Abstract: Quality of eLearning components is becoming a key issue in a virtual learning environment. The main objective of this research is to provide educators and content experts a better understanding of the significance of usage of Learning Objects (LOs) or core components provided in an eLearning courseware. Most significant outcome of this research is to share statistical techniques to analyze the usage of various learning objects (LOs) or components for improving the quality of eLearning courseware. This research will be accomplished by capturing the student’s conference data through the activity logs and reports available in a Learning Management System (LMS). For the purposes of this work, Moodle, an open-source platform being used to host the eLearning programs at Assumption University will be utilized. The raw conference data about various learning objects (LOs) or components provided in four M.S. (ICT) courses will be collected through *activity logs* and *reports* for two semesters. The captured data will be processed and statistically analyzed for usage patterns of various components. The results will be used for developing a framework for evaluating the usage of learning objects (LOs) or components in an eLearning course. The outcomes will also be used to improve learning objects (LOs) or components in an eLearning courseware.

Keywords: eLearning, Framework, Learning Management System (LMS), Interactivity, Reports, Virtual Learning Environment (VLE)

1. Introduction- Learning Management Systems (LMSs)
In the increasing market of eLearning there are many software applications that can be used to create a virtual classroom. Some of these software platforms are open source products, others are commercial solutions. Angel, Sakai, WebCT, Blackboard and MOODLE\(^1\) are few examples of popular software platforms being used by thousands of organizations, businesses and universities worldwide.

\(^1\) MOODLE is one of the license free open-source software platform widely used by the universities. MOODLE is an acronym for Modular Object-Oriented Dynamic Learning Environment. Those involved with eLearning also call it as a Virtual Learning Environment (VLE)).
In the world of eLearning, words such as Virtual Learning Environment (VLE) and Learning Management System (LMS) are used interchangeably. But both are designed to help instructors, educators, and content experts design online learning material with opportunities for rich interaction. Modular design of an LMS allows the universities to design and add their own learning components to enhance eLearning strategies. This has contributed towards rapid growth, development, and adoption of various open-source LMS worldwide.

Learning Management System (LMS)'s infrastructure supports many types of plug-ins such as Activities, Resource types, Question types, Data field types (for the database activity), Graphical themes, Authentication methods, Enrollment methods, Content Filters and Reports. Many third-party solutions are also available. Champion mentioned that all Learning Management Systems (LMSs) are useful in outcomes-based learning environments that could be better understood through reports and activity logs of a courseware hosted on the system.

1.1 Learning Objects (LOs) in a Virtual Learning Environment (VLE)

Virtual Learning Environments (VLE) are defined as computer-based environments that are relatively open systems, allowing interactions and knowledge sharing with other participants and instructors and provide access to a wide range of components hosted on the system. The value of a VLE is to fully enable "learning anywhere at any time" by providing an array of learning objects (LOs) or components, opportunities for active participation, mastering content and self-learning. A learning object (LO) in a virtual learning environment is usually defined as any entity, digital or non-digital that may be used for education and learning. It is also called as web-based interactive chunks or parts of eLearning courseware designed to explain a stand-alone learning objective. An LMS has become the prime model of an interactive system. McMillan (2005) states that interactivity can occur at many different levels and degrees of engagement and that it is important to differentiate between these levels. User-to-system interactivity is at the core of this work. In an eLearning environment a digitized entity can be used, reused or referenced many times during the learning process. However, there is general consensus that a learning object (LO) should be:

- **Reusable**: can be modified and versioned for different courses,
- **Accessible**: indexed and retrieved using metadata
- **Interoperable/Portable**: operate across different hardware/software
- **Durable**: remain intact across upgrades of hardware/software

As a complement, the learning object (LO) should also have a measurable component of information which helps its identification, storage, and recovery through a database.

2. Research Method

Why measure usage of learning objects (LOs) or components given in an eLearning courseware? Because without data we only have opinions about the usage of courseware components. Why analyze the systems LMS reports and
activity logs? Because the data collected in a LMS logs can help us understand interactivity in a VLE and it can be further used to shape our decisions. Why use LOs for measurement their usage in a VLE? Measurement and analysis involves gathering quantitative data about products, processes, and projects and analyzing such data can help influence our actions and plans. Learning objects (LOs) constitute the core components of a eLearning courseware. Quantitative measurement and analysis allow us to-

- Characterize, or gain better understanding of our processes, products, components, and environments
- Evaluate, to determine the status of courseware with respect to our plans
- Predict, by understanding relationships among processes and products so the values we observe for some attributes can be used to predict others
- Improve, by identifying roadblocks, root causes, inefficiencies, and other opportunities for improvement

2.1. Research Questions and Data Collection Tools
As mentioned above, one of the main objectives of this research is to describe the use of an automated, static, multi-browser, visualization tool called Reports, which depicts the pattern of the interaction between the students and various learning objects (LOs) of a courseware in an asynchronous conference. Statistics provided by the Reports can be used for motivating students and building more robust and interactive content in a courseware. The two main variables of the Report consist of view and post whose individual properties are described below.

For views and posts, the views simply means that the data about access to an learning object (LO) or component doesn't get saved into the database, An
example of *views* is that a student logs on to the system and watches an online video for a particular chapter or just views the power-point slides for a chapter. Whereas all data about the *posts* means anything new that is created and uploaded does (forum posts, assessment uploads, etc.) get saved in the database. An example of *posts* will be that a student submitted or uploaded an assignment or a quiz.

**2.2 Accessing System Reports & Logs**

The Learning Management System (LMS) in its menu provides a set of tools to evaluate the progress of an eLearning course. In case of MOODLE, the browser interface as shown in Figure-1 provides a list of tools in its menu given on the left. Clicking on the *Reports* takes the instructor to a menu shown in Figure-2. After selecting “All activity (views and posts) Students” an instructor is taken to the next page where he or she can access all the data about the course.

![Figure-2 LMS Interface for accessing Reports](image)

For each course the *Reports* provides statistics using three fields- Course, Reports Type and Time Period-last. The drop down menu can be also used to examine “All activity (All roles)” to get a comprehensive picture of interactivity in an eLearning courseware.

**2.3 Scope and Sample Courses**

For this preliminary study the authors used *Reports* generated for four sample ICT courses offered at College of Internet Distance Education (CIDE) to analyze the *views-posts* data to examine the level of interactivity. The details of the *views* and *posts* for four eLearning courses are given in Table-1. Theses four courses included a total of 30 students who accessed various learning objects (LOs) hosted in the Moodle. For the purposes of this paper the collection of data started on September 5 and ended on December 19, 2009. The actual titles of the ICT
courses and details about students have been removed to accommodate concerns about privacy of information.

Table-1 Ratio of Views to Posts & Correlation

<table>
<thead>
<tr>
<th>Course</th>
<th>Views</th>
<th>Post</th>
<th>Total Log Size</th>
<th>Ratio (V to P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT-1</td>
<td>742</td>
<td>9</td>
<td>751</td>
<td>82</td>
</tr>
<tr>
<td>ICT-2</td>
<td>3719</td>
<td>258</td>
<td>3977</td>
<td>14</td>
</tr>
<tr>
<td>ICT-3</td>
<td>2216</td>
<td>81</td>
<td>2297</td>
<td>27</td>
</tr>
<tr>
<td>ICT-4</td>
<td>3238</td>
<td>37</td>
<td>3275</td>
<td>88</td>
</tr>
</tbody>
</table>

Correlation = 0.704469

3. Data Analysis

Data collected through the reports and activity logs have been processed and analyzed using Microsoft Excel and SPSS, two main statistical tools often used.

3.1 View & Post Ratio and Correlation

Careful examination of data given in Table-1 shows a wide range of values for views and posts for the four classes included in the sample. ICT-1 shows the lowest values for both variables. ICT-2 shows the highest values for both views and posts. However, the ratio of views and posts is very close for the ICT-1 and ICT-4 classes. Figure-3 shows the graph derived from the data in the Table-1. From the given graph it is easy to make an observation that level of engagement in ICT-1 and ICT-4 is lesser then what is seen in other two classes. By further examination of the activity log it is clear that the resource view for learning objects (LOs), such as video, audio or power point slides is lowest in ICT-1. The total count in the log is given in the column 3 of the Table-1. ICT-2 has the maximum entries (3977) in the activity logs. For lack of space the details of activity logs for all the four classes are not included here. However, a partial sample file of the ICT-2 activity log is given in Table-2.

Table-2 Partial Data from Activity Log

<table>
<thead>
<tr>
<th>Course</th>
<th>Time</th>
<th>IP Address</th>
<th>Full name</th>
<th>Action</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT_2</td>
<td>2009 December 20 7:31</td>
<td>203.158.118.15</td>
<td>Student_2</td>
<td>resource view</td>
<td>Audio Lecture</td>
</tr>
<tr>
<td>ICT_2</td>
<td>2009 December 20 7:28</td>
<td>203.158.118.15</td>
<td>Student_2</td>
<td>resource view</td>
<td>Audio Lecture (2)</td>
</tr>
<tr>
<td>ICT_2</td>
<td>2009 December 20 7:25</td>
<td>203.158.118.15</td>
<td>Student_2</td>
<td>resource view</td>
<td>Audio Lecture (1)</td>
</tr>
<tr>
<td>ICT_2</td>
<td>2009 December 20 7:20</td>
<td>203.158.118.15</td>
<td>Student_2</td>
<td>resource view</td>
<td>Audio Lecture</td>
</tr>
<tr>
<td>ICT_2</td>
<td>2009 December 20 7:19</td>
<td>203.158.118.15</td>
<td>Student_2</td>
<td>resource view</td>
<td>Lecture Note - Unit 12</td>
</tr>
<tr>
<td>ICT_2</td>
<td>2009 December 20 7:17</td>
<td>203.158.118.15</td>
<td>Student_2</td>
<td>resource view</td>
<td>Lecture Note - Unit 12</td>
</tr>
<tr>
<td>ICT_2</td>
<td>2009 December 20 7:17</td>
<td>203.158.118.15</td>
<td>Student_2</td>
<td>resource view</td>
<td>Lecture Note - Unit 12</td>
</tr>
<tr>
<td>ICT_2</td>
<td>2009 December 20 7:15</td>
<td>203.158.118.15</td>
<td>Student_2</td>
<td>resource view</td>
<td>Audio Lecture</td>
</tr>
<tr>
<td>ICT_2</td>
<td>2009 December 20 7:14</td>
<td>203.158.118.15</td>
<td>Student_2</td>
<td>resource view</td>
<td>Audio Lecture</td>
</tr>
</tbody>
</table>
The correlation coefficient is a statistical measure of relationship between variables ranging from -1.00 (a perfect negative relationship) to 0.00 (no relationship) to +1.00 (a perfect positive relationship).

![Figure-3 View & Posts for 4 Classes](image)

This work assumes that views are almost mandatory in an eLearning course and hence it can be labeled as an independent variable. Activities dependent on and generated from posts can be classified as dependent variable. The data derived from Reports for the four ICT classes show a weak but a positive correlation value of 0.704469 which is a sufficient proof of relationship between the two variables, views and posts. Figure-4 given below illustrates the view and post values for the sixteen week of the activities in the four ICT classes. The Figure-4 also shows uneven activities throughout the 16 week period of the class. The beginning of the semester, the midterm during 6th and 7th week and last two weeks of semester approaching final examination shows a spike in on-line activities in all four courses. So as to provide a better visual of the varying activities in the four classes same data is represented in the coverage area graph in Figure 5.

![Figure-4 16-Week Activity for Four Classes- View & Posts](image)
As shown in Figure-3 both instructor as well as the students can access these reports for examining their own activities for each course. The statistics provided by the reports enables assessment of triangular relationship between learning objects (LOs) online participation and interactivity based on usage. The details of the activities are extracted from the database and displayed in graphical format in a browser as shown in Figure-4.

3.2 Proposed 7-Stage Framework for improving quality of eLearning courseware

Based on the current practices in eLearning as well as the results of this work a new framework for evaluating the life cycle of a courseware is proposed. This 7-Stage framework in some way is similar to 6-Sigma process. One of the key elements of Six Sigma is the use of measurement and analysis of data for process improvement. In Six Sigma low usage of a product would be seen as something happening due to “defects.”
The first three stages proposed framework requires collection of data through *Reports* and *Activity logs*. This should be an ongoing process so that a large data set is available for analysis. Larger the data set more valid and reliable will be the outcomes of the statistical analysis.

### 4. Conclusions

A well designed eLearning courseware should provide ample opportunities for usage of its core learning objects or resources which can increase the flexibility of learning while keeping the participants engaged. The Figures 3-6 discussed above gives a glimpse of weekly pattern of *views* and *posts* for four ICT course hosted on the Learning Management System (LMS). Pedagogical studies in eLearning have revealed that a meaningful and effective interaction with learning objects (LO) in a VLE system enhances the learning experiences. The proposed framework given in Figure-7 lists the seven stages for evaluating the life cycle of a eLearning course, in a way to assists the instructor to understand several important indicators without any further investigation or research. Such indicators are based on-

1. Information in reports and activity logs in a Learning Management System (LMS) can be collected through Stage 1-3.
2. Usage data about various objects or resources provided in a courseware can be processed through Stage 4-6.
3. Statistical results and analysis to take proactive action to modify or change the nature of objects or resources through Stage 7.

These results along with data derived from views and posts is crucial for understanding the usage of learning objects or components of an eLearning program. Incorporating Six Sigma terminology we can assume that there are “defects” in these objects or components. Then the next question is- what should be done when the data indicate under usage of learning objects or components in a courseware? Stage 7 proposes setting up a process to improve learning objects (LOs). This last stage should include reorganizing and refining learning components and creating new benchmarks for ongoing quality assessment of all components in a eLearning courseware.

References


