Dynamic Chunking and Concept Mapping

Ananth Yegavakota, Prajna Penmetsa

Dec 12, 2025

Abstract/Description

This research investigates "chunking" as a collaborative meta-learning principle by developing an interactive tool that facilitates dialogue between a Subject Matter Expert (SME) and a student to negotiate the breakdown of complex academic topics. The project integrates an LLM-driven chat interface with a visual canvas (using Mermaid.js or D3.js) to generate and modify concept maps that visualize these chunks and their connections. The study aims to evaluate whether this co-creative, interactive mapping process leads to better retention and understanding of conceptual relationships compared to traditional text-only or static summary methods.

Research Questions

1. Can an LLM-driven dialogue effectively guide a student to identify meaningful "chunks" of a complex academic topic?
2. Does the co-creation of a visual concept map lead to better retention and understanding of the relationships between concepts?

What progress has been made this week?

1. **Dataset Expansion & Granularity:** We expanded to the full IIIT Monsoon 2024 POC dataset, refining the JSON schema to split detailed syllabi by unit for better visualization and establishing a GitHub repository for version control.
2. **Backward Generation Pipeline:** We executed the description generation pipeline using a six-key Gemini API rotation to overcome rate limits, successfully filling missing descriptions for the entire catalog.
3. **Multi-Taxonomy Assignment:** We implemented the `assign_taxonomies` module using `gemma-3-27b-it` to tag learning objectives against Bloom's, ABCD, and SMART frameworks.
4. **Exploratory Data Analysis:** Initial analysis revealed significant class imbalance in the Bloom's dataset and high sparsity (frequent null values for "Condition" and "Degree") in the ABCD output.

What are the next steps?

1. Continue exploratory data analysis
2. Continue evaluation methods exploration
3. Refine Prompts & Data: iterate on the ABCD prompts to resolve data sparsity and develop strategies to handle the class imbalance in Bloom's taxonomy.
4. Implement Evaluation: start execution of the "LLM-as-a-Judge" proxy evaluation methods for both generated descriptions and taxonomy tags.
5. Human Verification: Select a stratified sample of the processed data to prepare for the human annotation phase.