Title: Conceptual Blending in Science and Science Education

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

Instructors: Dr. Mashood K. K., and Prof. Sanjay Chandrasekharan

Teaching Assistant: Mr. Prithu Ghosh

Course Number: SCE322.2

Course Day and Time: Mondays (11 AM to 1 PM)

Starting from August 14, 2023

Semester: August to December, 2023

Objectives of the Course:

1. Introduction to conceptual blending
2. Introduction to science education research based on conceptual blending as a theoretical framework
3. Critical analysis of conceptual blending from the perspective of how models give us knowledge
4. Exploring an artefactual approach to conceptual blending, to develop a theoretical framework more appropriate for science education.

Learning goals:

- Develop familiarity with conceptual blending and its cognitive science underpinnings
- Develop familiarity with science education literature that employs conceptual blending
- Analyze data from science classrooms and see how conceptual blending could help provide new insights
- Cultivate the ability to develop theories of science learning, based on cognition frameworks and empirical data collected from classrooms or student/teacher interviews

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 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. The course will then explore the development of a new framework - `artefactual approach to conceptual blending'. This structure could better support analysis of science education cases, as the existing discussions on conceptual blending is heavily influenced by discourses in linguistics, and as such have limitations.

Assessment will be based on the following accounts:

1) Presentation of papers

2) Participation in discussion

3) Two term papers - a mid term and a final term paper. The topic of mid-term paper will be assigned by the instructors. The expected length is around 2000 words. It will have half the weightage in score compared to the final term paper, whose expected length is 4000 -5000 words . For the final term paper students can choose a theme, in consultation with instructors.

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) Buckner, R. L., & Carroll, D. C. (2007). Self-projection and the brain. *Trends in cognitive sciences*, *11*(2), 49-57.

6) Amin, T. G., Levin, M., & Levrini, O. (2023). Theorizing Concept Learning in Physics Education Research: Progress and Prospects. *The International Handbook of Physics Education Research: Learning Physics*, 11-1.

7) 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.

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

9) 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.

10) 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.

11) 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).

12) 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.

13) 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).

14) 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.

15) 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.