Knowledge Management is a key activity in this phase. It brings together three core organizational resources – people, processes and technologies – to enable the organization to use and share knowledge/information more effectively for better education delivery in time phased manner [5].

Phase – IV: Knowledge Management: Data analysis that is available in system leads to the most critical part of developing knowledge pertaining to students, faculty, classes, department and the institution over the years. On the whole this knowledge will enable taking decisions for improvement of quality in all strata of imparting education. KM mainly is based on reports generated.

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III. System Design

The main idea behind the software tool EDULOGIC+ lies in making a huge information repository that is not just an information system but software that implements the principles of Knowledge Management through analyzing the data accumulated in the information base of the system. Knowledge data base also keeps coming up gradually. The database tables hold the qualitative data regarding students, faculty, classes and departments, which is organized in database as shown below in Figs. 1 - 4.

STUDENT
member_id
semester_id
subject_id
academics
acad_activities
soft_skills
attitude
aptitude
attendance
detained status

Fig. 1 Student Table

CLASS
class_id
semester_id
pass_%
achievements
feedback
behaviour
no_of_stud

Fig. 2 Class Table

FACULTY
member_id
semester_id
class_id
subject_id
pass_%
feedback
syllabus_coverage
deviations

Fig. 3 Faculty Table

SHEDULE
member_id
semester_id
subject_id
unit_no
topic_no
topic_name
classes_planned
date_planned
classes_took
date_took

Fig. 4 Schedule Table

Apart from the above figured tables, there exist a number of tables that store the basic and day to day data produced in institution. The data gets accumulated in the database and forms a huge information base that is ready to be analyzed and make decisions based upon the knowledge obtained from the reports generated from the analysis of data.

What data resides in EDULOGIC+?

The data that gets filled is mainly of two types. The first is the data that is generated very frequently and very basic and comprehensive like as following.

1) *login* and user data including role that restrict the access
2) *exam* related data like dates, marks
3) *attendance* related data
4) *subject allocation* related like subjects and classes
5) daily coverage of planned *teaching schedule and lessons*
6) *complaint, feedback* and *notices* related data
7) *timetable* data

And the other kind of data is one that is fed into the database table which is obtained in a period, at the end of semester and which is derived and calculated from the data described in the above case. The data that pertains to the second type is as following.

1) Data related to student's performance in academics, academic activities, attitude, aptitude, attendance, detention. All the fields are quantified by a scheme, like attitude is a quality, but the value which is provided to it is a numeric out of 100, which is a cumulative percentage of the values obtained by student in his/her assignment submissions, aggregate attendance(for punctuality), feedback values by faculty (which is again a percentage). Hence this way we can represent a qualitative attribute quantitatively.
2) Data related to the class such as its *achievements* (accepts values out of 100), *feedback* and other attributes depicted in Fig. 2, that give knowledge about a class as a whole.
3) Data related to *faculty members*, like their performance figures in past semesters, *feedback* about them by students.

The point to note is that the data either of first type or second, ultimately leads to a dataset that contains values that can be instrumental in generating reports that can lead to development of knowledge regarding any and every entity of desire with in an educational institution

IV. Knowledge Management through EDULOGIC+

The key difference-Data are raw facts, when being organized they become information and knowledge is meaningful information. *Knowledge drives strategy and strategy drives knowledge management.* Thus knowledge should be built and developed over time. In order to efficiently manage the academic activities, the best method is to plan out based on past experiences using KM tools. The previous year's plan and execution give a clearer picture to chalk out a better and more effective plan for the next year. Considering one phase corresponds to one academic-year, at the end of n-phases, maximum efficiency may be attained. After the first phase, planning may be successful up to 60%. By the end of the 2nd phase, success rate up to 80% may be reached [1]. Thus, there is an incremental improvement in the ratio between the percent executed to percent planned. When information is combined with experience and judgment, it becomes knowledge [4]. Knowledge extraction could be performed from the reports and audits generated.

Knowledge Management of Students

Based on the attributes in Student table depicted in Fig. 1, a student could be easily rated as e*xcellent, good, average or poor.* These inferences about the student are not merely based on the data fed into the databases rather the knowledge about

the student is accumulated in the *Tier 2 database tables (data tables at another level whose fields obtain values from the tables at the primary level which will store data that supports reporting)* in course of semesters/years and then the implications on the student's personality are known through the application of working strategy to relate various attribute of data tables in a proper fashion. For each class there is a *Class Mentor,* his job will be primarily to counsel the students and assess them thoroughly on regular basis to score the above mentioned attributes out of 100 for each student.

The table shown in Fig. 1 will be filled up with values given out of 100. The Academics will be filled up by the percentage secured in a semester and the other attributes will be filled by the scores awarded out of 100 by the *Class Mentors* based on their performance in that semester.

Let us take an example and show the working:

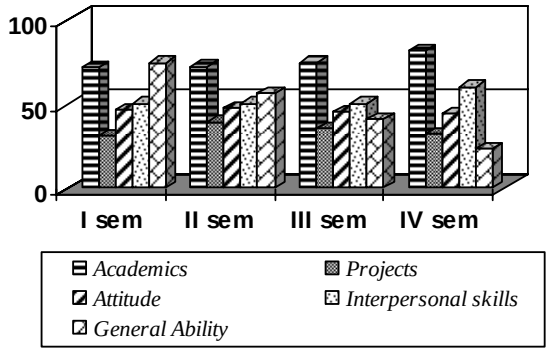


Fig. 5 Bar Graph for student's performance

From the above generated graphics EDULOGIC will be able to categorize the student as *"average"***.** Though the student has secured more than 70% in each quarter but other attributes do not classify him to be graded as "*Good"***.** *Hence in EDULOGIC+ there will be key factors like above for the successive semesters or quarters that will be taken into considerations as an average before generating the final inference about the student.*

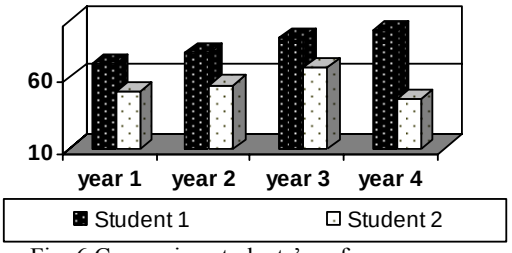


Fig. 6 Comparing students' performances

Let's look at the graph shown in Fig. 6, where performances of two students have been compared year wise. It is clearly visible that we had **data** of the student, and then we have collected that data to have the **information** regarding the student (see in Fig. 5), and from the graph in Fig. 6, we have the **knowledge** that student 1 is improving consistently while the other one's performance is not consistent. Now based upon this knowledge, we can take **decision** that student 2 needs extra help n care to improve and that student 1 is *better* than his counterpart. Various other kinds of knowledge can be obtained from the knowledge bank that develops and enriches year by year, especially useful for the overall assessment of final year students and preparing them for the job placements in the areas where they are weak and make decisions for further improvement.

Knowledge Management of Faculty members

The KM at faculty level will useful for analyzing,

1) Strong subjects and strong abilities/areas of faculty.
2) Capability to deal with various subjects with the same higher level, comparative analysis.
3) Scheduling & Syllabus Coverage efficiency.
4) Performances Benchmarking.

The above listed attributes will correspond to the creation of a *Tier 2 database table for faculty*, which shall hold the essential data to give knowledge about the faculty in the mentioned areas. The faculty member's strong areas will be identified by the outstanding results produced in a particular subject consistently. Of course the information in the tables will generate the faculty's strength in dealing with various subjects with the same level of ease. This shall be helpful in deciding about the subjects to be allocated to the faculty to enhance the quality and quantity of results. This knowledge about strength of faculty in various subjects shall be the guiding beacon in terms of training the faculty members in their weaker areas. The information in the tables about the scheduling of classes and rescheduling them will also be known. This will give the efficiency and vision for faculty in planning. The efficiency of the faculty members will be compared to arrive at a pattern of perfect planning of schedules. The knowledge of results secured in the subjects related to the faculty shall be maintained to grade the faculty.

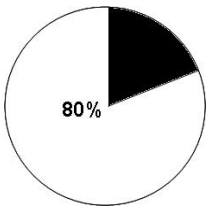


Fig. 7 A **pi-chart** is generated to show the coverage rate for each semester. This % coverage is recorded for each semester and a bar graph is available to give the knowledge of coverage pattern

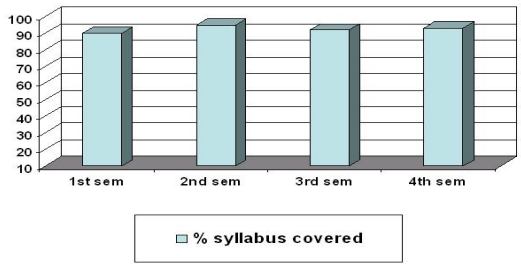
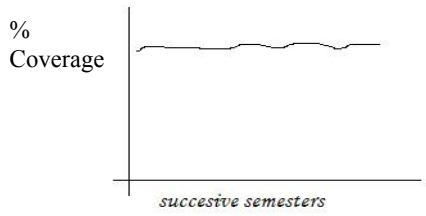
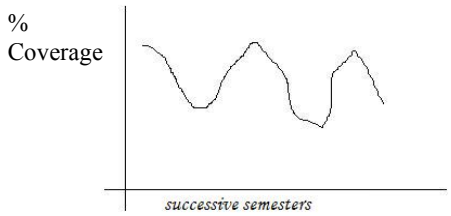


Fig. 8 A Bar graph is generated which shows the cumulative % coverage in all the semesters that give an overview of faculty's coverage efficiency. The above shown graphs are capable of inferring a faculty as *excellent*, *good* and *satisfactory*



(a)



(b)

The graphs in the Fig. 9(a) and Fig. 9(b) respectively, are the final grading graph that shall be grading the faculty. The graph (a) grades *excellent* as the graph suffers only little deviations, but in the case (b) the concerned faculty doesn't exhibit consistency in coverage hence *average grade.*

(2) The bar graphs will be generated as shown below in Fig. 10 that shall give the relative strength of faculty in dealing various subjects.

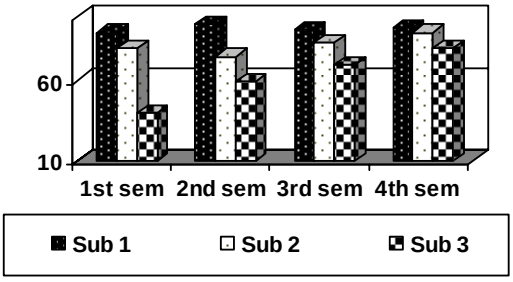


Fig. 10 bar graph representing pass percentages

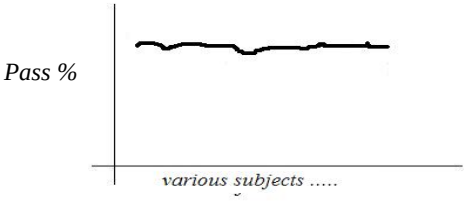


Fig. 11 graph corresponding to bar graph in Fig. 10

The above bar graph will be generated and based on that another graph will be generated whose level of uniformity will indicate the strength of the faculty in handling all the various subjects. As in the above case the faculty has almost above 85% pass percentage in all the 4 subjects he has dealt which corresponds to a uniform graph that reflects consistency in the capability of faculty in handling those different subjects.

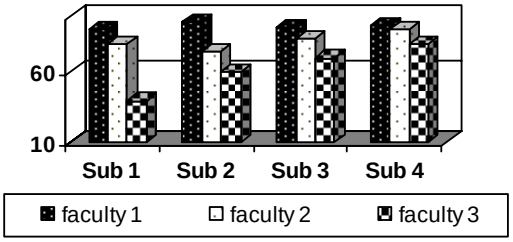


Fig. 12 Bar Graph depicting faculty performance in same subjects

The above bar graph gives the knowledge that faculty 1 has continued to perform better than others in the same subject and that too consistently across all subjects. We also extract the knowledge that Faculty 3 has continued to give poor results comparatively, hence requires counseling and some training.

So this way we can extract lot of knowledge from the various reports generated from the huge information base.

Knowledge Management of Classes

The KM at this level will be done basically for a group rather than any one individual. The various criteria for which the knowledge will be maintained are to visualize

1) Performance
2) Ability to cope with different faculty
3) Miscellaneous achievements
4) Behavior& attitude towards learning

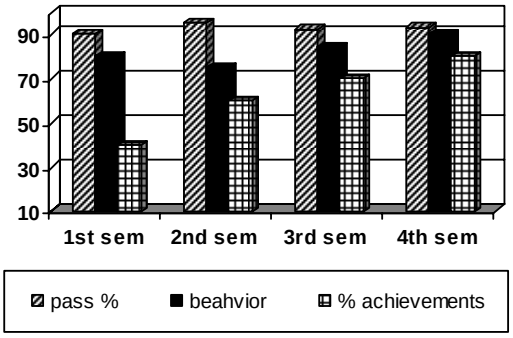


Fig. 13 Bar graph for a class

In the bar graph (in Fig. 13) it is clearly visible that the class is performing well cumulatively. The pass % corresponds to a uniform continuous graph that tells the consistency. The graph for behavior is also suffering fewer deviations and is above 70% satisfactory level.

It will also be possible for a class, to figure out a group of students who are performing consistently and producing good results in all the areas. The cases of weaker groups will also be highlighted.

V. Conclusion

KM is a philosophy which is accomplished through IT as a tool. KM acts as the cornerstone for promoting innovations and sharing the experiences. This paper described successful application of Knowledge Management in quantifying and planning educational activities for better academic management. It is clear from the results that structured education delivery leads to better achievement both by faculty and students. Computer-based planning and management of education delivery becomes an electronic database and knowledge for planning and management in the future. This is a gradual approach, which requires two to three years time to achieve the desired results. Around the core knowledge base gathered by using all the explicit information sources, innovative collaborative process are put into place. And the EDULOGIC+ system aims at the implementing the same to a greater extent.

References

[1] Saini, H. S. & Raviteja 2004 EduLogic – An Educational Software System and Knowledge Management Tool for Quality Education. International Conference on Information Technology in Tertiary Education. Avila Spain, July 16-19, 2004.

[2] Kidwell, Jillinda; Vander, Karen and Johnson, Sandra L. (2000) "Knowledge Management Practices Applying Corporate in Higher Education" EDUCAUSE QUARTERLY, No. 4, pp. 28-33.

[3] Milam H. John (2003) "*Knowledge Management in Higher Education*" – Eric Digest – University of Virginia.

[4] Monaghan, P. (1994) "*Powering Up the Students*." Chronicle of Higher Education, Nov., Pg 19-20.

[5] Petrides A. L. & Nodine R.T.(March 2003), *Knowledge Management in Education – Defining the Landscape*, Institute of Study of Knowledge Management in Education, A Monograph sponsored by SUN MICROSYSTEMS.

[6] Tiwana, A., 1999. Knowledge Management Toolkit, the: Practical Techniques for Building a Knowledge Management System. New York: Putnam. (Posted 12/00).

[7] Neighbors, J.M., "The draw approach to constructing software from reusable components," IEEE transactions of Software Engineering (10:5), September 1984, pp. 564-574.

[8] Emerald (n.d.) Journal of Knowledge Management: the reviewing process. Bradford: MCB University Press, Ltd. Available at: http://www.emeraldinsight.com/journals/jkm/notes.htm [Site visited 16th August 2002].

[9] Knowledge Awareness: Bridging between Shared Knowledge and Collaboration in Sharlok Hiroaki Ogata, Kenji Matsuura, and Yoneo Yano, Dept. of Information Science and Intelligent Systems, Faculty of Engineering, Tokushima University, Japan.