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EXTENDED ABSTRACT ONLY

What core integrated modelling skills should we teach future environmental planners, managers and decision makers?

M.E. Kragt [a]

[a] *School of Agricultural and Resource Economics, University of Western Australia, Perth.*
Email: marit.kragt@uwa.edu.au

Abstract: Teaching in our higher education system is traditionally based around single-disciplinary Schools or Departments. This means that environmental modelling units are typically taught from a particular disciplinary perspective, such as hydrology, geology or ecology. Such a single-disciplinary perspective can create problems when students are introduced to multi-faceted socio-environmental problems - which require multi-disciplinary solutions. Students are often not sufficiently equipped to consider such complex problems from different perspectives. However, the labour market increasingly requires environmental scientists, natural resource managers, spatial planners and policy makers to effectively collaborate with each-other, and with other disciplines and stakeholders. In addition, they are expected to work with computerised decision support tools to make better resource management decisions that account for multiple perspectives. How can we strike a balance between teaching in disciplinary degrees and this identified need for developers and users of interdisciplinary models? This paper addresses this question by presenting the practical experiences from modelling units taught at the University of Western Australia, augmented by data about modelling units taught in universities around the world.

I collected details about environmental modelling units from online university syllabi. Courses in GIS Modelling or Environmental Engineering were not included in the analysis because their specific unit objectives varied significantly from other environmental modelling units. Fourteen undergraduate and postgraduate units as well as two postgraduate degrees on Environmental Modelling were further reviewed to assess from what disciplinary perspective they were taught and whether interdisciplinary modelling played a role in the unit/degree.

The units reviewed are all taught from very different disciplinary perspectives: hydrology, ecology, economics, engineering, geography, and others. Core skills that are taught in most units are: (1) Assessing the model development process (i.e. steps involved in designing and building models); (2) System conceptualisation (conceptual modelling); (3) Analysing model structures, assumptions, and results; (4) Model calibration, verification and validation; and (5) Sensitivity analysis. The software packages that are used most are Microsoft Excel, R, and MATLAB. Nearly all units emphasise skills development to construct simple models and/or to be able to use and apply computer models to various environmental systems. This is particularly relevant for natural resource managers and other decision makers who will most likely be using, rather than developing, integrated decision support tools. One of the surprising findings of the review is that only three units and both MSc degrees included "integrated modelling" or "interdisciplinary expertise" in their course objectives (for example, "developing skills in modelling ecological, hydrological, agricultural and economic systems and the relationships between them"). While a unit syllabus may not completely represent the unit content, interdisciplinary modelling skills do not seem to be a focus of university teaching in Environmental Modelling. This could be problematic given the need for interdisciplinary model developers and users. I suggest that we should better train our students in assessing an environmental problem from different perspectives (be they different scientific disciplines or multiple stakeholder views). While the five core skills identified above are absolutely fundamental, I propose that a sixth core skill must be included in any Environmental Modelling unit: teaching our students critical multi-disciplinary thinking skills, so that they are able to assess whether a model adequately considers the different perspectives relevant to addressing the environmental problem under consideration. To demonstrate the challenges and advantages of integrated environmental modelling, instructors are advised to use real-world examples, drawn from a wide range of environmental issues (e.g. climate change, air and water pollution, agricultural land management, conservation planning, biodiversity and natural resource management).

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