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Analysis of the Impact Student-Facing Learning Analytics Dashboards on Learning Motivation and Behaviors according to the Motivational Type of Learners

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Abstract: The authors developed two types of dashboards according to learners' motivational type and analyzed the effects of differences in dashboard visualization formats on learning behaviors and motivation. The results showed that some subjects prefer the visualization format of the dashboard regardless of their motivational type. In addition, we confirmed that learners with increased motivation also had increased learning behaviors, such as viewing videos.

Keywords: Learning Analytics, Dashboard, Motivation, Adaptive Learning

1. Introduction

According to a previous study, "learning analytics (LA) has grown from a hypothetical future into a concrete field of inquiry and a global community of researchers and practitioners" (Lang, Siemens, Wise, Gašević, & Merceron, 2022, p. 10) over the last 10 years. Research on LA includes measurement, collection, analysis, and reporting of learning data (Ferguson, 2012). The present study focuses on the reporting function, especially in regard to the Learning Analytics Dashboard (LAD) application. The target users of the LAD include teachers, learners, administrators, and researchers (Schwendimann et al., 2016). This study focuses on learner-facing LAD.

When designing a learning analytics system, it is essential to align with the needs of learners, their individual characteristics, personalization, and adaptivity (Schumacher & Ifenthaler, 2018). Rets, Herodotou, Bayer, Hlosta, and Rienties (2021) developed an LAD in which learners were involved in the design and evaluation and found that each learner had preferences for dashboard contents and wanted a more personalized version.

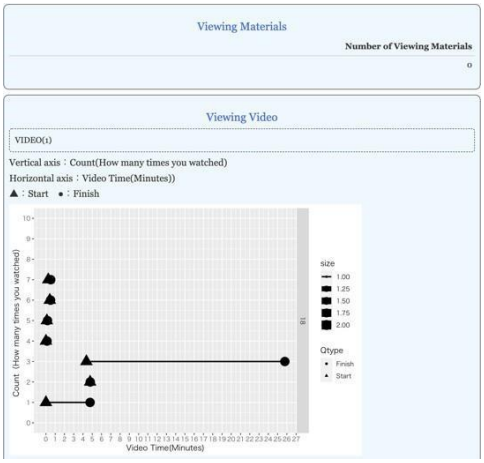
Given this background, the present study aimed to verify the hypothesis that different dashboard visualizations based on learners' motivational types affect their learning motivation and behaviors. In other words, we hypothesized that if the dashboard visualization matched the learners' motivational types, their learning motivation and actions would increase. The findings could be expected to lead to the individual optimization of the LAD based on learning theory and enable more effective feedback.

2. Methods

2.1 Data Collection and Development

To design and verify the effectiveness of dashboards, learning activity data were collected from Moodle, a learning management system (Moodle, 2022). The acquired data included students' viewing logs of the learning videos, materials, and dashboards developed for this study. Learner motivational type was collected using a questionnaire from Sugiyama and Sensaku (2010). Learning motivation before and after viewing the dashboards was also measured using a questionnaire.

Then, we developed dashboards. Ryan and Deci (2000) proposed the self-determination theory and classified motivational types into "amotivation," "extrinsic motivation," and "intrinsic motivation." Based on this, we developed dashboards according to two types of motivation: "(a)intrinsic" and "(b)extrinsic" (Figure 1). The dashboard for intrinsic type visualized one's own learning activity data so that one could understand one's learning situation. On the other hand, the dashboard for extrinsic type visualized other students' learning activity data as well so that they could be compared and evaluated.



(a) Dashboard for the intrinsic type.

(b) Dashboard for the extrinsic type. *Figure 1*. Dashboards according to two types of motivation.

2.2 Experiment and Analysis

An experiment was conducted with students in a liberal arts course offered at Sophia University in Japan who provided consent to participate in this research. The experiment was conducted 3 times as shown in Table 1: first with no dashboard, second with a dashboard for intrinsic/extrinsic motivational type, and third with a dashboard of reversed type. To eliminate the influence of the order of the conditions, the students were assigned to two groups in random order.

In order to analyze, we categorized the students into two groups according to their motivational type based on the answers to the motivation questionnaire. Then, we compared differences in their learning motivation and behaviors when they viewed the dashboards fitted and not fitted to their motivational type.

Table 1. *Experiment Framework*

	# 1	# 2	# 3
Group 1	Without dashboards	Dashboard for intrinsic type	Dashboard for extrinsic type
Group 2		Dashboard for extrinsic type	Dashboard for intrinsic type

3. Results and Discussion

First, we showed students' learning motivation. In the questionnaire, we asked the students "Did your behavior and motivation change as a result of viewing the feedback?" According to the results, no students

felt that their motivation or behavior had decreased. Also, some learners' learning motivation and behavior did not change with or without the dashboard. Among the students with intrinsic type, 66 percent reported increased motivation and behavior when looking at the dashboard. On the other hand, only 17 percent of students with extrinsic type reported increased motivation and behavior. It was also clear that 33 percent of students had not looked at the dashboard.

Next, we showed students' learning behavior. We calculated the average video viewing rates 3 times ("without dashboards," "with dashboard for intrinsic type," and "with dashboard for extrinsictype") for each of the two types of students. No significant difference in the viewing rates was seen in students with intrinsic type at 3 times ($p>0.05$). Learning behaviors did not change when these students viewed the dashboard for extrinsic type. By contrast, a difference was found in students with extrinsic type ($p=0.03$). Learning behaviors decreased when they viewed the dashboard for extrinsic type.

An analysis of variance conducted on the video viewing rate revealed a significant difference in the viewing rate between the tasks of reports and implementations ($p=0.002$), which suggests that students with the extrinsic motivational type are more likely to be influenced by the learning behaviors of different task types, whereas students with the intrinsic motivational type are more likely to engage in learning behaviors regardless of the task type.

Then, from the viewing logs of the learning materials, we calculated the average number of views viewed as with video viewing rates. Unexpectedly, learning behaviors increased when students with intrinsic type viewed the dashboard for extrinsic type. On the other hand, the number of times students with extrinsic type viewed documents increased during the times using compared with those not the dashboards. Unexpectedly, learning behaviors increased when these students viewed the dashboard for intrinsic type.

In addition, we showed students' evaluations of the dashboard interface design. In the questionnaire, we asked the students about visualizations that they felt would increase and decrease their motivation and learning behaviors. The results revealed that the dashboard for extrinsic type was selected for both questions and the dashboard for intrinsic type was selected only for the visualizations that the students felt would decrease them. Moreover, some students took action immediately after viewing the dashboard to compare the dashboards with their actions, suggesting that real-time visualization may have been more effective for these students.

4. Conclusion and Future Research

In this study, we presented learners with dashboards designed to fit their motivational type and measured differences in the learning motivation and behaviors of learners who viewed each dashboard. The results showed that individual differences existed in learning motivation and behavior changes due to differences in dashboard visualization formats. This suggests the need for individual optimization of dashboard visualization formats.

As a future task, the experiment situation needs to be improved by removing elements such as task differences that are unrelated to the experimental design. In addition, dashboard contents that fit each motivational type more closely need to be designed, and the classification of dashboards to be optimized based on learning theories needs to be examined in more detail.

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