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Will defend the Thesis on

Date: May 8, 2026

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Pullman Campus: Cleveland Hall Room 353

Zoom: Link by request ceshs.gradstudies@wsu.edu

Faculty, students and the general public are encouraged to attend

Title:

THE IMPACT OF THE SIGNALING PRINCIPLE ON LEARNING OUTCOMES IN CONCEPT-MAPPING ENVIRONMENTS: A META-ANALYSIS

Chair: Olusola Adesope

Concept mapping is a widely studied instructional strategy with demonstrated benefits for retention, comprehension, and transfer. However, the effectiveness of concept maps depends on their design. Signaling, also called cueing, is one design principle with particular relevance to concept-mapping contexts. It involves adding perceptual cues such as color coding, arrows, highlighting, or labels to direct learner attention toward important information. Despite robust evidence for signaling in multimedia learning broadly, its role in concept-mapping contexts remains unclear, and primary studies report inconsistent findings. This meta-analysis synthesizes evidence from 22 experimental studies published between 2000 and 2025 to estimate the overall effect of signaling on learning outcomes in concept-mapping contexts and to examine whether that effect varies across key moderators.

A random-effects model yielded a moderate pooled effect, Hedges' g = 0.57 (95% CI [0.42, 0.72], p < .001). Outcome type significantly moderated effects, $Q^T(9) = 19.41$, p = .022, with the strongest results for retention (g = 0.82), transfer (g = 0.73), and learning performance (g = 0.67). The effect on self-reported cognitive load was small and nonsignificant (g = 0.27, p = .272). Signaling benefits were consistent across science and non-science domains. Learner level (K-12 vs. college) did not significantly moderate effects, though directional patterns were consistent with theoretical predictions. Publication bias diagnostics supported the robustness of the observed effects. These findings indicate that signaling is an effective design principle in concept-mapping contexts and point to directions for future research.

Keywords: signaling principle, concept mapping, multimedia learning, cognitive load theory, meta-analysis, attention cueing, instructional design, learning outcomes.