

Exploring the Relationship Between Assignment Submission Behavior and Final Grade of Information Literacy Education Using Big Data

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Abstract: This study aims to investigate the relationship between students' assignment submission behavior and final grades in information literacy education using a large volume of learning logs stored on the LMS. A total of 12,516 freshman students participated in this study from the year 2018 to 2022, across the COVID-19 pandemic. The students were divided into high, medium, and low performance groups using k-means clustering. The results of the characteristics analysis show a significant early submission behavioral trend and a late submission behavioral trend in high and low performance groups, respectively. The on-demand class format during the COVID-19 pandemic resulted in more consistent early submission behavior for high performance students and late submission behavior for low performance students, respectively. The findings suggest that time management skill is a critical factor in both blended and online learning environments, affecting weekly submission behavior and final grades.

Keywords: Submission behavior, learning performance, time management skill

1. Introduction

Online learning is a revolution that is currently emerging. The benefit of viewing and reviewing e-learning resources without time and space limits in online classes leads to increased learning effectiveness (Soffer & Nachmias, 2018). There is a huge volume of learning logs tracked in the Learning Management Systems (LMS) in online classes after the impact of the COVID-19 pandemic. In the context of information literacy education, the learning effectiveness and learning behavior in online courses have not been well validated, especially in different performance groups and different class formats. This study aims to investigate the relationship between assignment submission behavior and final grades in information literacy education courses using a large volume of learning logs stored on the LMS.

2. Method

An Information Fundamentals course was offered to freshman students across all departments in a national university in Japan. The course covered essential knowledge in information literacy and contained the following topics in seven lectures: account and network in the university, use of e-mail, use of the internet, internet security, utilization of information, information ethics, and summary. A total of 12,516 freshman students in the course participated in this study. The course was offered once in an academic year from year 2018 to 2022. It was conducted in mixed format (face-to-face and on-demand) before and after COVID-19 pandemic, and on-demand format only in year 2020 during COVID-19 pandemic.

The students were given weekly report assignments and quizzes based on the lecture topics from the 2nd to the 6th lecture, with a final report assignment for the 7th lecture. In the weekly report assignments, students were asked to critically respond to the core question of

the lecture in approximately 200 characters. In the final report assignment, students were asked to discuss multiple questions in the lecture, with around 100-200 characters for each question. For example, the core question for “use of the internet” lecture is how to critically browse web pages. In the quizzes, students were delivered 10 multiple-choice lecture-related questions to answer.

The final grade of students consisted of 25 points in quizzes, 50 points in weekly report assignments, and 25 points in final report assignments with a max of 100 points.

The submission time of report assignments, the submission period, and quizzes were extracted from the LMS log data in the course. A submission value T was computed based on the submission time and period as shown in the following formula to represent the degree of the earliness of submitting assignments (Itoh et al., 2009).

$$T = 1 - \frac{t - T_s}{T_e - T_s}$$

Here, t represents the submission time, T_s is the start time of the submission period, and T_e is the end time of the submission period. The units for t , T_s , and T_e are in seconds. The earlier an assignment is submitted, the higher the submission value T is. In this study, it's indicated the following status of submission behavior based on the submission value.

- Early submission: Submission value is equal to or greater than 0.8
- Late submission: Submission value is equal to or less than 0.3
- Overtime submission: Submission value is less than zero.

To investigate whether there are learning behavior characteristics based on final grades, we performed k-means clustering on the students' final grades. We set the number of clusters to $k=3$ to divide students into high, medium, and low performance groups.

By visualizing the calculated submission values, we analyzed the characteristics of report assignment and quiz test submission behavior in three performance groups. Furthermore, we conducted the Mann-Whitney U test to compare the submission values in all report assignments and quiz tests between high and low performance groups after a normality test was rejected. We then analyzed the characteristics of report assignment and quiz test submission behavior across the COVID-19 pandemic. The 6th report and test were excluded from the analysis since their learning topics are not the same during the five academic years.

3. Result

Figure 1 gives a visualization of the average submission values of students in report assignments and quiz tests in three performance groups.

High performance group students had the most early submission behaviors in the report assignments (submission value ≥ 0.8 , percentage = 84%) and in the quiz tests (submission value ≥ 0.8 , percentage = 92%). Their submission values in the other reports and tests were between early submission and late submission. Medium performance group students showed more than half of early submission behaviors in the report assignments (submission value ≥ 0.8 , percentage = 56%) and nearly half of the behaviors between early and late submissions in the quiz tests ($0.3 \leq$ submission value < 0.8 , percentage = 48%). Low performance group students had nearly a quarter of early submission behaviors in the report assignments (submission value ≥ 0.8 , percentage = 24%) and had very little early submission behaviors in the quiz tests (submission value ≥ 0.8 , percentage = 4%). On the other hand, they had the highest late submission behaviors in the reports (submission value ≤ 0.3 , percentage = 28%) and in the quiz tests (submission value ≤ 0.3 , percentage = 44%). They also had the highest overtime submission behaviors in the reports (submission value < 0 , percentage = 20%) and in the quiz tests (submission value < 0 , percentage = 32%).

Furthermore, the results of comparison analysis using the Mann-Whitney U test show that all submission values in report assignments and quiz tests were significantly different ($p < 0.001$) between high and low performance groups, with a large effect size ($r > 0.5$).

The results in Figure 1 also show the students with high performance had consistent early submission behaviors from year 2018 to 2022 during the COVID-19 pandemic. On the other hand, the students with low performance tended to submit assignments just before the

deadlines in year 2020 during the COVID-19 pandemic, comparing the more overtime submission behaviors before the COVID-19 pandemic.

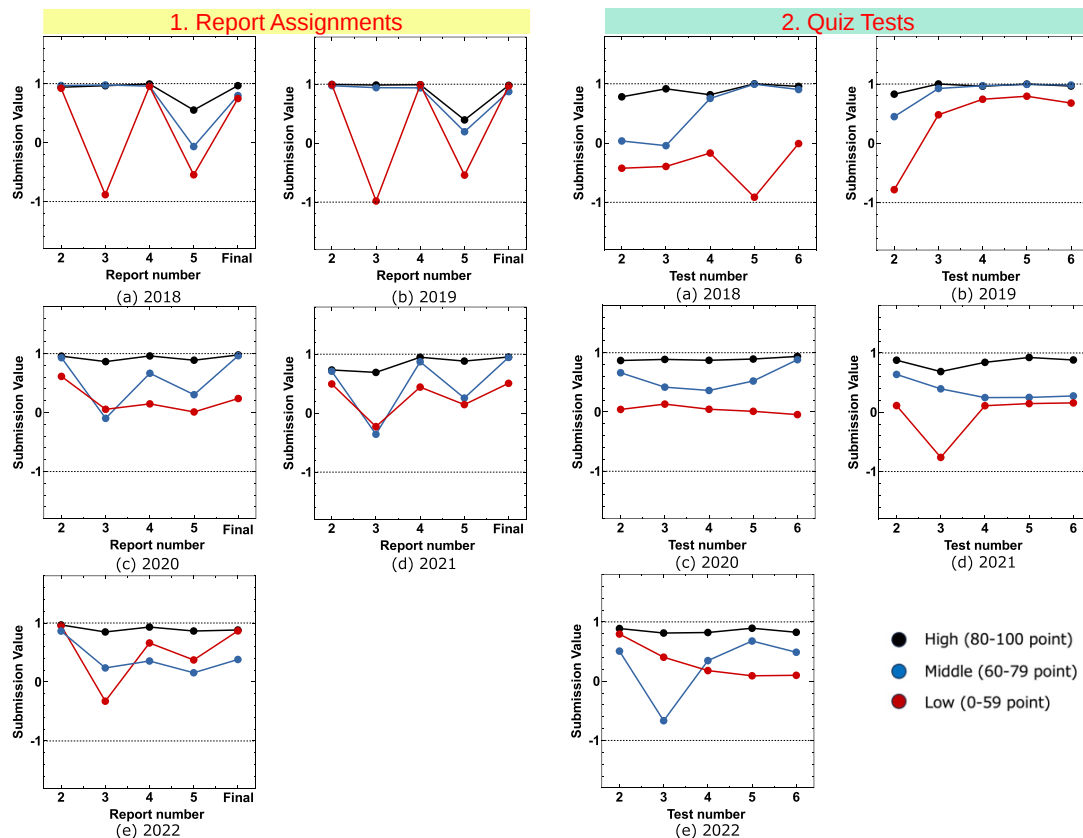


Figure 1. Average submission values in report assignments and quiz tests in high, medium, and low performance groups.

4. Discussion

In this study, we conducted a clustering analysis to explore the relationship between students' assignment submission behavior and final grades in information literacy education courses using a large volume of learning logs stored on the LMS. The findings of this study reveal that different performance students have unique behavioral characteristics on assignment submissions. The on-demand class format during the COVID-19 pandemic resulted in more consistent early submission behavior for high performance students and late submission behavior for low performance students, respectively. These findings suggest that time management skill is a critical factor in both blended and online learning environments, affecting weekly submission behavior and learning performance. The learning support should provide individual feedback promptly based on students' submission behaviors in trace data.

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