More content and less time: Opportunities and challenges for interdisciplinary marine science students

Today's undergraduates in marine science have been presented with tremendous opportunities, yet are confronted with many challenges. Marine science is becoming an increasingly complex and interdisciplinary field that requires an understanding of a vast and diverse collection of data sets across a variety of spatial and temporal scales, from coarse scale remote sensing data to finer scale genomic experiments. These data are creating unprecedented opportunities to investigate scientific questions in the marine environment across regional, continental, and global scales. Likewise, students are increasingly being required to develop their quantitative reasoning and computational skills to be able to work with these data and to address the increasingly complex ecological/scientific problems in the marine environment. To compound that, students have increasing number of software tools and coding languages choose from to useful for their analyses.

The University of Tasmania's Institute for Marine and Antarctic Studies is one of many marine science programs that use an interdisciplinary approach to learning. Parts of the program integrate the study of natural science with current practice in management, policy and law, while other parts integrate biological and physical sciences. This interdisciplinary approach attempts to synthesize more than one discipline and typically involves teams of teachers, joint teacher planning (in theory) and block teaching. This supposed interdisciplinary approach allows students to see different perspectives, work in groups and provides for broadened perspectives and the ability to synthesize and analyze information from two different disciplines. One of the main criticism against interdisciplinary learning at the undergraduate level is that educational development is often hindered when students lack a mature base in any of the contributing disciplines. Since educational development requires critical reflection on part of the student, the lack of fundamental foundation skills will more than likely lead to conceptual confusion and a cursory command of a smattering of subjects. On the other hand, there is great potential in the interdisciplinary curriculum. For highly motivated students, there are benefits to interdisciplinary learning, such as a deepened learning experience gained from applying the knowledge from one discipline to another. In addition, in a blended learning environment with more online content and less instructor interaction, the challenge has become to increase 1) the interdisciplinary capacities of undergraduates, and 2) their fundamental foundation skill in quantitative reasoning and computation. More content, less time.

To attempt to address this challenge we are developing a series of learning modules in MATLAB that will serve to facilitate interdisciplinary learning and the development computational skills in an interdisciplinary marine science major. In these modules, students will collect and interpret aggregated data from large on-line marine scientific data repositories to, 1) gain technical skills in discovering, accessing, managing and visualizing large, numerous and disparate data sources, 2) interpret, analyze and design approaches to visualize these data. Each activity has a progressive step-wise structure with three exercises that build from relatively simple to more complex. The full progressive module allows students to complete a learning cycle involving data access (discovery), analysis (including data aggregation and integration) and visualization. All module activities include a short recorded lecture to introduce the topic, a handout that gives an overview of the activities, an instructor's manual with a detailed methodology and discussion points, a student assessment (quiz and level-specific challenge task), and survey. The modules address four marine science themes (climate change, algal blooms, habitat mapping and biodiversity) through the progressive step-wise structure, utilizing a series of marine science and oceanographic data portals and repositories, the IMAS Data Portal (IMAS-DP), IMAS Temperate Reef Base (IMAS-TRB), Australian Ocean Data Network (AODN), Integrated Marine Observing System (IMOS), Ocean Color Web (OCW), USGS

Global Visualization Viewer (GLOVIZ), and National Oceanographic Data Center (NODC). The analysis and visualization instruction involves the use of UTas licensed MATLAB software. These modules will not replace existing quantitative course offerings for the traditional disciplines, but will be placed within the interdisciplinary offerings.