Role of Mathematics in Learning Physics

Introduction

- Recent PER work shows that when students lack essential mathematical conceptual understanding it becomes problematic when engaging in the discourse practices of physics (e.g., Chistensen & Thomson, 2012).
- In South Africa, only 4 in 100 learners leave school with a pass mark in mathematics! The further you go in physics, the more mathematical it becomes.
- The main problem seems to be when students have to “move between various modes or semiotic systems” (Duval, 2006: Bezem Kress, 2008).
- How can students be given access to abstract, mathematically dense physics ideas?

Key Concepts

- **Social semiotic framework** (Airey & Linder, 2009) – Semiotic resources (or modes) refer to the tools, activities and representations which constitute the discourse of physics, within a social semiotic framing. The ‘actors’ engage with the ‘content’ of the discourse in a social space in which meanings are constructed in a specialized way.
- **Multimodality** – communication of disciplinary knowledge requires coordination between sets of resources (Kress, 1997).
- **Transduction** (Kress, 1997) – refers to the making of meaning across modes within social semiotic view of multimodality.
- **Disciplinary affordance** – the disciplinary-specific meaning potential of a semiotic resource (Fredlund, et. al., 2012)
- **Pedagogical affordance** – the aptness of a given resource for the teaching and learning of disciplinary content (Airey 2015).

Methods / Data Collection

- **Phase 1 of study will focus on coordinate systems.**
- Video recording students and facilitators / researchers engaging and interacting with digital / experimental design.
- **IOLab** (Interactive Online Lab system) – allows students hands-on activities anywhere anytime.
- Potential for high pedagogical affordance i.e. “making the invisible visible” – students can manipulate the IOLab in 3 dimensions and in so doing develop a “feel” for aspects in physics which are abstract and not easily noticeable.

Some research questions

1. What are the key aspects of coordinate systems students need to notice?
2. What semiotic resources in physics are available, and which are problematic, for students to develop disciplinary fluency when working with coordinate systems.
3. How can students’ own everyday semiotic resources be leveraged to appreciate meaning potentials of physics resources?
4. Does the IOLab facilitate transduction between resource systems?

**Footnotes**


