Through the RME Looking Glass: Utilizing Analogies to Bridge the Gap for Beginners

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According to Gentner (1983), an analogy maps a source domain (the unfamiliar) to a target domain (the familiar). Thus, the objective of an analogy is to capture the essence of the concept and demonstrate that idea in a familiar setting. In our poster, we will introduce an example of a carefully constructed analogy and how it can be a useful tool for beginners that are still gaining intuition in unfamiliar concepts. Consequently, the audience for the analogy assumes only comfortability in college algebra skills. The goal of our research is to demonstrate an example of the resourcefulness of analogies as a teaching tool and the notion of translating complex mathematical concepts into unconventional contexts.

The teaching topic in question is introducing a specific numerical method for solving linear variable-coefficient ordinary differential equations (ODEs) in a two-point boundary value problem (target) by utilizing an analogy involving a cube of varying density restricted to a ruler (source). Variable-coefficient ODEs are equations that are defined on an infinite domain and thus often must be restricted to a set interval to become manageable when solving. For a boundary value problem, the ODE is simply paired with the given solution at its boundary.

Our analogy relates an ODE and cube in the following ways: their restriction to a set interval (two-point boundary and ruler), dependence on varying characteristics (variable coefficients and varying density), solutions (function $y(x)$ and total weight of cube), boundary conditions (given say $y(1)$ and $y(4)$ and weight of cube at 1 in. and 4 in.), and method for solving (steps of numerical method explained in target and source domain). Along with the poster itself, we include manipulatives that represent the physical components in the source domain: a cube, ruler, tape measure, thumbtacks, paper slices acting as slices from the cube, etc.

Through our analogy, we introduce an approachable example that can engage students and, ideally, create a fun and memorable learning experience. These qualities are at the core of Realistic Mathematics Education (RME) and research in embodied cognition. RME urges that mathematical instruction should be realistic and rooted in real-world context. Gravemeijer & Doorman (1999) define "realistic" in RME to situations that students can imagine and comprehend and thus are relevant in the student's reality. Our analogy (or "the model") meets students at their level of understanding and thus allows them to reason and gain intuition in multiple unfamiliar concepts (Gravemeijer, 1999). Additionally, our analogy provides visual and interactive components that encourage embodied cognition. When students can engage their bodies in physical actions, gestures, object manipulation, and so on, this allows them to form a deeper understanding and have a more memorable learning experience (Antonides & Battista, 2022; Lakoff & Núñez, 2000; Nathan, 2021).

Overall, RME and embodied cognition education research tend to stray from the "traditional classroom" that involves no student engagement and only instructor-based lectures. Thus, with the support of RME and embodied learning, the addition of analogies to the classroom can hopefully open the doors for math to be more fun, memorable, and engaging—not only for children, but also for students in higher education. Feedback is welcomed on the proposed use of analogies as a teaching tool, the notions of unconventional math translations, and on the analogy itself.

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