The Use of the Blackboard as a Knowledge Discovery System

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Abstract - This study shows how one can use the blackboard as a knowledge discovery system at a higher education institute. The objective of such system is to monitor student progress and predict their performance in the course to identify at an earlier stage the students in need of the right advising or counseling before they drop out of the course. The system also serves to improve the teaching and assessment quality and assure its alignment with the learning outcomes of the course as the Blackboard discovery system provides information about course usage and activity as well as data on course items that have been aligned to goals.

Keywords: Educational Computing System, Blackboard, Data Discovery System, Data mining, Data analysis.

1 Introduction

The use of the existing e-learning systems and tools in education is not enough for achieving a quality education. Even with the use of very good learning management systems like Moodle and Blackboard and the use of very sophisticated e-learning tools like web publishing tools such as blogs and WordPress, conferencing tools like videos, video conferencing, and communication tools like e-mail and instant messaging, we still need an information system that provides the educator and the management with a system that provides tools for creating and sharing knowledge as well as a multidimensional analytic capabilities that is needed to do all sorts of ad hoc analysis and decision making regarding student, educator and management performance [1, 3, 5, 7, 13]. This system should somehow relate to existing intranets and be part of the Educational Computing System (ECS) which refers to education-oriented information technology that is critical to an educational institute’s operations.

1.1 The Role of Knowledge Management in Higher Education

Academic environment is a treasure of knowledge and knowledge Management (KM) in higher education are the strategic management activities that support educators in using the institute’s knowledge resource to effectively teach and research. These knowledge management practices can help capture, discover, share and apply knowledge in schools through the use of information and communication technologies. Therefore KM makes available for use satisfactory communication channels for educators to debate about important school topics and problems within the academic body, the students and the administration. The feedback from such a debate could be used to develop further strategies and plans to ameliorate school policy and improve teaching effectiveness [5]. These are some of the goals of a knowledge management in higher education [5]:

- KM is a knowledge platform that provides educators with a discussion forum where they can debate ideas concerning their teaching and research work and a place to post their course materials and tools for students to learn.
- KM allows experienced educators to transfer their knowledge to new educators and foster a knowledge sharing culture in the university.
- KM allows teachers and management to use data mining techniques to discover knowledge about student performance, strengths and weaknesses as well as career guidance.

One of the problems with such management information systems is its high cost. Not all higher education institutes are capable of purchasing such a system. One option is for these institutes to use existing system that provide some of the knowledge management system capabilities. The objective of these studies is to give a brief introduction to how such use can take place in a university environment and among educators. But before we embark, let us briefly define what knowledge is and what knowledge management systems are and what knowledge discovery (kd) is.

1.2 What is Knowledge Management and what is Knowledge Discovery?

Knowledge is the information, skills, and understanding that one has gained through learning, observation or experience.

Knowledge management (KM) is described as the tools, techniques, and strategies to retain, analyze, organize, create and share this knowledge [4]. KM associates three fundamental resources of any organization namely people, processes and technologies. The KM processes include knowledge discovery, knowledge capturing, knowledge sharing, and knowledge application [5]. Knowledge Discovery (KD) is the process of developing new tacit or explicit knowledge from data and information or from the synthesis of prior knowledge.
In this short paper, we will focus on how higher education institutes with no or limited access to knowledge management systems could use the blackboard for achieving some knowledge discovery. We will not talk about the other knowledge processes, namely knowledge capture, knowledge sharing, and knowledge application but we will briefly mention how blackboard can be related to educator’s intranets as part of the Educational Computing System (ECS) to support these processes.

For example in the university where I am teaching there is no knowledge management system and not even a learning collaborative system. There is only a Virtual Learning Environment (the blackboard) that is available for both faculty members and students to manage the course tools and provide collaborations between students and educators. There are also educator’s intranets for internal collaboration between the educators and a university web site that provides information about the services offered by the university and access to regulations, forms, and files that the user can use online or download to his computer. The question is “how can we use this Virtual Learning Environment to be able to achieve knowledge discovery?”

The rest of the paper is organized as follows. Section 2 reviews and discusses some existing research work related to knowledge management in higher education. Section 3 describes the knowledge discovery process and how it relates to students, educators, and management. Section 4 describes how the blackboard could be used as a knowledge discovery system. Finally section 5 concludes the paper and presents future directions.

2 Related Work

Knowledge management and knowledge management systems in higher education have been widely studied in the literature [1,5,6,10,11,13,14]

In [1], the author offers a data mining model for higher education system in the university. This model uses decision trees classification algorithm to evaluate student’s performance. The model extracts knowledge to predict students’ performance in final examination and help in identifying at an earlier stage the students in need of a special attention before the drop out of the school. This finding allows the educator to suggest the right advising/counseling. This is an interesting study except that it requires developing the model which might be expensive and time consuming as opposed to using an existing application like the blackboard which is part of most LMSs in the Saudi Arabia Universities. Besides, the blackboard provides other components of a KM system like knowledge capture and sharing. In addition, it does not describe how this model integrates with the existing component of the ECS.

The paper in [14] discusses how to integrate e-Learning systems and Knowledge Management Systems technology to improve the capture, organization and delivery of training courses and corporate knowledge. The author proposes a model for the phases of knowledge management that includes concepts and technology from e-Learning. He then uses the model to illustrate real world scenarios that add increasing amounts of knowledge management to an e-Learning environment. This study however does not address the knowledge discovery component of a KM system and how some of it can be achieved using e-Learning systems like the blackboard. As in the previous study, this paper does not describe how this model integrates with the existing component of the ECS.

3. The Knowledge Discovery Process

In knowledge discovery, one develops new tacit or explicit knowledge from data or information. This new knowledge could also be the result of synthesizing (combining) prior knowledge. The knowledge discovery will explore the opportunities for knowledge discovery in educational data. It will use the data collected from the VLE, to predict future student performance and learn the underlying structure of student knowledge from these datasets. It will also explore the nature of educational data and what factors are important in determining student knowledge.

Examples of educator-student interaction that can lead to knowledge discovery are:

- Educators should supervise student to detect student behaviors that can lead to student dropping or failing the course.
- Educators perform data mining in student test scores in order to identify students’ strengths and weaknesses. He then uses this knowledge to effectively design his instruction tools.

Examples of educator-educator interaction that can lead to knowledge discovery are:

- Educators meeting for time to time (e.g in department and College Board meetings) to assess the overall performance of the students and the amendments that might need to be made to the courses and curriculum.
- Educators assessing the key performance indicators in different subjects and different programs.
- Educators working collectively in research with the opportunity to learn from each other and to help each other.

Examples of student-student interaction that can lead to knowledge discovery are:

- Students participating in discussion boards by posting their views in the discussion forms.
- Students looking at other students research projects and learning from them.
- Students looking at the answers to the assessment and training questions and learning from them.

4. The Blackboard as a Knowledge Discovery System

The Blackboard which is a Virtual Learning Environment (VLE) allows online access to learning materials and
activities. It offers some tools that are known to be used as part of a knowledge management system like wikis, blogs, discussion boards, e-mail, SMS, Journal, etc. [5,12] as well as tools for outcomes rubrics, course analytics, assessment, communication and collaboration through real-time web conferencing and multimedia recording. This study shows how one can use the blackboard as a knowledge discovery system at CBAK to monitor student progress and predict their performance in the course in order to identify at an earlier stage the students in need of the right advising or counseling before they drop out of the course. The system will also serve to improve the teaching and assessment quality and assure its alignment with the learning outcomes of the course. Some of the services that blackboard offers that relate to knowledge management are:

- Publishing the material related to a course.
- Communication between educators and students.
- Collaborating between students and educators using wikis, blogs, and discussion forms.
- Course work submission.
- Online assessments and training of students.

The benefits of the blackboard are as follows:

- Allows easy, anytime anywhere access to course tools including handouts, web links, assessment, training material, reading material etc.
- Allows an easy way to announce course information and deadlines to the members of a course.
- Allows the educator to monitoring and tracking student’s access and progress.

We will now discuss the knowledge management tools offered by blackboard and how it can be used for knowledge discovery. We will concentrate on the use of the blackboard to allow educators to supervise students to detect student behaviors that can lead to student dropping or failing the course and to perform data mining in student test scores in order to identify students’ strengths and weaknesses.

4.1 How to Discover Knowledge using the Blackboard?

To discover knowledge from the blackboard, we mine the existing data concerning student performance and access in each assessment and in the course as a whole. The objective is to identify students’ strengths and weaknesses and to use this knowledge to effectively design his instruction tools. The Blackboard has assessment analysis tools. These tools can be accessed from the course grade center or from the course evaluation center. We will start by the tools we could use from the grade center.

4.1.1 Grade Center

In the left menu bar, go to the grade center rubric and choose the type of assessment you want to analyze (Assignments, Tests, or all Assessments). You will be transferred to that grade center related to the chosen assessment where the grades displayed as a table. By choosing the one of the assessment you want to analyze, a drop down menu will appear that allow you to do the following analysis:

1. Attempt Statistics.
2. View All Attempts.
3. Item Statistics.
5. Grade Report.

**Attempt Statistics**

This option will get you to a page whose title is Test Statistics and provides with the following information about the whole test:

- Total number of attempts for this Test
- Average Attempt Score
- Number of Graded Attempts
- Number Attempts that Need Grading

This option also provides information about the individual questions:

- For each multiple choice questions, it provides the percentage of students per choice (the percentage of students who selected the first choice, the percentage of students who selected the second choice, etc.). This is important as it tells you whether the question was a good question or no. When most students have selected an incorrect choice for a given question, you should find the clue to why this happened and what could have possibly gone wrong in the lecture or tutorial. It may also be that the question needs re-wording as it was misunderstood by the majority of students.
- In the multiple answer questions, the system gives you information about the percent of correct and incorrect answer for each answer. Here again if most of the students chose a wrong answer then this might be an indicator of a mistake in delivering the knowledge related to that part of the lesson.
- In the fill in the blanks, the system gives you information about the percentage of correct and partially correct answers and for each correct answer, the attempt count as percentage of total attempts. This might be a clue to a general misunderstanding of the blank if is not the correct one.

**View All Attempts**

This option will provide for each student the number of attempts, the date of the attempt, whether the attempt was completed or not and if so the duration of the attempt. This could be used to determine whether the time allotted to a test is a reasonable one.

**Item Analysis**

This option will provide test summary that includes test discrimination and test difficulty. Test discrimination is used to test good, fair and poor question effectiveness at discriminating those who know the content from those who do not. It explains the degree to which students with high test
scores scored in good, fair, and poor questions [15]. An example of an analysis is this:

9 Good Questions Discrimination > 0.3
1 Fair Questions Discrimination = 0.1 to 0.3
1 Poor Questions Discrimination < 0.1
0 Cannot Calculate

If the discrimination value is higher than 0, the question is a good one. If the discrimination is between 0.1 and 0.3, the question is a fair question and if the discrimination is less than 0.1, it is a poor question. In addition this option provides the degree of difficulty of the questions based on student scores. If 80% of the students were able to answer the question that it is an easy question. If 30% to 80% of the students answered a question, the question is a medium question. If only 30% of the student or less answered a question, it is a hard question. An example of an analysis is this:

4 Easy Questions Difficulty > 80%
2 Medium Questions Difficulty = 30% to 80%
5 Hard Questions Difficulty < 30%

In the same window detailed information about each question is given. It provides for each question the discrimination value, the difficulty value, the average score along with the standard deviation and standard error. By clicking on any question in the list, the system gives more information about the question concerning for example the number of times a particular answer was chosen etc. One can also select to view the poor questions only. This will allow you to modify these questions or understand why their discrimination value is low. The same could be done about the difficulty of the questions. You can use this information to improve questions for future test or to adjust credit on current attempts. Fig 1 illustrates the result of item analysis for one of the tests I was administrating to my student in the MIS department.

**Column Statistics**

This option allows users to view statistics about students’ performance in a test. Students who are unavailable are not included in column statistics. The information provided with this tool is described in the table 1.

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Status Distribution</th>
<th>Grade Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Minimum Value</td>
<td>9.00</td>
<td>More than 100</td>
</tr>
<tr>
<td>Maximum Value</td>
<td>10.00</td>
<td>90 - 100</td>
</tr>
<tr>
<td>Range</td>
<td>1.00</td>
<td>Needs Grading</td>
</tr>
<tr>
<td>Average</td>
<td>9.89</td>
<td>80 - 89</td>
</tr>
<tr>
<td>Median</td>
<td>10.00</td>
<td>Exempt</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>0.31</td>
<td>70 - 79</td>
</tr>
<tr>
<td>Variance</td>
<td>0.10</td>
<td>60 - 69</td>
</tr>
<tr>
<td>Less than 0</td>
<td>0</td>
<td>50 - 59</td>
</tr>
<tr>
<td>0 - 9</td>
<td>0</td>
<td>40 - 49</td>
</tr>
<tr>
<td>20 - 29</td>
<td>0</td>
<td>30 - 39</td>
</tr>
<tr>
<td>10 - 19</td>
<td>0</td>
<td>20 - 29</td>
</tr>
<tr>
<td>Less than 0</td>
<td>0</td>
<td>10 - 19</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>
Grade Report
In the Grade Center for any type of assessment or in the full grade center, one can click on the report menu and choose the create report option. Once the required information is filled, one can run the report. Example of the information one needs to provide includes the student names and the assessment you want to report on (one can choose multiple students and multiple assessments or all students and all assessments). The system will allow you to include some simple statistics concerning the course (Average, Mean). The result would be similar to what is illustrated in Fig 2.

![Print Report]

**Quiz Report for OTHMAN MOHAMMED ALASMARI.**

<table>
<thead>
<tr>
<th>Item</th>
<th>Grade</th>
<th>Average</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Quiz</td>
<td>4.50</td>
<td>3.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Second Quiz</td>
<td>3.00</td>
<td>4.37</td>
<td>3.00</td>
</tr>
<tr>
<td>Third Quiz</td>
<td>5.00</td>
<td>4.13</td>
<td>5.00</td>
</tr>
<tr>
<td>Fourth Quiz</td>
<td>5.00</td>
<td>4.39</td>
<td>5.00</td>
</tr>
<tr>
<td>Fifth Quiz</td>
<td>-</td>
<td>3.39</td>
<td>3.50</td>
</tr>
<tr>
<td>Seventh Quiz</td>
<td>3.00</td>
<td>1.77</td>
<td>2.00</td>
</tr>
<tr>
<td>Sixth Quiz</td>
<td>-</td>
<td>3.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Eighth Quiz</td>
<td>4.00</td>
<td>3.67</td>
<td>4.00</td>
</tr>
<tr>
<td>Ninth Quiz</td>
<td>-</td>
<td>3.17</td>
<td>3.00</td>
</tr>
</tbody>
</table>

Fig.2. This figure illustrates the grade report for the student Othman Mohammed Alasmari on 9 quizzes.

4.1.2 Evaluation Center
Blackboard has also an evaluation center that allows you to monitor student overall performance. The evaluation center includes the following:
1. Course Reports
2. Performance Dashboard
3. Retention Center

Course Reports
One can run several types of course reports to view information about course usage and activity. You can view summaries of course usage such as which course areas are used most frequently and course access patterns for specific students. Basically you can:

- Display a summary of all user activity inside content areas for a course. One could use this report to determine which students are active in your course and which content areas they use.
- Display overall activity within a single course, sorted by student and date. Data includes the total and average time spent per active student and the total amount and type of activity each student had in the course. Optionally, you can filter the report by one or more groups. Only students who are members of the selected groups are included in report results. Again this information could be used to increase the course activities that are most popular with the students.
- Display data on course items that have been aligned to goals. This is very important in discovering the course coverage by determining which course activities are more within the learning outcomes of the course and which learning outcomes were never covered or were covered very little by the different course activities.
- Display how a single course performs against a selected set of goals. One can use this information either to change the course activities or the course goals.
- Display the overall summary of user activity for all areas of your course, as well as activity dates, times, and days of the week. One can use this report to view student access as well as how often course activities are performed.
- Displays the number of user submissions in your course for assignments, tests, discussions, blogs, and journals within the chosen time frame. If no activity exists for an item type, no column appears. If no students submitted an assignment in the chosen time frame, no assignment column appears in the report.
- Display an individual student's activity within your course, sorted by date. Data includes the total overall time a student spent in your course. You can view detailed information about a student's activity, such as which items and content areas a student accessed and the time spent on each. Use this report to check a certain student's course activity.
- Display a summary of user activity in discussion forums in your course.
- Display a summary of user activity in groups for your course.
Retention Center

The Retention Center provides an easy way for the educator to discover which students in the course are at risk. One can also keep track of patterns over time. The patterns include Missed deadlines, Grade alerts, Activity alert, Access Alert. By clicking on one of the patterns for a particular student, you get more information about student behavior in that pattern. This allows you to take the necessary actions to remedy the student risk. If you click on the name of a student at risk, it gives you more information about him. You can choose to monitor him by clicking on the monitor button or notify him by sending a message like “Your activity and performance levels have triggered an alert from this course. Please contact your instructor for details.” The retention center can be customized by choosing the activities you want to monitor. These activities are included in this table.

<table>
<thead>
<tr>
<th>Name of Activity</th>
<th>Type of Activity</th>
<th>Criteria of Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default Activity Rule</td>
<td>Course Activity</td>
<td>Activity in the last 1 week(s) is 20% below course average</td>
</tr>
<tr>
<td>Default Course Access Rule</td>
<td>Course Access</td>
<td>Last access more than 5 day(s) ago</td>
</tr>
<tr>
<td>Default Grade Rule</td>
<td>Grade</td>
<td>External Grade is 25% below class average</td>
</tr>
<tr>
<td>Default Missed Deadline Rule</td>
<td>Missed Deadline</td>
<td>1 deadline(s) have been missed by more than 0 days</td>
</tr>
</tbody>
</table>

5. Conclusions

In this short study, we explained why knowledge discovery is important in higher education and tried to show how the Blackboard could be used for knowledge discovery. We showed that the objective of such use is twofold. First the knowledge discovery system of the blackboard allows monitoring student progress and predicting their performance in the course to identify at an earlier stage the students in need of the right advising or counseling before they drop out of the course. Second, the Blackboard knowledge discovery system allows educators to retrieve information about course usage and activity as well as data on course items that have been aligned to goals. This is very important as it allows educators to build better courses and better course assessments. In the future, we will show how this system can be integrated with educator intranets to visually display student performance so as to have a more sophisticated performance dashboard or even better a balanced score board to allow for visual analysis of student performance and the alignment of course activities with the course learning outcomes. We will also how this integration with educator intranets can provide the institute with a knowledge management system that provides knowledge capturing, sharing, and application processes in addition to the knowledge discovery process. This whole system will be an essential part of the Educational Computing System (ECS).

5. References