User Interactions Analysis on a Moodle-based Online Learning Management System during Pandemic

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Keywords: Academic, Moodle, Learning Management System, Pandemic.

Abstract: The Covid19 pandemic in Indonesia has provided a concise overview and practical understanding of how technology might aid educational continuity. This pandemic presents a unique challenge for academic innovation in establishing the optimum technology-based distribution strategy. Moodle was one of the most popular LMS sites for providing an online learning experience during the pandemic. However, not all educational institutions are subject to the government's online learning model. This study uses a sample dataset from Moodle, a learning management system (LMS) platform used in the odd semester of 2020/2021. Start on September 21, 2020, until February 5, 2021. During the study, data was collected from only three departments at Universitas Kristen Maranatha. According to the statistics, the Informatics Engineering undergraduate department student interacts with LMS for 17200 hours and 11455 times throughout a semester.

1 INTRODUCTION

In March 2020, most universities and educational institutions shuttered to limit the COVID-19 outbreak, which was quickly followed by the launch of online education (Alghamdi, 2021). However, as previously reported by Abidah et al. (Abidah, Hidaayatullaah, Simamora, Fehabutar, & Mutakinati, 2020), not all educational institutions are prepared to face the government's online learning model.

It has been a year since all the learning completed working online. Universities have adjusted all restrictions to the use of technology as an alternative learning technique, according to prior research by Abidah et al. (Abidah et al., 2020). Online learning processes are regulated by higher education institutions, which include lecturers' growing grasp of online learning technologies. Both asynchronous and synchronous implementations should be usable and well-assembled in the online learning environment.

In synchronous e-Learning, the educational and learning process that students go through in a natural context is virtualized. Technology such as electronic board apps, live chat applications, and video conferencing systems, all available through an LMS, are used in the learning process. The learning activity is timed, and everyone must be logged in at the same time. Asynchronous e-Learning, on the other hand, is a type of online learning. Students take part in learning exercises that the teacher fictionalizes at their leisure, and they have access to the resources that have been provided to them (Ülker & Yılmaz, 2016).

As indicated in prior research by Deepak Kc (KC, 2017), students and lecturers gain from accessing the LMS, the primary platform for lectures, directly during learning activities, also known as an online learning management system. Furthermore, the system would serve as the principal means of disseminating books, teaching, learning services, and other online information. As stated in table 1, both teaching techniques are based on Daniel Stanford's quadrant of Internet bandwidth usage.

Using learning platforms, particularly Moodle, can be driven from various viewpoints from an academic standpoint. Individuals will, for example, customize the appearance of the course, resulting in a more pleasant and inspiring learning environment. (Sayco Evale, 2017). On the other hand, formal online education offers enormous potential to expand access to higher education and diversify the student

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Suteja, B. and Handaya, W.
User Interactions Analysis on a Moodle-based Online Learning Management System during Pandemic.
DOI: 10.5220/0010753100003113
In *Proceedings of the 1st International Conference on Emerging Issues in Technology, Engineering and Science (ICE-TES 2021)*, pages 314-319
ISBN: 978-989-758-601-9

population. Furthermore, different students and levels of education are transforming the learning environment by including digital content and activities that stimulate cooperation and connectedness (Mohd Kasim & Khalid, 2016).

Table 1: Bandwidth Immediacy Matrix.

No	Spectrum of Internet connection strength	Categories of Activities
1	Low immediacy and high bandwidth	• Pre-recorded video • Pre-recorded audio • Asynchronous Discussions with Video • Asynchronous Discussions with Audio
2	High immediacy and high bandwidth	• Video conferences • Audio conferences
3	Low immediacy and high bandwidth	• Discussion boards with text and images • Readings with text and images • Email
4	High immediacy and low bandwidth	• Collaborative documents • Group chat and messaging

This epidemic period will train and instill the habit of becoming independent learners who continue to build and improve online activities through various online classes or webinars attended by students (Sadeghi, 2019). In addition, students will work together to solve problems and address real-world difficulties. When it comes to imparting education, this circumstance is difficult for both students and lecturers, as lecturers must ensure that students understand the topic. As a result, institutions frequently employ open-source learning management systems such as Moodle (Modular Object-Oriented Dynamic Learning Environment) (Juárez Santiago et al., 2020).

This study uses a sample dataset from Moodle, a learning management system (LMS) platform used in the odd semester of 2020/2021. Start on September 21, 2020, until February 5, 2021. This study examines how MOODLE LMS's extensive data analysis may be utilized to analyze the degree of interaction between academic civitas in a department during complete online learning.

2 METHODS

Any exceptionally vast and complex piece of data is referred to as "big data." Because of their size, all of these enormous data constitute a high-value perspective on student behavior for numerous education research domains, according to Fischer et al. in a previously published (Fischer et al., 2020). It is, therefore, critical to include it in the earliest and continuous stages of learning (Ruiz-Palmero, Colomo-Magaña, Ríos-Ariza, & Gómez-García, 2020).

The characteristics of Big Data are as follows:

a. Volume
   There are many numbers to go through.
b. Velocity
   Data is received at a rapid speed and can be used instantly.
c. Variety
   Traditional data styles are often standardized. The amount of unstructured data grows in tandem with the amount of structured data.

There are 185 tables in the Moodle Learning Management System. One table, for example, is utilized as log data for all activities performed when using the LMS in online learning activities. As seen in Figure 1, log data will become increasingly valuable as LMSs are increasingly employed for online learning. As a result, data can be collected, aggregated, analyzed, categorized, and learned so that it can be used to study the behavior of digital technology users.

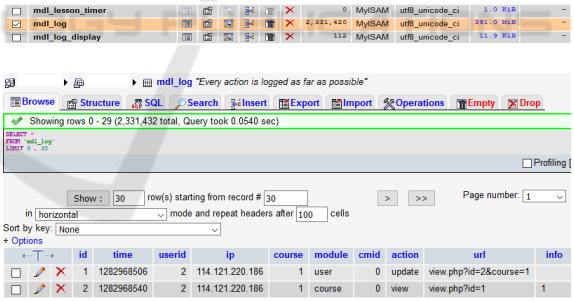

Figure 1: Data Log for Moodle.

2.1 Entity Relationship

It is essential to log in to analysis, reporting, and analytics. Moodle can keep track of all user activity data, allowing for intelligent, evidence-based decisions. The researcher, for example, will look to check if a user has accessed a specific course, signed in, or logged out of the system.

This study analyzed learning data using Moodle log data (Rapanta, Botturi, Goodyear, Guàrdia, & Koole, 2020). Most of this study is focused on entity relationships. The entity-relationship model is used

for logging data. As seen in figure 2, a user, who in this situation could be an instructor, student, or administrator, will be registered numerous times in the log table.

Figure 2: Relationship between the Log Entity and the User.

The log table has ten fields: id, time, userid, ip, path, module, cmid, action, url, and data. The components that can be employed in this study are time, userid, ip, and activity. The userid will be associated with the user table to determine the identity of the access viewer. The IP will be used to determine the location of the user's access, and the behavior involving the operation or contact from the user to the LMS will all be used to determine the access case. Figure 3 shows the log table structure of the Moodle LMS database.

Field	Type
id	bigint(10)
time	bigint(10)
userid	bigint(10)
ip	varchar(15)
course	bigint(10)
module	varchar(20)
cmid	bigint(10)
action	varchar(40)
url	varchar(100)
info	varchar(255)

Figure 3: Structure of a Log Table.

2.2 Data Iteration

A UNIX-timestamp time field in the log table can be utilized to read the log data. The Unix-time stamp represents the number of seconds since Unix was created on January 1, 1970. This Unix time must first be converted before it can be used to compare the time conditions of log data retrieval. In the analysis, IP addresses were also employed as a component of time. As a result, the IP address and time of the user are utilized to group them. The overall number of user interactions and their length will be calculated using this classification. However, first and foremost, a method for retrieving user interaction data from the Moodle LMS is required:

1. View all log data recordings from September 21, 2020, until February 5, 2021.
   Here is the SQL command that was used:

```
SELECT mdl_log.userid, mdl_user.username,
mdl_user.firstname, mdl_user.lastname
FROM mdl_log, mdl_user WHERE
mdl_log.userid = mdl_user.id and
FROM_UNIXTIME (mdl_log.time,'%Y-%m-%d
%H:%i:%s') between :starttime and
:endtime group by mdl_log.userid order
by mdl_log.time
```

2. Each user id is utilized to construct time and IP groupings from each iteration, allowing the LMS system to calculate the number of interactions from that IP.
   Here is an example of a SQL command:

```
SELECT FROM_UNIXTIME
(mdl_log.time,'%Y-%m-%d'),
mdl_log.ip, count(mdl_log.ip) FROM
mdl_log WHERE
FROM_UNIXTIME(mdl_log.time,'%Y-%m-%d
%H:%i:%s') between :awal and :akhir
and mdl_log.userid=:id group by
FROM_UNIXTIME(mdl_log.time,'%Y-%m-
%d'),mdl_log.ip order by mdl_log.time,
mdl_log.ip
```

3. Perform the shelter's stage over a while and with various user activities or interactions—formulas for calculating time differences.
   $\Delta t = t1 - t0$, as seen in figure 4.

Figure 4: Interaction time detection.

Where Ta is the amount of Δt:

$$\text{First Iteration: } \Delta t = t1 - t0 \quad (1)$$
$$\text{Second Iteration: } \Delta t = t2 - t1 \quad (2)$$

Where Tb is the sum of Δt:

$$\text{First Iteration: } \Delta t = t1 - t0 \quad (3)$$

The total interaction time:

$$Ta + Tb \quad (4)$$

The SQL command that was used:

```
SELECT mdl_log.action,
FROM_UNIXTIME(mdl_log.time,'%Y-%m-%d
%H:%i:%s') as wkt FROM mdl_log WHERE
FROM_UNIXTIME(mdl_log.time,'%Y-%m-
%d')=:wkt and mdl_log.ip=:ip and
mdl_log.userid=:id order by
mdl_log.time
```

3 RESULTS AND DISCUSSION

This study aims to determine the number of interactions and periods users communicate with the LMS system. Detection can be used to evaluate the interactions of administrators, instructors, students, or a combination of these groups, all the way up to the entire user. A visualization illustration from a computer science postgraduate department is shown in Figure 5.

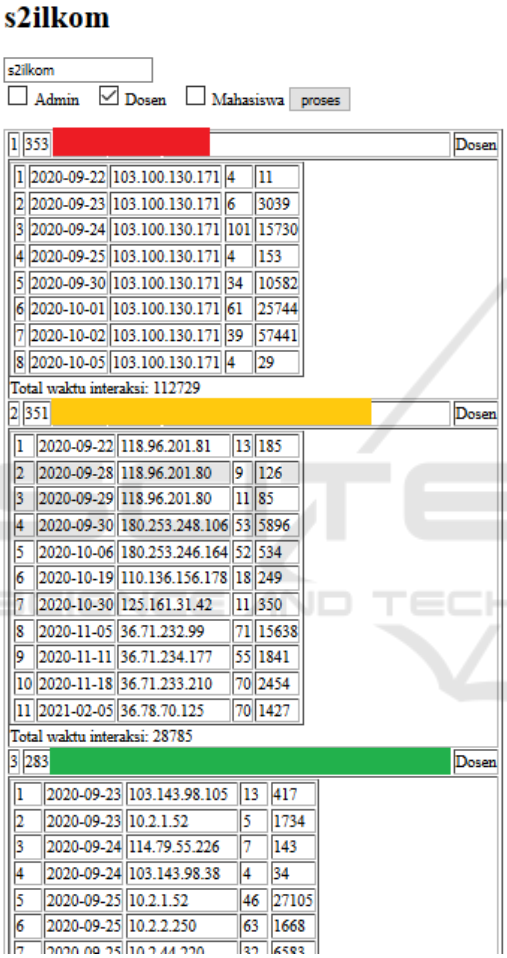

Figure 5: Output samples for interaction time detection.

The instructor interacted with the device 11 times during the odd semester 2020/2021. The most interactions 71 times occurred on November 5, 2020, for 15638 seconds, equivalent of 4.34 hours on the day, and from an IP address of 36.71.232.99. Figure 6 displays a more detailed visualization.

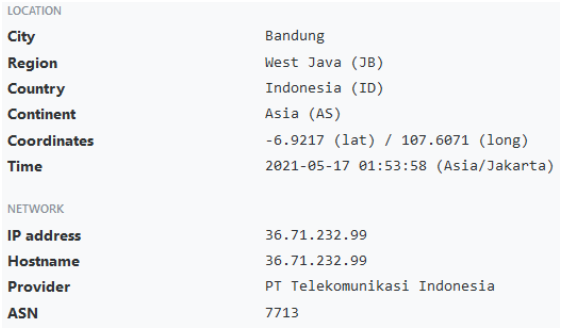

Figure 6: Examples of user login activity logs.

Figure 7 shows the lecturer's involvement time with the LMS system based on log data acquired from the Computer Science postgraduate department.

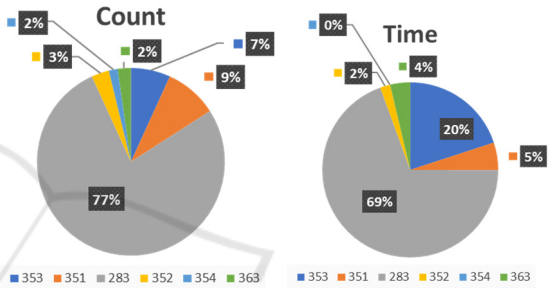

Figure 7: Time spent interacting with the lecturer.

Figure 8 displays the length of time students spent interacting with the LMS system.

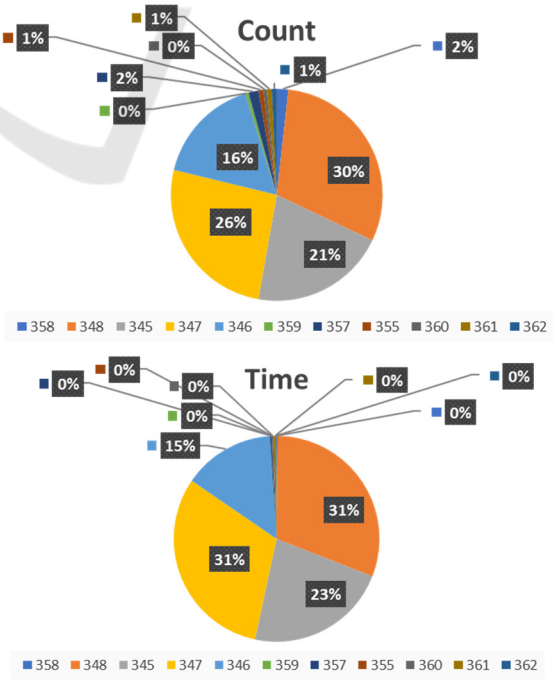

Figure 8: Time spent by students interacting.

Figure 9 depicts the comparison of research from the Computer Science postgraduate, Informatics Engineering undergraduate, and Information Systems undergraduate departments as a description of data processing in the final stage of data comparison of three undergraduate and postgraduate related to the university LMS. The results acquired reveal valid data from the Universitas Kristen Maranatha Learning Management System for a total of 17200 hours and 11455 times, the majority of which were conducted by students from the Informatics Engineering undergraduate department.

	Time	Count
s2ilkom	4955695	637
s1if	62026251	11455
s1si	17546200	4167

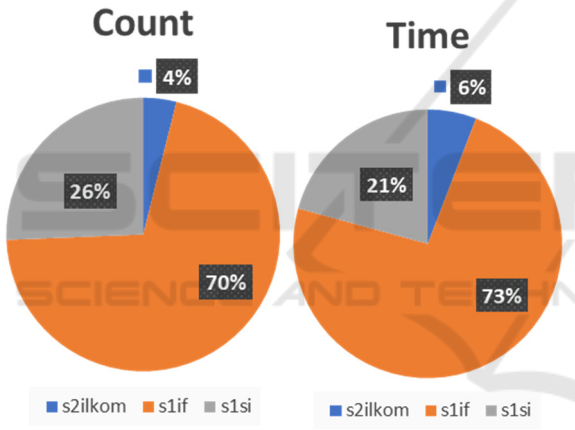

Figure 9: Three departments' duration of time and activity.

4 CONCLUSIONS

In the odd semester of the 2020/2021 academic year, the research was only performed in three departments. Nonetheless, using analytical data from MOODLE Learning Management System log files to predict user interaction activities can help educational institutions detect and improve LMS effectiveness.

This study's findings can be used to help higher education institutions integrate online learning. Internally managed LMS across departments can help implement these policies by integrating all knowledge resources into a single system. In addition, the strategy to permit hybrid learning during the pandemic will undoubtedly influence educational institutions in selecting the optimum approach to organize the educational process in their respective institutions based on policy readiness, supporting infrastructure, and human resources.

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