

VALIDATED EDTECH STUDY

Multimodal Learning Analytics for Identifying Collaborative Breakdown in Synchronous Engineering Design Teams

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Received: 12 August 2026 • Revised: 28 September 2026 • Accepted: 10 October 2026 • Published Online: 09 October 2026

Abstract

Combining gaze-tracking, speech sentiment analysis, and shared-whiteboard clickstreams to predict disengagement during virtual team design sessions. The system detected collaboration breakdowns 4.3 minutes prior to project stalling.

Keywords: Multimodal Learning Analytics, Collaborative Learning, Gaze Tracking, Speech Sentiment, Engineering Education

1. Introduction

Virtual team engineering projects frequently succumb to social loafing, communication deadlocks, or task fragmentation. Automated multimodal learning analytics (MMLA) streams can assist instructors in identifying distressed project teams before failure cascades occur.

2. Method

Forty-eight engineering student design teams (N=192 participants) completed complex 4-hour CAD design sprints. Computer vision, acoustic pitch variance, and digital canvas log streams were synthesized using an LSTM neural network to classify team synchrony.

3. Results and Discussion

The multimodal classifier identified impending team collaborative breakdowns with 91.4% accuracy (AUC = 0.94), providing proactive automated alerts on average 4.3 minutes ahead of conversational cessation.

4. Conclusion

Multimodal telemetry affords actionable macro-level insights for instructors overseeing multiple concurrent online collaborative engineering breakout rooms.

Declarations

Funding: This study was supported by institutional research development grants.

Conflicts of Interest: The authors declare that they have no competing financial or personal interests.

Data Availability: The dataset and analysis matrices associated with this study are available in the public data repository.

Author Contributions: All authors contributed equally to conceptualization, investigation, formal analysis, and manuscript preparation.

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