Winter 2020 FIG Report

What does Representational Fluency look like? & What does the lack of Representational Fluency look like? (in Chemistry, Mathematics, Physics)

Member Information

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Completed planned activities, meetings and topics

We met throughout the term for one more day than proposed (see below). The proposal list below provides a good general outline of the scope of our inquiry and conversations.

- **Mtgs 1 &2:** Discussion of literature regarding representational fluency and approaches to identifying representations and representational fluency in our disciplines. (Meeting preparation necessary.)
- **Mtgs 3&4:** Reports/discussions of concrete investigations and reflections.
- **Mtgs 5&6:** Discussion of further and wider pedagogical connections and opportunities for increasing representational fluency.
- **Math & Science colloquia** on representational fluency, organized by FIG group.

Accomplishments

This FIG embodied and validated the practical utility and foundational need for representational fluency as supporting curriculum improvement in disciplines, curriculum improvement across disciplines where common explicit language can be especially productive for students integrating their learning, and for faculty member communication in creating optimal curriculum alignment.

As a special case among four disciplines from Mathematics and Science, this positive experience suggests focus on representational fluency on a larger scale with grant funding, which would support improvement in student learning across Lane and beyond.

- **Our FIG modeled a description of representational fluency, which had resonance among faculty.** In the proposal, FIG discussion, and in a wider Math/Science divisions presentation, representational was introduced in the following way:

- From DeAnn Hunker's "Representational Competence: A Renewed Focus for Classroom Practice in Mathematics" (Hunker – 2015):

  Representational competence in mathematics is the ability to use representations meaningfully to understand and communicate mathematical ideas and to solve problems. In the literature, this ability is sometimes referred to as "representational flexibility" (Greer, 2009), "representational fluency" (Nathan, Alibali, Masarik, Stephens & Koedinger, 2010), or "representational thinking" (Pape & Tchoshanov, 2001). Regardless of the term, each emphasizes the value of students' ability to work proficiently with varied representations and how that ability supports students' success in learning mathematics. In fact, Collins (2011) challenged the profession to elevate the importance of representations when he suggested that "the teaching of representational competence should lie at the center of classroom practice in math and science" (p. 105).

  In "Representational Competence: A Commentary on the Greeno Analysis of Classroom Practice" (Collins - 2011), Allan Collins, quoted in the above (Hunker – 2015) paper, provides elaboration and further perspective, including:

  There are many representational forms or model types that are specific to a particular science and new ones are always being invented. System-dynamics models and production-system models are relatively recent inventions, made possible by the development of computers, with their dynamic modeling capabilities. If learners develop the capabilities to produce, manipulate, and interpret these different representational forms, they are gaining use of powerful epistemic tools for making sense of the world. Gaining representational competence should be a major goal of all mathematical and scientific education.

  … As we develop new technologies representing knowledge … we are expanding capabilities to formulate our theories in precise terms (Feurzeig & Roberts, 1999). We are, as it were, at a time of representational flowering. Teaching representational competence will become more and more critical for education in the future.

- Active discussion over most of the term engaged members from Astronomy, Chemistry, Mathematics, and Physics, which generated rich discussion and a wide variety of points of understanding across disciplines, which will have a life of their own. It validated the representational fluency lens as a productive cross-disciplinary framework.

  The FIG topic itself, served as an encouraging context for a Science colleague outside the FIG to share an article on representation regarding integral calculus with the FIG members and Math colleagues teaching calculus.

Representation was introduced and put into practice in the FIG and during the Math/Science colloquium, modeling and providing space for others to engage in cross-disciplinary discourse

The FIG supported immediate improvements in curriculum (at a small, but significant scale) and validated representational fluency's connection to curriculum improvement.

- One discussed example was Erickson's work on discernment in use of the HR-diagram in Astronomy. His paper provided direct comprehensive guidance about this powerful representation, including a concrete identification of its many layers and aspects and the difficulties students face. This informed the ASTR 122 class pedagogy on that subject. It also offered an example of representational fluency, in particular the concept introduced by Erickson of "professional discernment", as an umbrella concept encompassing detailed literature on student difficulties and subtleties of common curriculum elements, which is especially helpful.

- Explicit use of the concept of representation took place in our discussions, which provided language for metacognition in faculty conversations. When representation and representational fluency is specifically dissed in class, it became a form of metacognition for students about the subject matter of the class, in general, which is correlated to better pedagogy and better learning by students

- In general, discussions of representation demonstrated that they created greater space for others to engage in cross-disciplinary discourse. For example, in describing our teaching, a focus on representation led to discussing the many layers of increasingly complex visual Chemistry representations of atoms and molecules. And in another situation, a greater appreciation was developed of explicit inclusion of narrative representation along with diagrammatic and mathematical representation in a variety of contexts.

- Such discussions also demonstrated their tendency to validate and support the curriculum work involving representation and representational fluency.

We briefly discussed further engagement with representational fluency.

- The FIG was appreciated as part of ongoing support for representational fluency and the Scholarship of Teaching and Learning (SoTL).

- We discussed issues of future grant funding and inservice participation.