Title: Conceptual Blending in Science and Science Education

Credits: 2 (~ 22 hours, about 1 contact session per week of 2 hours)

Instructor: Mashood KK

Co Instructor: Sanjay Chandrasekharan

Semester 1: January to April, 2026

Objectives of the Course:

1. Introduction to conceptual blending
2. Introduction to science education research based on conceptual blending as a theoretical framework
3. Understanding the role of conceptual blending in the construction of knowledge in science
4. Applying conceptual blending to model-building contexts like physics derivation, simulations etc. exploring the process of knowledge construction underlying them
5. Applying conceptual blending to design novel technologies to teach/learn science and mathematics

Learning goals:

- Develop familiarity with conceptual blending and its cognitive science underpinnings
- Develop familiarity with science education literature that employs conceptual blending
- Analyze themes and topics from science to understand the dynamics of knowledge construction in them
- Analyze data from science classrooms and see how conceptual blending could help provide new insights
- Analyze pedagogical approaches and learning technologies to understand how they embed conceptual blending

Class Structure and Assessments:

The course will provide an introduction to conceptual blending (CB) and its implications for science education. We will discuss the cognitive science underpinnings of the key ideas involved in CB. After an overview of the framework, we will apply the framework to themes and topics like derivations in physics, simulations etc. The goal is to unpack the dynamics of knowledge construction underlying them, from the perspective of conceptual blending. We will then focus on how CB is currently used in science education research studies. Some data collected from classrooms or student/teacher interviews will be analyzed using conceptual blending as a theoretical

framework. The data analysis exercise will also serve as a context to critically analyze the current implementation of conceptual blending in science education.

Assessment will be based on the following accounts:

1) Presentation of papers

2) Participation in discussion

3) Projects where in the framework of CB have to be applied to to themes and topics like derivations in physics, simulations etc.

Readings:

1) Chapters 1-3, Fauconnier, G., & Turner, M. (2008). *The way we think: Conceptual blending and the mind's hidden complexities*. Basic books.

2) Fauconnier, G., & Turner, M. (1998). Conceptual integration networks. *Cognitive Science*, 22(2), 133-187. https://markturner.org/cinLEA.pdf

3) Van den Eynde, S., Schermerhorn, B. P., Deprez, J., Goedhart, M., Thompson, J. R., & De Cock, M. (2020). Dynamic conceptual blending analysis to model student reasoning processes while integrating mathematics and physics: A case study in the context of the heat equation. *Physical Review Physics Education Research*, *16*(1), 010114.

4) Redish, E. F. (2023). Using math in physics: 7. Telling the story. *arXiv preprint arXiv:2305.12267*.

5) Van den Eynde, S., Deprez, J., Goedhart, M., & De Cock, M. (2022). Undergraduate students' difficulties with boundary conditions for the diffusion equation. *International Journal of Mathematical Education in Science and Technology*, *53*(8), 2176-2198.

6) Hutchins, E. (2005). Material anchors for conceptual blends. *Journal of pragmatics*, *37*(10), 1555-1577.

7) Zandieh, M., Roh, K. H., & Knapp, J. (2014). Conceptual blending: Student reasoning when proving “conditional implies conditional” statements. *The Journal of Mathematical Behavior*, *33*, 209-229.

8) Gire, E., & Price, E. (2013, January). Arrows as anchors: Conceptual blending and student use of electric field vector arrows. In *AIP Conference Proceedings* (Vol. 1513, No. 1, pp. 150-153). American Institute of Physics.

9) Hoehn, J. R., Finkelstein, N. D., & Gupta, A. (2016). Conceptual blending as a tool for analyzing group discourse. In *2016 Physics Education Research Conference Proceedings* (pp. 152-155).

10) Al-Zahrani, A. (2007). Darwin's metaphors revisited: Conceptual metaphors, conceptual blends, and idealized cognitive models in the theory of evolution. *Metaphor and Symbol*, *23*(1), 50-82.

11) Brahmia, S. W. (2018). Negative quantities in mechanics: a fine-grained math and physics conceptual blend?. In *2017 Physics Education Research Conference Proceedings* (pp. 64-67).

12) Dreyfus, B. W., Gupta, A., & Redish, E. F. (2015). Applying conceptual blending to model coordinated use of multiple ontological metaphors. *International Journal of Science Education*, *37*(5-6), 812-838.

13) Gregorcic, B., & Haglund, J. (2021). Conceptual blending as an interpretive lens for student engagement with technology: Exploring celestial motion on an interactive whiteboard. *Research in science education*, *51*, 235-275.