A study on learner motivation by visualizing LMS learning activity history using open source BI tools

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Abstract: This study investigates how visualizing learning activity history using open-source BI tools affects learner motivation and social presence. A system combining Moodle, Apache Superset, Apache Drill, and ECharts was developed to visualize learning data from an LRS. Three participants engaged in IT Passport exam learning while viewing peer activity dashboards. Questionnaires showed enhanced sense of connection and motivation through time-based activity graphs.

Keywords: Learning Management System (LMS), Learning Record Store (LRS), Social Presence, Learning Analytics, Open Source BI Tools, Learner Motivation

1. Introduction and Related Work

This study explores how visualized learning analytics can enhance motivation and social presence in LMS environments. Prior works like LAaaS-docker (RCOS, 2025) and Kato et al. (2022) offered custom visualization models. Our approach integrates Moodle (Moodle.org, 2025) with Superset and ECharts to enable time-based, customizable peer activity visualizations. Visualization can make peer activities more tangible, which may enhance learners' sense of connection and reduce feelings of isolation. This study is also informed by Social Presence Theory (Gunawardena, 1995), which emphasizes the importance of interpersonal awareness in online learning. By making others' actions visible and contextualized, the visualization of peer activity is expected to strengthen learners' perception of social presence and promote engagement. While many existing LRS platforms offer basic dashboards, they often lack customizable, time-based, peer-oriented visualization directly embedded in LMS interfaces. This study addresses this gap by integrating open-source BI tools to present activity history in a learner-centric, real-time format.
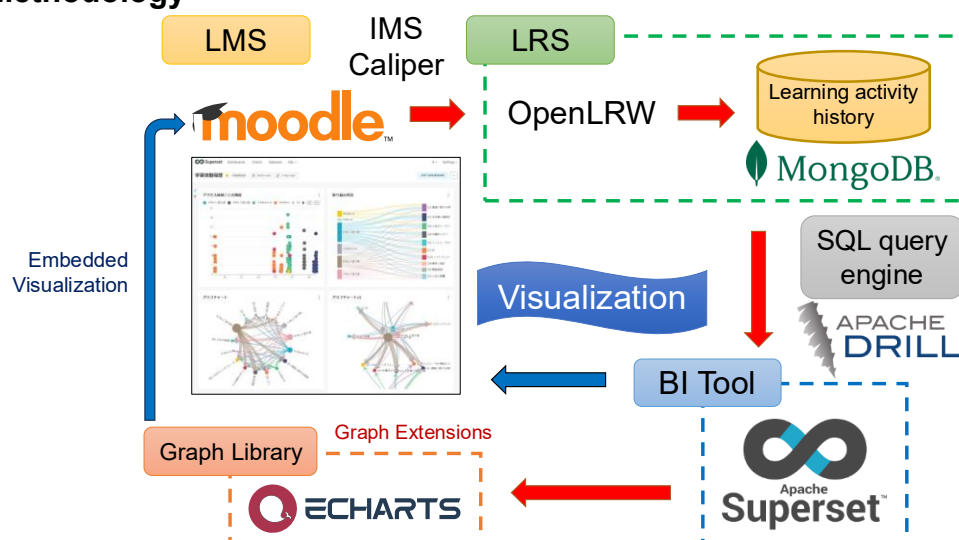
2. Methodology

Figure 1. Overview of the system structure (cf. Fukuno, 2025)

Figure 1 shows the architecture of a system built using open-source tools. This system visualizes activity data exported via IMS Caliper plugin to OpenLRW, which is then queried with Apache Drill, and rendered using Superset and ECharts (The Apache Software Foundation, 2025). Participants—current students or graduates with Moodle experience—completed IT Passport learning and responded to three questionnaires assessing media perception, peer connection, and graph impressions.

3. Results

Questionnaire 1 used Gunawardena's (1995) adjective pairs (SD method) on a 5-point scale to assess media characteristics. The results are shown in Table 1.

Table 1. Questionnaire 1   *Averages in the 1.0 range are highlighted.*

Contents	A	B	C	Avg.
The system is Stimulating-dull	1	3	2	2
The system is personal-impersonal	1	4	3	2.7
The system is sociable-unsociable	1	3	2	2
The system is sensitive-insensitive	2	5	2	3
The system is warm-cold	1	5	2	2.7
The system is colorful-colorless	2	4	1	2.3
The system is interesting-boring	1	4	1	2
The system is appealing-not appealing	1	4	1	2
The system is interactive-non interactive	2	2	3	2.3
The system is active-passive	*1*	*2*	*1*	*1.3*
The system is reliable-unreliable	*1*	*1*	*1*	*1*
The system is humanizing-dehumanizing	1	5	4	3.3
The system is immediate-non immediate	*1*	*1*	*2*	*1.3*
The system is easy-difficult	2	4	4	3.3
The system is efficient-inefficient	1	4	2	2.3
The system is unthreatening-threatening	1	3	2	2
The system is helpful-hindering	*1*	*2*	*1*	*1.3*

A 5-point scale from 1 (positive) to 5 (negative)

Questionnaire 2 we set a five-point rating for five questions regarding connections with others using this system. The results are shown in Table 2.

Table 2. Questionnaire 2   *Averages in the 1.0 range are highlighted.*

Contents	A	B	C	Avg.
This system made me feel like I was studying together with others	1	4	2	2.3
This system allowed me to know the progress of other students	*1*	*2*	*1*	*1.3*
This system gave me the feeling of belonging to a group	*2*	*2*	*1*	*1.7*
This system reduced my feelings of loneliness	1	3	2	2
This system encouraged me to study	1	5	1	2.3

A 5-point scale from 1 (agree) to 5 (disagree)

Questionnaire 3 set a 5-point scale for the degree to which students felt other learners' activities when looking at the graph. The graphs were selected based on the variables of user identification, resource name, action name, event time, and event count, and were applied to Superset / ECharts graphs. (cf. Fukuno, 2025) The results are shown in Table 3.

Table 3. Questionnaire 3   *The number one ranking is highlighted.*

Graph No.	Graph Overview (Tentative Name)	A	B	C	Sum
5	***User activity frequency***	*5*	*4*	*5*	*14*
6	***Number of accesses (users/day)***	*5*	*4*	*5*	*14*
7	***Activity of all learners***	*4*	*5*	*5*	*14*
1	Frequency by access time	5	2	5	12
10 (Moodle)	Task activity check	4	3	5	12

11 (Moodle)	User activity history	4	2	5	11
8	Cumulative user events	5	2	4	11
9	LMS events	4	3	4	11
2	Engagement status	5	1	4	10
4	Graph chart v2	2	2	4	8
3	Graph chart	2	2	3	7

The degree of feeling is rated by the number of stars, with 5 being the highest score.

4. Discussion

In Questionnaire 1, Table 1 indicate average values ranging from 1.0 to <2. positive results were obtained for the categories of "active-passive", "reliable-unreliable", "immediate-non immediate", and "helpful-hindering". In Questionnaire 2, Table 2 indicate average values ranging from 1.0 to <2. learners rated the visualization system highly for the categories of "This system allowed me to know the progress of other students." and "This system gave me the feeling of belonging to a group.". In Questionnaire 3, Table 3 indicate the most highly rated graphs. In the free-response section, learners highly rated the ability to understand their own situation and the situation of others, and the immediacy of the system. Figure 2 shows the graph that received the highest rating.
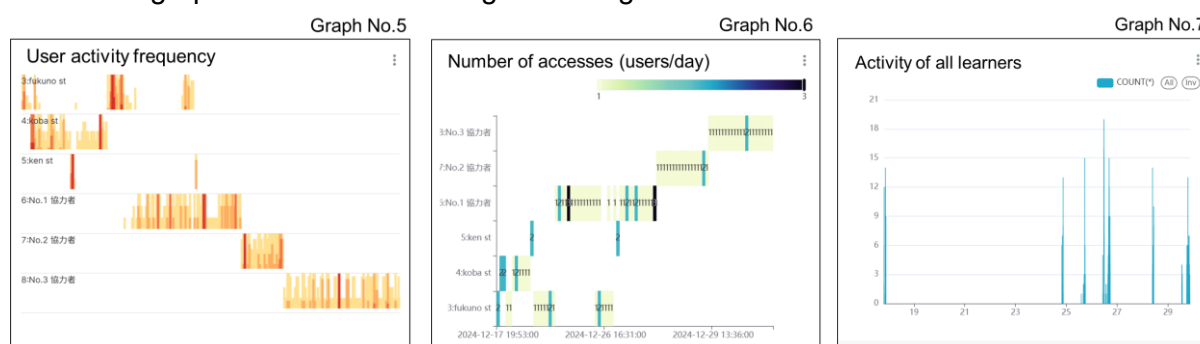

Figure 2. Graph of the top rated (cf. Fukuno, 2025)

The researchers selected and arranged the graphs based on variables such as user ID, resource name, event occurrence time, and number of events. In the future, it will be necessary to understand through interviews what kind of visualization and information manipulation the learners want, and then organize and incorporate their requests.

5. Conclusion

Despite a small sample, the results suggest that visualizing peer activity enhances learner motivation and social presence. The approach demonstrates the utility of open-source tools for improving engagement in asynchronous online learning.

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