STEM Students' Views on the Meta-Roles that Function Plays Across the Mathematics Curriculum

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Keywords: Function, Curricular Coherence, Narrative Learning Theory, Multivariable Calculus

One of the purported goals of undergraduate mathematics is to encourage students to draw connections between the various mathematical subfields (Zorn, 2015, p. 11). The function concept—which is crucial in almost every area of mathematics—could serve a primary role in forming these connections, yet this role often goes unnoticed by students (e.g., Melhuish et al., 2020). Indeed, function is a critical recurring theme throughout undergraduate mathematics (Zandieh et al., 2017) that could be leveraged by students to increase their sense of curricular coherence across courses. This theme recurs implicitly and even explicitly in most mathematics courses, but research reminds us that students do not always take up course ideas and themes in the ways instructors intend (Clift & Brady, 2005; Lew et al., 2016). Despite this, there are few studies that speak to the ways that students leverage function as a theme to organize and make sense of their curricular experiences both within and across courses. In particular, there is much research on the metaphors students use for the *concept* of function across contexts (e.g., Lakoff & Núñez, 2000; Melhuish et al., 2020; Zandieh et al., 2017), but much less research on the *meta-roles* that students view function as serving in organizing the mathematics curriculum.

In this poster, I address two questions: (1) What do students' stories about functions reveal about the meta-roles that the function concept plays for them in organizing the mathematics curriculum? (2) In what ways do these general meta-roles appear (or not) in students' stories for functions in a specific course context? I answer these questions by analyzing the stories of three STEM students pursuing different majors who were enrolled in multivariable calculus (MVC). These stories were told during a sequence of four, 1.5-hour, task-based interviews spread throughout a semester—the first concerned the role of function across mathematics and STEM courses and the remaining interviews focused on single-variable; multivariable, real-valued; and multivariable, vector-valued functions, respectively. Using narrative learning theory and Dietiker's (2015) analytic framework for viewing the mathematics curriculum as a story, I juxtapose students' stories about the meta-role of function across the undergraduate curriculum with the stories they tell about different types of multivariable functions they encountered throughout MVC. I attend to students' stories because, as Clark and Rossiter (2008) put it, "Every day we are bombarded with a dizzying variety of experiences and we make sense of those by storying them, by constructing narratives that make things cohere. Coherence creates sense out of chaos by establishing connections between and among these experiences" (p. 62). In other words, stories are a primary representation of students' sense of curricular coherence.

Based on this preliminary, exploratory analysis, I find that students' general stories reveal developed, idiosyncratic views of the meta-role that function plays as an organizing, cross-curricular theme (e.g., "functions are like the ABCs of mathematics", "functions are kind of like canvases, and we're being trained as painters"). On the other hand, students' specific stories about functions in MVC did not explicitly leverage the same meta-roles or thematic structures that were present in their general stories. This suggests that if we want students to use function as a productive, organizing curricular theme, we must provide further reflective opportunities for students to coherently organize their course experiences with respect to this theme.

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