

Leveraging Learning Analytics to Model Student Engagement Behavior in Graduate Statistics: A Problem-Based Learning Approach in Agricultural Education

Introduction

- ❖ Statistics is essential across disciplines but often creates anxiety for graduate students (DeVaney, 2010).
- ❖ Learning Management Systems (LMS) provide structure, access to resources, and improved communication (Hariri, 2014).
- ❖ Problem-Based Learning (PBL) promotes active, applied engagement and more positive attitudes toward statistics (Armanta et al., 2019).

This study examined how students with different performance levels engaged with the LMS and how they perceived their learning outcomes in a PBL-supported graduate statistics course. To guide this study, we asked three simple but powerful questions:

1. What clusters of students emerge based on LMS interaction patterns and academic performance?
2. How do engagement behaviors and effort regulation differ between these groups?
3. How do students from different groups perceive their learning outcomes (impact of PBL, self-efficacy, interpretation of effects)?

Theoretical Framework

Problem-Based Learning (PBL) engages students in solving realistic problems through collaboration and guided support, rather than passive learning (Barrows, 1986). Instructors acted as facilitators, monitoring progress and providing feedback throughout the process (Schmidt et al., 2011).

Methodology

This study used an **explanatory sequential mixed-methods design**, combining LMS log data with interviews to capture both patterns and perceptions.

- ❖ **Participants:** 19 graduate students in a PBL-supported statistics course
- ❖ **Quantitative:** LMS log data analyzed with k-means clustering and independent t-tests
- ❖ **Qualitative:** 43 semi-structured interviews at three time points; thematic coding with MAXQDA

Figure 1. LMS Interaction Trends by Group

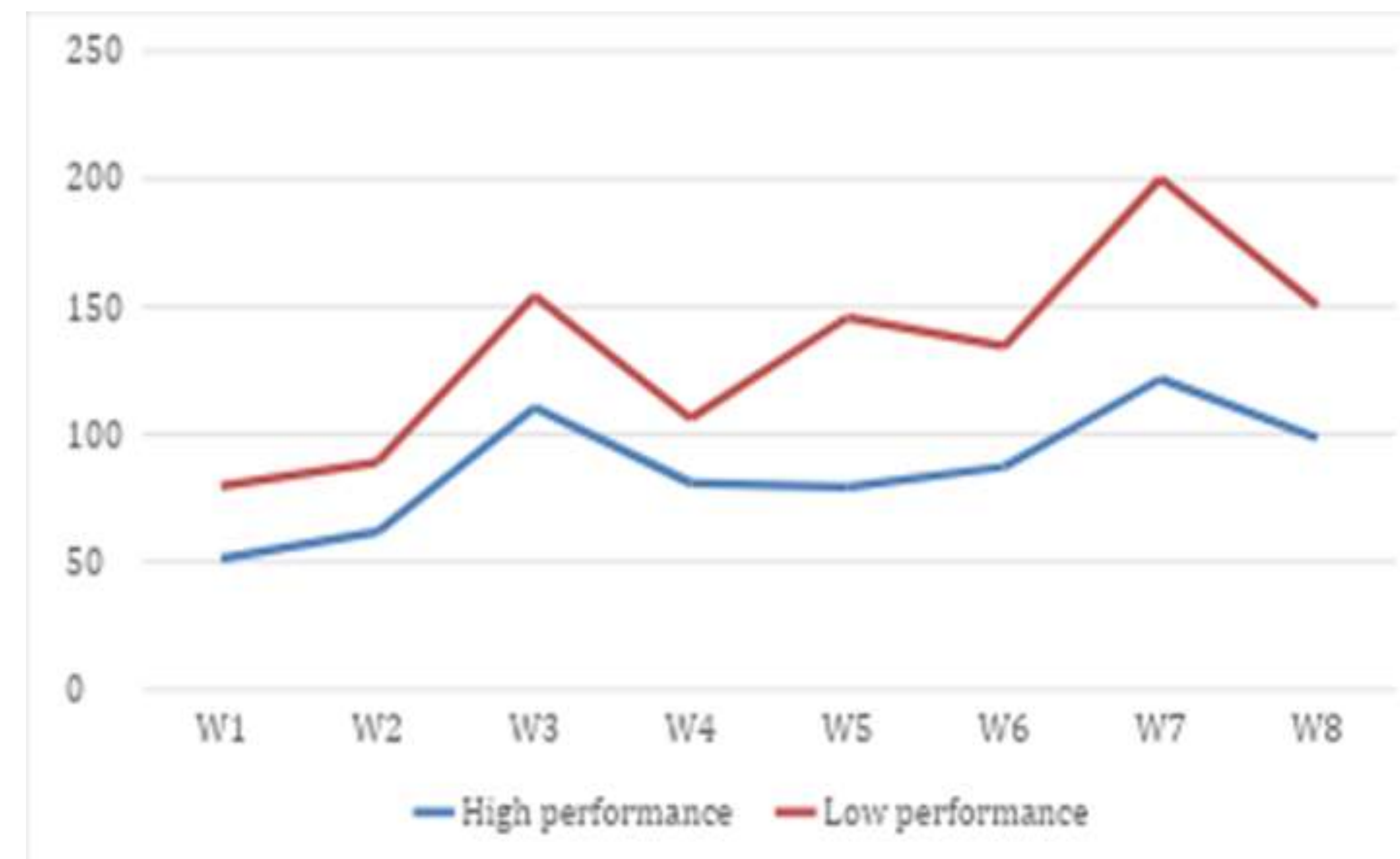


Figure 2: Emerging Themes from Interviews



Findings

Engagement Patterns

Two clusters emerged (see Figure 1). High-performing students engaged in purposeful, steady LMS use, often completing tasks early. Low-performing students checked the LMS more frequently, often reactively, seeking guidance and materials before deadlines.

Emerging Themes:

Interviews highlighted six themes that explain these differences (see Figure 2):

- **Behavioral Engagement** – high performers kept steady routines; low performers worked reactively.
- **Knowledge & Skill Gain** – both groups improved in statistics and software, but at different depths.
- **Role of Assessment** – assignments and exams motivated activity, with high performers using them to confirm learning and low performers to catch up.
- **Self-Efficacy** – confidence grew, especially for low performers, over time.
- **Emotional Struggle** – low performers reported early stress and confusion, while high performers struggled mainly with time pressure.
- **Instructional Support** – all valued feedback and organization, though low performers depended on it more heavily.

Conclusions

Two distinct engagement patterns emerged: high-performing students engaged less but consistently, while low-performing students engaged more around deadlines. Both groups reported growth, reflected in six key themes of engagement and learning.

Recommendations

- ❖ Use LMS data to flag students needing early support.
- ❖ Provide layered support (live coding, reminders, self-paced practice).
- ❖ Scaffold assignments and include reflection to build engagement and combine learning analytics with qualitative insights for equitable PBL.

References

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