

Chapter 2

Evaluating a Genetics Concept Inventory

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ABSTRACT

This chapter examines the reliability and validity of a subset of the Genetics concept inventory (S. Elrod) to discriminate good students from poor performing students in the undergraduate units Genetics and Molecular Biology taught at the University of Canberra, Australia. These two units went through a series of reforms since 2005. These reforms included the implementation of a number of online and tutorial language exercises and strategies designed to promote scientific language competence and subsequent genetics learning. The effect of these interventions was analyzed through grade and assessment performance comparisons with earlier traditionally taught Genetics cohorts as well using the genetic concept inventory. The genetic concept inventory questions used at the University of Canberra have been found to be reliable and valid according to a number of statistical tests.

INTRODUCTION

Molecular Biology and Genetics are taught to undergraduate students at the second and third year level of their University of Canberra degrees. The assumption is, particularly for the third year students who have passed previous units/subjects in fundamental chemistry, biology and biochemistry that the concepts and many of

the details confronted in the more specialised discipline areas like genetics/molecular biology will be familiar. Anecdotally, this has not been true and the specialised language, for a majority of students, leads to a loss of engagement with the content of the unit and hence the learning outcomes. While there are issues around retention of knowledge from previously studied foundation units, it seems a bigger problem is that students find the lecture material, readings and other study material impenetrable.

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Researchers have acknowledged the importance of language in science education for over 40 years. The history of thinking in this field has been reviewed by Wellington and Osborne, and these authors go so far to suggest that language is of primary significance to learning science, a situation that may have been deflected traditionally by the focus on practical/laboratory work in science curricula. Furthermore, previous research in looking at the language of science (Gardner; Gardner and Australian Science Education Project; Pickersgill and Lock) suggested students have problems with both technical and non-technical vocabulary especially with the logical connectives. While these studies did not set out to examine the retention of scientific vocabulary, there was recognition that the comprehension of difficult scientific articles necessitates the retention and understanding of both types of vocabulary. These studies promoted the idea that language understanding, as well as reflective and active reading, are skills that must be taught.

The aim of this study was to investigate whether learning of the genetics/molecular biology unit content, and associated concepts, was enhanced through the application of educational techniques normally found in language learning. To determine the efficacy of this mode of teaching, quantitative and qualitative analyses were performed to compare the 2005 - 2008 (experimental) cohort with the 2001- 2004 student cohorts who studied *Genetics* under a traditional transmissive mode of delivery.

SURVEY PROCEDURES AND STUDENT PROFILE

In order to establish what students do know when reading scientific articles, a pre-project questionnaire was administered to 32 students consisting of 24 females and 8 male students in the 2005 cohort. The average age of the student body was 23 years of age. Questionnaire data reviewed that

21/32 students highlight the difficult words in the article and try to read and read again if they encounter something they do not understand. Most of the difficulties encountered were: (1) not understanding the terms, and (2) having difficulty in maintaining focus.

Students were also asked to make suggestions to improve their reading. Many of them requested shorter articles and a provision of terms, definitions and abbreviations. The pre-experiment questionnaire results suggested that this group of students might be using too few strategies in reading; and secondly when reading, too few modalities were used. In other words, students in this unit were rather passive in the way they learned. Not only did they appear to learn passively, it was also difficult to ascertain whether there was any active construction of knowledge involved at all. Learning seemed to involve a process of reading with a pen.

For the student body involved in this experiment, there were a large number of students who were school leavers. Guided by the research of Gardner (1972, 1977) and Pickersgill and Lock, (1991), a range of techniques were used to teach or reinforce active reading and subsequent reflection skills to students who were set a number of readings from the primary literature in genetics and molecular biology. Underpinning much of this process was a focus on translating scientific words/terms as if they were from a foreign language. Specific techniques employed in this study are outlined in the next section.

EXPERIMENTAL TECHNIQUES APPLIED TO ENCOURAGE LANGUAGE LEARNING

To encourage active learning, a number of techniques used in language teaching and education were introduced over 13 weeks. The techniques employed are shown in Table 1.

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