

PEDI - Piazza Explorer Dashboard for Intervention

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Abstract—Analytics about how students navigate online learning tools throughout the duration of an assignment is scarce. Knowledge about how students use online tools before a course's end could positively impact students' learning outcomes. We introduce PEDI (Piazza Explorer Dashboard for Intervention), a tool which analyzes and presents visualizations of forum activity on Piazza, a question and answer forum, to instructors. We outline the design principles and data-informed recommendations used to design PEDI. Our prior research revealed two critical periods in students' forum engagement over the duration of an assignment. Early engagement in the first half of an assignment duration positively correlates with class average performance. Whereas, extremely high engagement toward the deadline predicted lower class average performance. PEDI uses these findings to detect and flag troubling engagement levels and informs instructors through clear visualizations to promote data-informed interventions. By providing insights to instructors, PEDI may improve class performance and pave the way for a new generation of online tools.

Index Terms—learning analytics dashboards, forum activity, real time visualizations

I. INTRODUCTION AND RELEVANCE

Data analytics and dashboards provide awareness to stakeholders about visual features of data systems, processed information and overall system activity. Data captured from educational systems are data sources for learning analytics dashboards (LADs); these sources include intelligent tutoring systems [1], college programming and collaboration tools [2]–[4] and help-seeking tools [5]–[7].

We introduce PEDI, a learning analytics dashboard layer on top of the Piazza question and answer forum system. Piazza allows students to ask questions via posts on the forum and tag the folder relevant to their question. Both instructors and students can respond to public posts. Piazza records the time the question was asked, question content, replies, number of replies, number of views, and number of likes [8].

A. Inspiration for PEDI

PEDI was designed based on recommendations from our prior studies of students' activities on Piazza [5]. When

students ask for help on the forum, they have usually begun working on that assignment, and may have been working on it for a while [5]. Students often use the Piazza forum near an assignment deadline rather than seeking help early. However, research shows that students who start working earlier have more time to seek assistance when they get stuck [9]–[11].

Detecting Late Help-Seeking: PEDI provides filtering and ranking features for instructors to monitor current levels of forum activity in the first half of an assignment's duration. For each assignment, PEDI presents forum activities as visualizations and allows instructors to compare current levels of forum-usage and rate of help-seeking with those of previous semesters. This comparison can help instructors identify patterns of help-seeking for possible interventions.

Detecting Unusually High Rate of Help-Seeking: Our prior study also found that rates of forum activity towards the end of an assignment duration negatively correlated with class average performance. We identified the need to alert course instructors about unusually high levels of interactions on the forum compared to levels found in previous semesters [5].

Piazza provides limited statistics and visualizations. It provides no filtering, ranking, or alerts. As found in our prior work, the relative timing of class forum posts to assignment deadlines, and the comparison with prior semesters are important. PEDI provides these features which present instructors with important insights which can lead to interventions that improve performance.

II. DESIGN

The goal of the PEDI tool is to provide instructors with useful forum trends before the end of each assignment.

A. System Capabilities

PEDI was built using Shiny, an open source R package. The main data analysis was done in Python [5]. We used R's reticulate package [12] to run Python scripts in R environment.

PEDI displays information to instructors using the following components: *Average Post Frequency* line graph, *Forum Activity* pie chart, *Post Frequency* histogram, *Post Likes and Replies* tree map and a few tables to provide context of students' forum activities.

1) **Average Post Frequency:** PEDI allows instructors to compare activities of the current semester with previous semesters using the sidebar panel control and *average post frequency* line graph in Figures 1a and 2a respectively (see Appendix A). The line graph shows the average posts per day (this is the number of posts per day divided by the class size) for an assignment during the goal semester. The goal semester is the current semester. The goal semester in Figure 2a is Fall 2020. Observe that the highest peak for the goal semester is slightly higher than those of previous semesters. This means that students are asking more questions than usual towards the end of an assignment duration. Instructors might wish to investigate the reason for this by exploring other charts.

2) **Post Frequency:** PEDI allows instructors to dig deeper into post traffic that catches their attention. For example, in Figure 2b the 08/27/2020 bar had the highest number of posts, when this bar is clicked, all the posts for that day are displayed as a table (not shown) below the histogram. This is important because questions asked on this day might be in the an area of shared difficulty by the class. Instructors might decide to intervene by sharing the posts and clarifying expectations or challenges during class time.

3) **Forum Activity:** The pie chart on the PEDI tool allows instructors to observe the number of students who have not been active on the forum and what activities are being performed on the forum (see Figure 3a). Instructors could decide to email students and motivate them to use the forum. They could also provide positive feedback to students providing answers to other students' questions or consider recruiting those students as future graders.

4) **Post Likes and Replies:** Our prior research found a negative correlation between the number of likes on posts on an assignment and the class average performance [5]. The tree map in Figure 3b displays posts with the highest number of likes. The higher the number of likes, the bigger the rectangle. A high number of likes on a post could be important to instructors for two reasons. The first reason is that the post might be particularly helpful for an assignment and the post should be highlighted and visible for all students to benefit from it. The second reason is that posts with a high number of likes may indicate difficulty faced by majority of the student cohorts which may lead to lower class performance if not addressed properly. The tree map has a control in Figure 1b that allows users to also view posts with the highest number of replies.

5) **Alert System:** Based on our prior research [5] the following scenarios should trigger an alert indicating a situation where an instructor may want to consider an intervention.

For an assignment:

- when the level of *no-activity* during the first half of an assignment's duration, is higher than the average across previous semesters
- when the percentage of students on the forum during the first half of an assignment's duration, is lower than previous semesters

- when student traffic (percentage of class actively posting on the forum) close to the final deadline is higher than previous offerings of that assignment
- when the average number of questions asked towards the final deadline is higher than other semesters

PEDI alerts reveal concerns that instructors may wish to address by promoting early help-seeking and resolving issues with assignments.

These components are all on one page to provide instructors with just the right amount of information to make a decision and act on it. PEDI's components provide insightful summaries to reduce the time instructors spend getting insights. Furthermore, PEDI follows the basic principles of the Visual Information Seeking Mantra: overview, zoom and filter, details-on-demand, and relate as described by Shneiderman [13].

B. PEDI workflow

A walkthrough demo displaying PEDI's design and functionalities will be presented at the VL/HCC conference.

PEDI is meant to be used at least twice within the duration of an assignment (halfway and two-thirds of the way to an assignment deadline (a few days before deadline)).

1) **The Early Forum Activity tab:** helps instructors reflect on their student forum usage from the time the assignments are released until halfway to the deadline. The *Average Post Frequency* line graph which shows the average number of posts per day and the *Forum Activity* pie chart which shows the percentage of students and what activities they are performing on the forum, help the instructor get an overview of the current forum usage. To filter, zoom in, or get details on an assignment of interest, the instructor may select the assignment and adjust the due date using the date control in Figure 1a. They may also relate the current semester to a previous on the line graph in Figure 2a. This may help the instructors reflect on how effective their past interventions were or detect if their recent interventions have improved early help-seeking.

2) **The Tracking Assignment Difficulty tab:** is best for checking forum use within 2/3 of an assignment's duration. Heavy forum usage closer to the deadline may indicate higher assignment difficulty. This page provides a forum usage overview in the *Average Post Frequency* line graph, *Forum Activity* pie chart, *Post Frequency* histogram, and *Post Likes and Replies* tree map, each with its own filtering, zoom, and 'relate' options. The *Post Frequency* histogram provides access to more detail.

III. CONCLUSION

PEDI addresses the knowledge gap by analyzing and presenting visualizations of forum activities in a meaningful way to instructors while students work on assignments. PEDI enables instructors to gain important insights by comparing forum usage of one class to another, relative to assignment deadlines. As found in prior research, interventions based on these insights have the potential to improve class performance.

APPENDIX A PEDI COMPONENTS

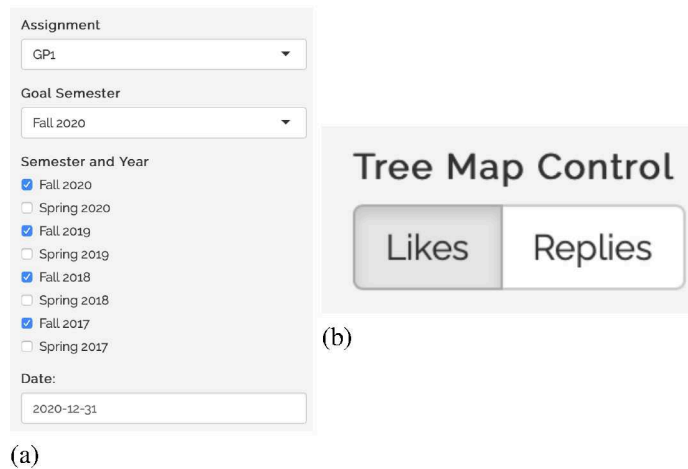


Fig. 1. (a) Sidebar Panel Control (b) Tree Map Control

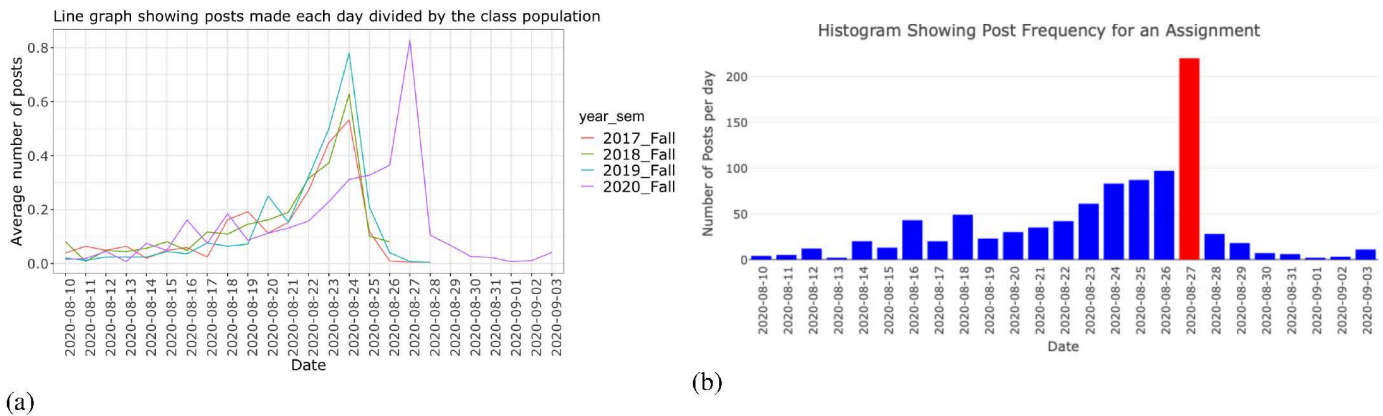


Fig. 2. (a) Average Post Frequency line graph showing average posts per day (b) Post Frequency histogram showing the number of posts per day

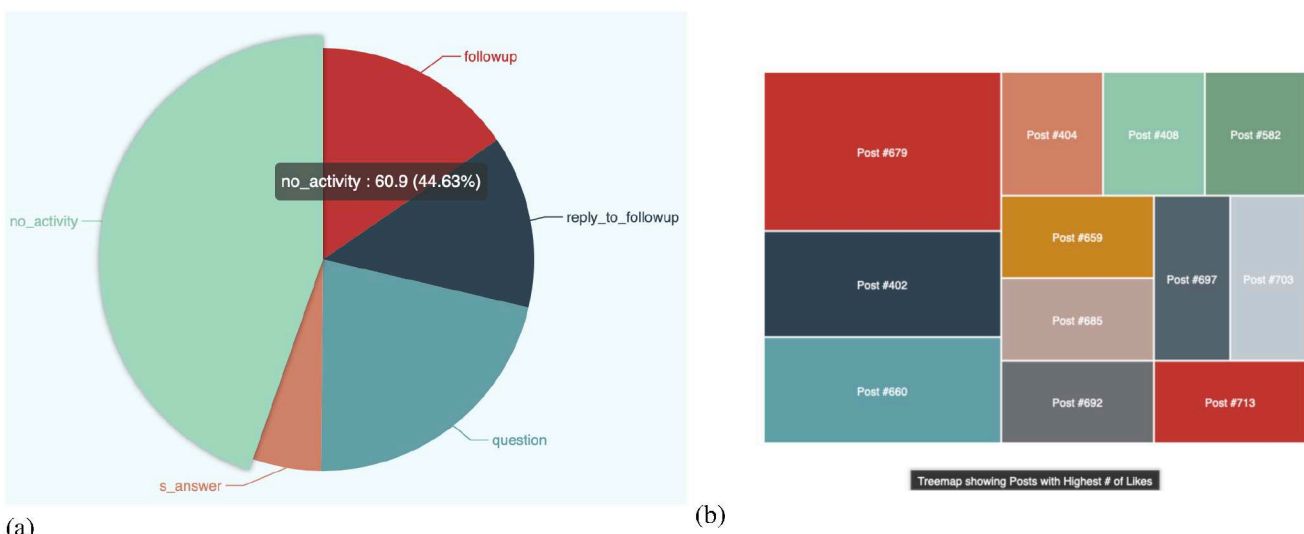


Fig. 3. (a) Forum Activity Pie chart showing that 60.9% of the class has performed no visible activity [5] on the forum and the 'no activity' slice is 44.64% of the pie chart. s_answer means student answer. (b) Post Likes and Replies Tree Map showing forum posts with the highest number of likes

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