# Improving Student Takeaway in Introductory Numerical Analysis/Scientific Computing Courses: A Threshold Concepts Approach

Jonathan Calver, Tom Fairgrieve, Paul Muir

Saint Mary's University, Department of Mathematics and Computing Science, Technical Report 2021_001, 2021

In this report, we describe a project whose goal is to address issues associated with student takeaway, i.e., issues with enduring learning, in introductory courses in Numerical Analysis/Scientific Computing (NA/SC) commonly taught in undergraduate degrees in Computer Science, Mathematics, Engineering, and Physics.

The fundamental point we begin with is the observation that if we want our students to take away important concepts from our courses, then our course material, the way that the course is taught, and the corresponding evaluation instruments must focus on those important concepts. Deeper student engagement with these concepts implies that they will be better retained by the students after the course is completed.

It is therefore essential that a careful analysis of the course content be undertaken in order to identify the concepts, the essential ``gems" of the curriculum, that students should take away. In this project, we have employed the well-known framework of Threshold Concepts (TCs) in order to identify essential ``takeaway" concepts for introductory NA/SC courses. We report on the TCs we have identified for introductory NA/SC courses and show how components of a typical/traditional NA/SC curriculum map onto the TCs. An initial effort to better incorporate these TCs into a recent offering of an NA/SC course is described. We also report on the results of two types of surveys that we have developed and given to students in order to further investigate the impact of the threshold concepts that we have identified.

Focusing a course on the TCs allows for a more extensive treatment of these featured concepts through the use of active learning activities in the classroom coupled with authentic assessment instruments that require deeper student engagement with course material at higher levels within Bloom's taxonomy of learning.