Aligning Assessment in Higher Education:

Using a cognitive structural model to gain insight into student understanding of ecological practice

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A thesis submitted for the degree of Masters of Education with Honours
University of New England

March 2010
Certification

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help receive in this thesis, and all sources used, have been acknowledged in this thesis.

Signature...... 

........ date..27th March 2010..........................
Acknowledgments

I would like to thank my supervisor Professor John Pegg for his advice and guidance over the course of this research, particularly in extensive discussions of SOLO coding. I would also like to thank my co-supervisor A/Prof Debra Panizzon for her support and inspiration through my transition from environmental science to education. Thanks go to both supervisors on comments on drafts of this thesis.

A special thanks to Dr Darren Ryder for his support and assistance in interrogating his environmental science units. Thank you also, for discussions on development of course and unit objectives. Also gratitude is given for comments on extensive drafts of my thesis.

I would like to thank the School of Environmental and Rural Science at the University of New England and specifically acknowledge the students in the unit ECOL202 who provided their assignments for participation in this project, without which this research would not have been possible.

My thanks go to my family and friends who have provided encouragement during my studies and especially Darren and my children Ben, Ollie and Toby for their tolerance of a preoccupied mother at times during this project.
Abstract

Student outcomes in a tertiary science setting are expected to be multi-faceted. Learning outcomes in science encompasses the range of incomplete and partial understanding of single concepts to complete and integrated understandings of multiple concepts accepted by the scientific community. Assessment in the disciplines of Ecology and Environmental Science often focuses on the progression of independence by the student, in scientific research design and report writing.

Qualitative models such as SOLO (Structure of the Observed Learning Outcome) have previously provided a framework for aligned curriculum design with allied assessment items for the teaching and learning of single scientific concepts. There has been no precedent for diverse and multiple concept analysis by SOLO to multi-faceted educational science outcomes. This research project aims to develop a protocol for marking scientific written assessments using a cognitive structural perspective provided by the SOLO model for a second year tertiary level ecology unit. A sectional based and holistic approach within the cognitive structural model was used to compare the effective alignment of assessment through extended written assignments.

The major analysis determined qualitative learning outcomes based on written assessment items which reflect both skills in scientific report writing, and execution and analysis of an ecological study. A subsample of the 2007 cohort was used to design a pilot framework to qualitatively assess a similar assessment task for the following years’ students. The conceptual context for the investigation of qualitative differences in learning outcomes was the written expression of ecological studies as a scientific report. The categorisation of student outcomes was compatible with the theoretical framework of the two–learning cycle per mode version of the SOLO model.

The results of the sectional analyses identify that the majority of students could present a scientifically written review, formulate testable questions, and design and carry out robust replicable studies in a scientific framework. All students within this
cohort could synthesize their results in the given ecological framework, and some students demonstrated greater abstract cognition and application by presenting ideas beyond those directly instructed for the task. This suggests that within a mode, the cycle level is likely to increase. Although this extended assessment task was analysed as separate sections, the lucidity and trail of presented evidence leading to the student outcomes of each section were not independent.

The holistic analysis used three interrelated elements for categorisation: Theoretical, Functional and a Practical understanding. There was a significant and clear separation of holistic outcomes between cycles of the concrete symbolic mode, and between the concrete symbolic and formal modes. A highly positive relationship between qualitative outcomes and quantitative grades was also apparent and were best interpreted by a holistic impression of a students’ work. The strength of a holistic approach is that it integrates all aspects of validity within the single model. Whereas the content validity is definitive in the sectional approach, construct and criterion related issues are strengthened by the holistic approach. A major part of the assessment task under investigation was to uncover a measure of an individual’s reasoning process through construct application of the scientific process and a scientific writing style. The constructs of reasoning, creativity and attitudes were all facets of the functional understanding integrated in the holistic SOLO framework.

Establishing SOLO categories for scientific reports and for the holistic assessment of structured written scientific assignments provides a framework that can more rapidly evaluate meaningful qualitative differences in student outcomes when applied to other extended written scientific tasks within multi-faceted disciplines. The findings of this study have relevant implications for research and development aspects of tertiary teaching and learning; specifically, curriculum design, evaluation of teaching methods, and professional development.
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