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# GWpulse: Supporting Learner Modeling and Group Awareness in Online Forum with Sentiment Analysis

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**Abstract:** Collaborative learning in online context has been in educational practice and also gained attention during the emergency remote teaching due to the pandemic. This study follows the Group Learning Orchestration Based on Evidence (GLOBE) framework that considers four phases of technology-supported group work and proposes data-driven services for each phase. In this paper, we present an analysis tool named "GWpulse" that processes learning log data and shares the analysis results as an attribute of the learner model considered in GLOBE and also presents it in the group work dashboard to facilitate group awareness. In the current version GWpulse considered logs of forum activity generated during group activities in the learning management system. Apart from including that data in the learner model, it also visualizes the activity data for the orchestration, evaluation and reflection phases. GWpulse dashboard displays the basic statistics of their students' forum activities such as time interval and the number of posts, as well as a novel indicator of "Assistance Needed Level" calculated using sentiment analysis method that classifies textual statements into positive and negative.

**Keywords:** Group awareness, learner modeling, learning analytics, sentiment analysis

## 1. Introduction

Collaborative learning is becoming increasingly important in educational activities (Stahl et al., 2006). The GLOBE framework organizes research to support and analyze collaborative learning, sketching a cycle composed of 1) group formation, 2) orchestration, 3) evaluation, and 4) reflection (Liang et al., 2021). In each phase of the GLOBE framework, learning log data are used and generated by each other. Beyond the GLOBE framework, there is an integrated learning platform called "LEAF", which captures various learning activities as log data for learner modeling and analysis and provides visualized feedback to teachers and students (Franagan & Ogata, 2017). Once group activities under GLOBE framework are conducted, learning log data can be integrated as part of this platform as well and used as evidence in different modules in LEAF.

In this paper, we propose a system named "GWpulse" that stores and visualizes the results of the analysis of conversation logs in Moodle forums as learning log data in the orchestration phase of group activities in light of the GLOBE framework. Our goal is to help teachers and students understand the status of group activities and support their decision making with group awareness information (Schnaubert et al., 2019) to improve performance during the group work. Sentiment analysis is implemented to provide an indicator of how much intervention by the teacher is needed.

## 2. Related Works of Group Activity Visualization and Sentiment Analysis

There have been several group awareness tools that visualize asynchronous group activities on online forums. For example, an application has been proposed which displays a graph showing the number of contributions and online status of each student, with some patterned sentences to encourage equal distribution of participation when student contributions are unbalanced (Strauß & Rummel, 2021).

Experiments with this application showed that simply checking of the tool by students did not affect the equal distribution of participation, but the satisfaction with the group activity decreased when the equal distribution of participation was biased. Conversely, the satisfaction with the group activity increased when the equal distribution of participation was achieved.

There are various types of sentiment analysis, each with different characteristics. Approaches using Support Vector Machine (SVM) can classify the dataset linearly (Medhat et al., 2014). A framework to find important reviews efficiently by classifying the quality of product reviews on the Internet (Chen & Tseng, 2011) and a framework to discover market intelligence (MI) to support decision makers by aggregating and classifying opinions on microblogs have been proposed by using SVM classification (Medhat et al., 2014). Asari (Nakayama, 2019), an open-source software under MIT license, is one of the SVM modules for Python that performs positive / negative sentence classification of Japanese sentences.

## 3. System Design

Figure 1 shows the data flow of GWpulse working with Moodle and analysis tools in LEAF, and UI of the group awareness dashboard of GWpulse. In addition to visualizing the results of the analysis of the conversation logs during the group activities, it stores them and makes them available to other phases of the GLOBE framework and other modules in LEAF. The database of learning analytics dashboard (Dashboard DB) stores learner model. The learner model enhancer module in GWpulse periodically copies tables from the Moodle database (Moodle DB) to the common database of Dashboard DB.

When user access to the group awareness dashboard, 1) user selects Forum and/or Discussion. 2) Then, the average of the count of posts, count of characters, and interval between posts of the group, 3) group level Assistance Needed Level (ANL), mean negative\ness score for sentiment analysis for each post, divided into four levels with thresholds of [0.00, 0.20], (0.20, 0.40], (0.40, 0.55], and (0.55, 1.00], 4) graphs of count of posts, count of characters and interval of posts for each user, 5) and post level ANL are displayed for each discussion. Sentiment Analysis is performed using "asari", a Python library specialized for positive / negative classification of Japanese sentences.

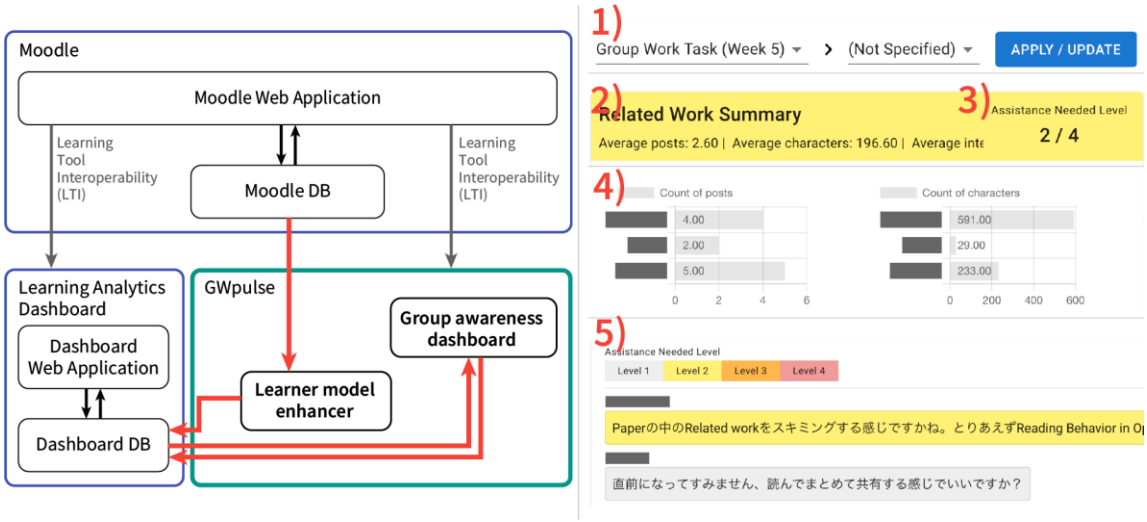


*Figure 1.* The data flow and the UI of the group awareness dashboard

We expect that GWpulse functions can be utilized in orchestration phase as well as other phases.

**Evaluation Phase:** By checking the Group awareness dashboard, students can look back at their own, their group's, and other group's activities objectively and visually. In other words, by checking the visualized data by GWpulse in the evaluation phase, we can expect each participant to make evidence-based evaluations.

**Reflection Phase:** Students can check their own or other students' or other groups' activities with GWpulse when they reflect on their own participation in the group activities after receiving peer evaluation from other students or evaluation from the teacher.

**Formation Phase:** Teachers can use aggregated indicators calculated from GWpulse that describe the characteristics of students in the group learning process as parameters when creating groups for the next group activity.

## 4. Discussion and Conclusion

We expect that visualization and confirmation of these indicators can be used as evidence for teachers to decide whether to make interventions such as putting actively participating students in leadership roles and encouraging passive students. Formative indicators such as count of posts can also remind those who are passive to be aware of their low motivation and change attitude toward participation thus improving their group work performance in a timely and informed manner (Coll et al., 2014). It is expected that with data accumulation by GWpulse, we can use them as parameters for creating a learner model in the group formation phase and other learning analytics tools.

The group work module "GWpulse" proposed in this paper is developed as an extension of the existing learning analysis platform that contributes to the accumulation and transparency of learning log data during the orchestration phase of group activities. By combining this system with the existing systems utilized information and evaluation phases, it will be possible to accumulate learning log data in all phases of the GLOBE as comprehensive group learning evidence.

In future work, we are planning to enable GWpulse to provide feedback using the learning log data generated by other modules in LEAF, and also to store learning log data such as the history of interventions by the teacher and other decisions made by using GWpulse. In parallel, we are planning to measure the effects of GWpulse during group activities in real classes. And we also need some experiments to compare human-based classification ANL and threshold-based classification ANL because the threshold lacks scientific validation.

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