Relationship Between Precalculus Concepts and Success in Active Learning Calculus Courses

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As part of an ongoing project to redesign a calculus sequence centered around core calculus concepts through an active learning approach, we aim at understanding the knowledge students need in order to be successful in this setting. In particular, we are interested in exploring what conceptual understandings of precalculus concepts support students in an active learning intensive calculus sequence. We present preliminary results of an analysis carried out to answer the question: What is the relationship between students' precalculus understandings and performance in this newly redesigned calculus sequence?

Keywords: Assessment, Calculus, Student Outcomes, Active Learning

There has been a recent call for an increase in STEM bachelor's degrees (Olson & Riordan, 2012) and it has been suggested that empirically tested and validated teaching practices, like active learning, are critical to attain this goal (Freeman et al., 2014). In response to this call, there is an innovative calculus curriculum currently being developed and implemented by mathematics education faculty and graduate students at Portland State University. This curriculum has been designed with active learning strategies in mind and was adapted from Pat Thompson's DIRACC project which is grounded on research pertaining to students' mathematical thinking and understanding of core calculus concepts (Thompson, Byerley, and Hatfield, 2013).

For this study, we present some preliminary results aimed at answering our research question: *What is the relationship between students' precalculus understandings and their performance in this newly redesigned calculus sequence?* Data for this analysis was collected during the 2018 summer term. The pre-assessment we administered consisted of six items adapted from the Precalculus Concept Assessment (Carlson, Oehrtman, and Engelke, 2010), Aspire MMK assessment (Thompson, 2016), or from tasks created by Hackenberg and Lee (2015) designed to assess students' reasoning with linear equations. One section of each of the redesigned Calculus I (differential calculus) and Calculus II (integral calculus) courses received this assessment. There was a combined total of 64 students in the two courses who took the pre-assessment as well as completed the course.

A Pearson correlation was used to investigate the relationship between Calculus I students' precalculus understandings (M=2.85, SD=1.64) and their final exam scores (M=80.09, SD=16.2). Results suggest a significant positive correlation between precalculus understandings and final exam scores, ($r(30)$=0.52, p<0.001, N=32). A similar analysis revealed a moderately significant positive correlation ($r(30)$=0.28, p=0.058, N=32) between Calculus II students' precalculus understandings (M=2.93, SD=1.48) and their final exam scores (M=79.3, SD=15.95). Future analyses will investigate correlations between particular final exam items and performance on each of the individual items on the pre-assessment. We hope to use the results of this study to aid in the continual refinement of this calculus curriculum by providing insight into what knowledge our students are coming into calculus with and how that knowledge supports them in the success of this active calculus sequence.

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