



The Forum Factor: Exploring the Link between Online Discourse and Student Achievement in Higher Education

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ABSTRACT

The growth of digital education has expanded the use of online forums like Piazza. However, their impact on academic achievement is still being determined. This study investigates the relationship between Piazza engagement and academic performance in computer science. We explored four hypotheses: Piazza activity rates, endorsements, post frequency on assessments, and pre-assessment viewing habits. Data analysis from an extensive programming course showed that active Piazza users and endorsed students performed significantly better academically. While the number of posts related to assessments was generally not correlated with performance, students who viewed more posts about an assessment within a week of its due date tended to perform better.

CCS CONCEPTS

• **Social and professional topics** → **Computing education.**

KEYWORDS

computing education, discussion forum, engagement

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1 INTRODUCTION

The recent global pandemic has significantly increased the use of online educational tools, particularly online discussion forums such as Piazza. As remote learning became necessary, these forums emerged as pivotal spaces for student engagement and interaction, compensating for the limited face-to-face encounters [4, 8, 11].

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The diverse use of these platforms, including reading peer discussions, seeking information or actively contributing to discussions, caters to a variety of learning approaches, promoting personalised and collaborative experiences. However, as educators, it is important that we understand the impact of online tools on student learning outcomes and academic performance as usage increases. For example, recent work has established relationships between course performance and student engagement with various online resources, including lecture recordings and automated feedback systems [2, 7].

Findings on the relationship between forum participation and academic performance have been inconsistent with a mixture of positive and neutral findings [3, 5, 9, 10, 12], which suggests a need for further exploration. Of particular interest is analyzing the link between teacher-endorsed student activities and academic performance, discussing the quality versus quantity of student engagement [6, 13].

Also of interest are two key relationships: grades achieved by students with their assessment topic discussion frequency and grades linked to forum activity around assessment dates. These insights will be valuable for educators in course planning. Our works seeks to answer the following questions:

- **RQ1:** Is there a discernible difference in academic performance between active and non-active students on Piazza?
- **RQ2:** Do students who receive endorsements for their posts perform differently from those who did not?
- **RQ3:** What is the strength of the correlation between the number of assessment-related posts and academic performance?
- **RQ4:** To what extent do students who are active on the forum around assessment deadlines exhibit better performance?

By investigating these questions, we aim to understand the impact of forum engagement on academic performance, providing valuable insights for educators and institutions to integrate these tools effectively to promote student learning outcomes.

2 RELATED WORK

Prior research regarding relationships between student performance and online forum participation reveal mixed findings [1, 3, 5, 9, 12]. Most results exhibited positive correlations, with increased participation yielding better grades or being a predictor of

course success. However, studies like Wan et al.'s [14] and Smith et al.'s [10] challenge these conclusions, implying that a simple increase in participation does not equate to academic improvement. Despite some contradicting evidence, we believe ample research supports a link between forum activity and academic performance, warranting further examination.

Smith et al. [10] notably suggested that discussion quality outweighs quantity in predicting success, which complements several studies correlating discussion quality with performance [4, 5, 12]. Yet, the preceding research typically assessed discussion quality post-hoc. Analyzing the relationship between real-time feedback and academic performance might yield timely, actionable insights for improved student performance.

Previous studies have also explored instructor feedback. For example, Romero et al. [9], found that instructors' scoring of student messages correlated with course performance. However, given the role of student interaction in forum usage, considering feedback provided by students could be equally crucial.

Lastly, mixed findings emerge when dissecting the relationship between online activity and academic success [6, 10]. While Smith et al. [10] found posting frequency unsuited to predict academic performance, Mihail et al. [6] detected a positive correlation between post volume and final grades. Additionally, research by Smith et al. [10] challenged traditional assumptions, suggesting that viewing a larger number of posts, rather than actively posting, could reflect higher performance levels, highlighting the potentially underestimated impact of 'silent participation' on academic success.

3 METHODS

Our study uses an anonymised dataset provided by the University of Auckland. This data comes from a first-year engineering course that used Piazza, an online forum, as a teaching tool. The data set includes: individual grades for each assessment, a summary of each student's activity on Piazza, the content they contributed via posts and the post views they accumulated.

To answer RQ1 we extracted student activities and their final grade score from the dataset. We defined activity as posting questions or notes, follow-ups to a post or reply, and answering a question. Each activity counted as one point towards a student's activity score. We defined an "active" student as having at least one activity point and a "non-active" as having none, and then analyzed the distribution of grades in these groups. We calculated the Pearson Correlation between the two columns. We then calculated the mean grade for both active and non-active students.

For RQ2 we selected necessary attributes from the raw data, including ID, Final Score (numerical), and Final Grade (letter). From the activity data, we combined several attributes to get the total number of endorsements each student received, comprising both student and instructor feedback, as detailed in Table 1.

We merged the grade and activity data based on the ID attribute, ensuring only students with a final grade appeared in the resulting table. Additionally, students were split into two groups based on endorsement receipt.

To address RQ3, we extracted Piazza activity data for students who took at least one of the considered assessments. The performances of these active students were assessed by calculating their

Table 1: Forms of Feedback Received

	Student Feedback	Instructor Feedback
Question	Good Question	Good Question
Answer	Thanks	Good Answer
Followup	Helpful	Good Comment

mean marks for each assessment. We also determined the total number of each student's questions, follow-ups, and replies for each assessment, measuring their participation and contribution. Furthermore, we calculated the total number of posts for each assessment, considering only the posts and grades of active Piazza users.

For RQ4, we selected and merged posts related to the tests or exam to the post-view data. By appending assessment dates and their preceding week's dates, we filtered student views around each assessment's time. This process enabled us to count each student's views related to each specific assessment. The relationship between views and Final Score for each assessment was visualised using scatter plots.

4 RESULTS AND DISCUSSION

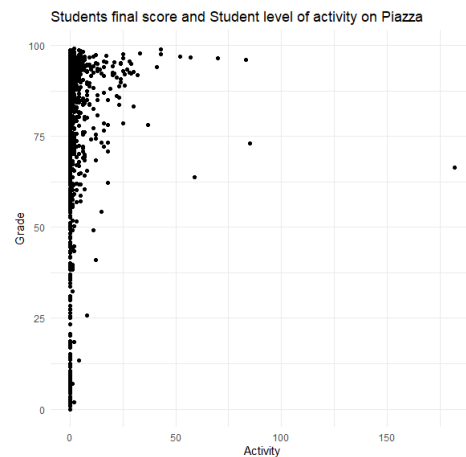


Figure 1: Students final score and Student level of activity on Piazza

4.1 RQ1: Active versus Non-Active Students

Our analysis of 1013 students highlighted a significant positive correlation between their final grade and their level of activity on Piazza, as visualized by Figure 1. A Pearson's product-moment correlation underlines this with an R value of 0.122 and a p -value less than .001.

The data analysis shows that there is a statistically significant relationship between the student's activity on Piazza and their final grades ($p < .001$). This means that there is some influence that connects student Piazza activity and academic performance, rather than this connection being random chance. There was also a weak

positive correlation between the student’s activity and final grade ($R = 0.122$), which means that it is slightly likelier that a student who participated more also achieved a higher grade.

Importantly, these results corroborate previous work on participation in online discussion forums [1, 3, 5, 9, 10, 12, 14] which found that participation in online discussion forums has a significant correlation with students’ academic performance.

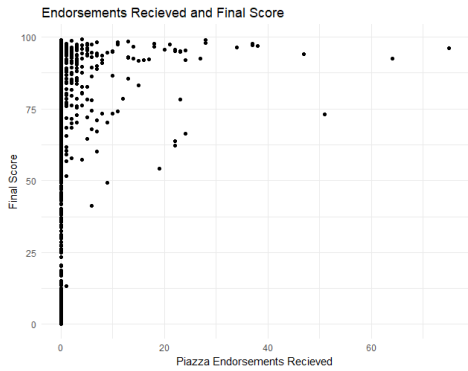


Figure 2: Endorsements received and final score

4.2 RQ2: Post Endorsements

The analysis of 1013 students established a weak positive correlation between endorsing posts, comprising of positive feedback both from peers and instructors, and final grades (shown in Figure 2). The Pearson’s product-moment correlation, $r = 0.134$ ($p < .001$), indicated a tendency of endorsed students towards higher grades.

Students with endorsed posts had a mean score of 86.4 in contrast to the 74.6 mean score of those without endorsements. The statistically significant relationship between endorsements and final score suggests that students who receive endorsements tend to perform better. Endorsements are given as a sign that the contributions made by a student are of some value. It seems probable that making valuable contributions reflects an understanding of course content, which can lead to better performance.

Understanding endorsements as a measure of the quality of discussion reinforces previous findings [4, 5, 12] that discussion quality correlates with student achievement.

4.3 RQ3: Posts by Topic Assessment

A scatter plot representing each assessment’s average marks and its related student posts is highlighted in Figure 3. Considering student posts related to 13 assessments spanning labs, projects, assignments, tests, and a final exam, the correlation between the number of posts made for each assessment and the average marks obtained for it was not significant, with the Pearson’s product-moment correlation near-zero, $r = 0.009$ ($p = 0.976$).

These results suggest there is no meaningful relationship between the average marks on each assessment and the number of posts associated with that assessment on Piazza. These findings, counter to some expectations, underline the complex and multifaceted nature of the connection between student participation in online discussion forums and academic outcomes.

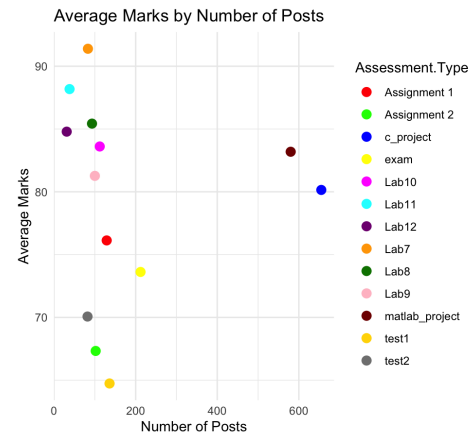


Figure 3: Average marks and number of posts

Such results underscore that learning and its contributing factors extend beyond the confines of traditional metrics and indicators. They highlight how students interact with digital platforms such as Piazza and derive value from digital platforms. The apparent lack of a clear-cut correlation between post-frequency and academic performance necessitates a deeper, more nuanced understanding of the interplay between digital engagement and academic success.

4.4 RQ4: Activity Timing

Scatter plots of final exam scores against the number of Piazza posts viewed within a week of assessment due dates revealed a positive correlation. Pearson correlation tests conducted for Test 1 (Figure 4, $n=411$); Test 2 (Figure 5, $n=358$); and the final exam (Figure 6, $n=459$) all indicated positive correlations ($R = 0.145, 0.105$, and 0.159 respectively) with low p -values ($p = .003, .046$, and $< .001$ respectively), suggesting that students active on the forum around assessments achieved better outcomes.

Our findings indicate a significant, albeit weak, correlation between increased post-frequency around assessments and improved performance, as reflected by the test statistics and p -values for Test 1, Test 2, and the final exam. These insights deepen our comprehension of how digital participation influences academic success, suggesting that active engagement on Piazza during assessments is positively related to better learning outcomes.

Nonetheless, this relationship cannot be separated from the context and quality of these posts or the individual characteristics of the students. Thus, the quality of accessible posts can potentially influence this relationship.

While these findings denote an association, causality is not implied due to the multifaceted nature of academic success, encapsulating factors such as preparation strategies, comprehension of subject matter, and time management skills that can intricately interact with Piazza engagement patterns. Our results mirror those of Smith et al. [10] who similarly reported that higher grades were evident amongst students accessing more online questions and answers.

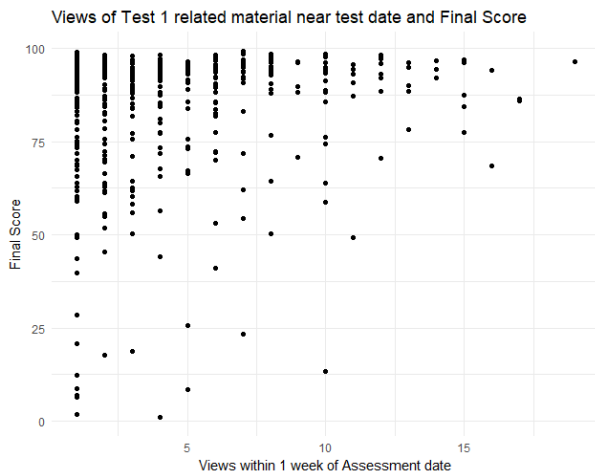


Figure 4: Average marks and number of posts

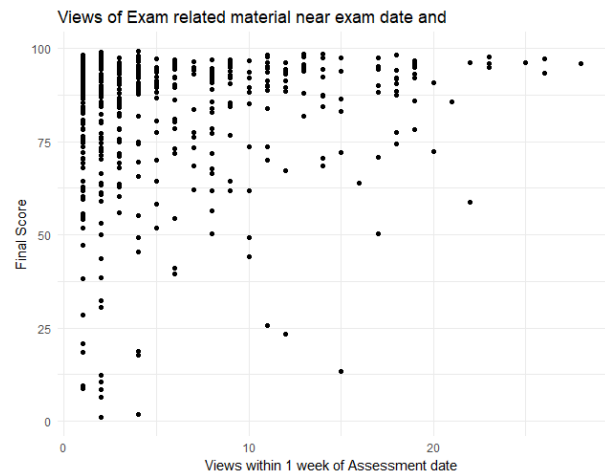


Figure 6: Average marks and number of posts

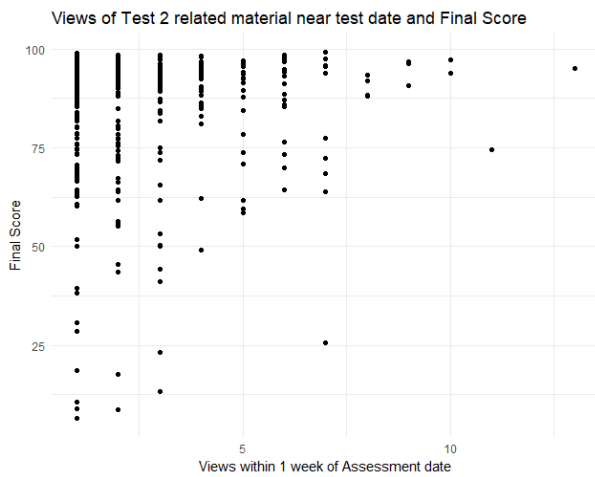


Figure 5: Average marks and number of posts

5 CONCLUSION

We analysed student activity on the discussion platform Piazza from a single course over a semester to examine the relationship with academic performance. It is worth noting that our method of calculating activity scores treats all forum actions equally, which may not accurately model the impact of different kinds of activity.

Relationships were found between activity or endorsement levels on Piazza and final grades; no similar correlations were found with the number of assessment-related posts and average assessment grades. However, viewing more assessment-related posts positively correlated with higher grades. Active online discussion engagement appeared beneficial for students and potentially informative for instructors designing interactive learning environments.

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