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A generic assessment framework as a tool for teacher development in agricultural science

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Abstract: *This project reports on the use of a generic assessment framework in Agricultural Science as a tool for teacher development, in response to an external imperative to implement criterion-referenced assessment (CRA) across the University of Tasmania. The framework uses a unique diagrammatic approach to describe four key criteria and sub-criteria of knowledge, analysis, practical skills and communication. The relative emphasis on assessment of student proficiency in each of the four years of the degree course are represented by polygons. The project incorporated: (i) ascertaining the number and type of assessment tasks and use of CRA; (ii) two on-line surveys on staff use of and attitude towards CRA over a six-month period; and, (iii) an evaluation of peer-to-peer professional learning in the use of a generic assessment rubric. CRA was used either consistently or some of the time by 70% of teaching staff who responded, when averaged across the two surveys. The process of implementing CRA and the development of the generic assessment framework resulted in a small increase in staff understanding of the structure of assessment rubrics. The majority of staff considered that CRA was of potential benefit to their teaching and to student learning, although there were a few exceptions; potential reasons for this are discussed. Qualitative feedback from the surveys and workshop identified further issues regarding assessment for discussion within the school. The process of developing the generic assessment framework, which meets the assessment requirements for agricultural science, could be adapted for use in other disciplines within the University of Tasmania, or at other universities.*

Keywords: *criterion referenced assessment, staff professional development*

Introduction

Appropriate assessment and effective feedback (Gibbs and Simpson, 2004) are considered to improve student learning outcomes when undertaken with teaching practices that encourage deep learning by students (Biggs and Tang, 2007). Assessment can be generally categorised into either norm or criterion-referenced assessment (CRA; Biggs and Tang, 2007). Norm-referenced assessment assesses student performance on the basis of grade distributions and is now widely considered to result in poor student learning outcomes through the over-emphasis on grades (Biggs and Tang, 2007). In contrast, CRA uses preset criteria and performance standards to assess student achievement and is either criteria- or competency-based (Sadler, 2008). The alignment between learning outcomes and carefully articulated and transparent assessment criteria and standards in CRA is regarded to improve student learning (Allen, Brown, Butler, Hannan, Meyers, Monkhouse and Osborne, 2007; Carlson, MacDonald, Gorely, Hanrahan and Burgess-Limerick, 2000; Neil, Wadley and Phinn, 1999) and may lead to self-regulation by students in learning and assessment (Nicol and Macfarlane-Dick, 2006).

The majority of Australian universities have opted to use the CRA approach to student assessment. At the University of Tasmania, the Academic Senate approved the recommendations of a CRA working party (Allen et al., 2007) to implement CRA across all faculties and schools by 2010 (Brown, 2008). Educational change with regards to assessment in a complex, large institution such as a university (Macdonald and Joughin, 2009) typically meets limited success when driven from senior management. Instead, the University of Tasmania has used a modified form of distributive leadership (LeFoe, Smigiel and Parrish, 2007) to promote change by engaging one member of the teaching staff to 'champion' CRA in their school, with support from a CRA implementation team. This approach, through peer-to-peer professional learning (Brookfield, 1995), gave each school champion scope to devise an agreed implementation strategy with staff that was best suited to meet their collective needs.

The School of Agricultural Science (SAS) at the University of Tasmania offers two undergraduate courses, including a 3-year Bachelor of Applied Science (Agriculture) and a 4-year Bachelor of Agricultural Science. The two courses have a relatively set schedule of units that progress in skill and knowledge development across years compared with, for example, the Bachelor of Science that offers a wider range of units and disciplinary majors. A survey conducted in the SAS in late 2008 on the use of CRA revealed that teaching staff solely used norm-referenced assessment to assign grades, consistent with the policies for academic assessment within the Faculty of Science, Engineering and Technology (University of Tasmania, 2008). Even though there was an external imperative to implement CRA in the SAS, potential barriers to adoption were numerous and included the attitude of the teaching staff to change (Anderson, 1996), technical issues around the time required and skill to write rubrics (Neil et al., 1999; Sadler, 2008) and the quality and consistency of the rubrics across year groups.

Text-based generic assessment rubrics or frameworks have been reported in the literature (Hughes and Cappa, 2007; Neil et al., 1999; QUT, 2008) that may be used assist staff in preparing assessment rubrics. None of these generic assessment rubrics, however, was appropriate for direct application in the agricultural science discipline, nor did they address issues of continuity and progression in assessment criteria within and across years. A generic assessment framework, together with exemplar assessment rubrics, were developed using the process of peer-to-peer professional learning to ensure a degree of consistency between units in the SAS (Botwright Acuna, 2009). The framework (Appendix) uses a unique visual diagram to represent the emphases on assessment of student proficiency in four key criteria and sub-criteria of: knowledge, analysis, practical skills and communication. Key features of the four criteria are similar to published literature that has categorised student-learning outcomes. This includes, for example, the SOLO taxonomy proposed by (Biggs and Collis, 1982) and the four dimensions of understanding of knowledge, purposes, methods and forms proposed by (Boix Mansilla and Gardner, 1997) in Harvard's Project Zero on the development of learning process in children and adults. While the process of developing the generic assessment framework has been previously reported (Botwright Acuna, 2009), there still exist research questions about the staff professional development and adoption of CRA in the SAS. The aim of this project was to evaluate the implementation of the generic assessment framework and exemplar assessment rubrics as a tool for teaching staff development in the use of CRA in the SAS. Both quantitative and qualitative techniques were used, including two surveys of teaching staff use of CRA in their teaching over a six-month period and recording staff attendance and feedback at a workshop about the generic assessment framework.

Methodology

The project

The research approach adopted a pragmatic method (Creswell, 2003) to address a real world issue in the SAS. The project used a very context-specific approach to address an external imperative at the University of Tasmania, which aims to implement criterion referenced assessment across all faculties and schools by 2010 (Brown, 2008). Teaching staff in the SAS had agreed to progressive implementation of CRA into 1st and 2nd year units in 2009, with the remaining 3rd/4th year units to follow in 2010. A generic assessment rubric was developed with the teaching staff, which, together with exemplar assessment rubrics for different year groups, aimed to ensure a degree of consistency and logical progression in assessment between agricultural science units (Botwright Acuna, 2009). The project aim was to evaluate the use of the generic assessment framework as a tool to assist staff development during the implementation of CRA in the SAS in 2009. This incorporated: (i) ascertaining the number and type of assessment tasks and use of CRA; (ii) two on-line surveys on staff use of and attitude towards CRA over a six month period; and, (iii) an evaluation of peer-to-peer professional learning in the use of a generic assessment rubric.

Number and type of assessment tasks

Ascertaining the number and type of assessment tasks used in the SAS was integral to mapping the adoption of CRA in the school across years. To do this, SAS staff were asked to classify their assessment tasks for each unit into one of the nine categories shown in Table 1 and note whether CRA was used, or not.

Project evaluation

Mixed method research of both quantitative and qualitative data was used in the project evaluation (Creswell, 2003). Quantitative data from six Likert (Uebersax, 2006) questions were collected through an on-line staff survey using Survey Monkey ("SurveyMonkey" 2009) in March and September 2009. Questions included staff use of CRA, the structure and content of assessment rubrics, and perceived value of CRA to teaching, student learning and a generic assessment framework. Staff were given an opportunity to provide written feedback to the survey questions. Survey data were collated and the means reported.

Qualitative data on the generic assessment framework were collected from staff in the form of post-workshop written feedback (Kirkpatrick, 1994). Staff were requested to annotate the draft generic assessment framework and to provide written feedback to three questions: Q1) What aspects of the meeting today did you find useful?; Q2) What questions do you have for future meetings?; and Q3) Any general comments? The number of staff who attended the workshop and completed the feedback form were recorded.

Approval was obtained from the University of Tasmania's Human Research Ethics Committee to undertake the project.

Results

Survey on the use of CRA in the school

A previous survey in September 2008 had showed that no teaching staff in SAS used CRA in their teaching (data not shown). By 2009, all assessment tasks for the two 1st year units used CRA, with the exception of the quiz (Table 1). In 2nd and 3/4th year units, CRA was used in around half and a third of all assessment tasks, respectively. Of these, CRA tended to be mostly used for written and laboratory reports and not for the other forms of assessment.

Table 1. Number and type of assessment tasks examined in the school that used CRA compared with the total (in brackets) in 2009. Totals exclude quizzes.

Year	# Units	Written					Poster	Seminar	Specimen collection	Quiz	Total
		Essay	Review	Report	Field	Lab					
1	2	2 (2)		1 (1)	2 (2)			1 (1)	0 (1)	6 (6)	
2	6	0 (1)	0 (1)	4 (6)	0 (1)	6 (6)	1 (3)	0 (1)	0 (1)	11 (20)	
3/4	14	1 (7)	0 (4)	3 (10)	1 (3)	3 (8)	0 (2)	2 (6)	0 (1)	10 (39)	
4	2		1 (1)	0 (4)			0 (1)	0 (1)		1 (7)	

Staff survey on use of CRA

The first survey in March 2009 was completed by 15 out of a total of 17 teaching staff in the SAS, while 13 out of 15 teaching staff completed the second survey in September 2009, excluding the author.

In both surveys, the majority (around 70%) of staff either agreed or strongly agreed that CRA would benefit their teaching. One staff member commented: "...the real benefit is the improved quality of the assessment tasks and better informed students..." (SAS1). However, one or two staff felt strongly that CRA would not benefit their teaching (Table 1), stating that: "CRA was a secondary means of assessment (to back up their own primary assessment of the work)" (SAS2), or was "a waste of time" (SAS3). Most staff (60%) also agreed or strongly agreed that CRA would enhance student learning.

In the first survey in March 2009, all staff either strongly agreed or agreed that a generic assessment rubric would assist them in developing their own assessment rubrics. One staff member commented that: "(the generic assessment rubric is) a great start... students become more familiar (and) there is constant reinforcement of the criteria they are being assessed against" (SAS4). Consistent with the generic assessment framework (Appendix 1), most staff used three to four criteria in their assessment rubrics, although a few staff used 5 or more criteria. One-third of staff surveyed did not use assessment rubrics in their teaching. With regards to standards of assessment, one staff member commented: "...definitions of fail, pass and HD would be sufficient with other grades lying in between" (SAS5).

From the time of the first survey in March to the second in September 2009, there was a small improvement in staff understanding of the structure of assessment rubrics (Table 2). At the time of the last survey in September, most, although not all staff considered that the generic assessment framework had assisted them to develop assessment rubrics.

Table 2. Staff survey on use of assessment rubrics on two occasions, (1) March; and, (2) September 2009.

Q1. CRA has potential benefit for my teaching	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1. Staff (n=15)	33% (5)	40% (6)	20% (3)	7% (1)	
2. Staff (n=13)	23% (3)	46% (6)	15% (3)		15% (2)
Q2. CRA will enhance student learning in the units that I teach	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1. Staff (n=15)	13% (2)	47% (7)	33% (5)	7% (1)	
2. Staff (n=13)	7% (1)	54% (7)	23% (3)	8% (1)	8% (1)
Q3. The generic assessment framework <i>will</i> assist me in developing assessment rubrics for the units that I teach (March 2009)	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1. Staff (n=15)	54% (8)	47% (7)			
Q4. My assessment rubrics contain:	2-3 criteria	3-4 criteria	4-5 criteria	5 or more criteria	I don't use assessment rubrics
1. Staff (n=15)	14% (3)	36% (5)		14% (2)	36% (5)
2. Staff (n=13)		46% (6)	8% (1)	23% (3)	23% (3)
Q5. I know the difference between assessment criteria and standards	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1. Staff (n=15)		33% (5)	40% (6)	20% (3)	7% (1)
2. Staff (n=13)	8% (1)	46% (6)	39% (5)	8% (1)	
Q6. The generic assessment framework <i>has</i> assisted me in developing assessment rubrics for the units that I teach (September 2009)	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
2. Staff (n=13)	23% (3)	38% (5)	23% (3)	8% (1)	8% (1)

Note: Values in brackets represent the number of staff endorsing a particular statement.

Workshop on the generic assessment framework and use of CRA

The generic assessment framework and experience in use of CRA was discussed among SAS teaching staff at a workshop. Six out of fifteen teaching staff attended the workshop, all of whom provided qualitative data through post-workshop written feedback.

All six staff had positive comments about the generic assessment framework in response to Q1) “What aspects of the meeting did you find useful?” Staff responses ranged from general positive comments on the opportunity to reflect on common experiences in using CRA, to specific comments on the generic assessment framework, such as: “...the importance of the core criteria and their relative weighting over the degree” (SAS6), and: “(the) inclusion of specific vs. general criteria in (assessment) rubrics” (SAS2).

All staff provided written, albeit diverse, feedback to Q2) “What questions do you have for future meetings?” Two staff commented on the potential for including other sub-criteria in the generic assessment framework, such as: “professionalism (and the) level of engagement in class activities” (SAS6). Three staff also noted that the use of CRA in examinations required further discussion. One staff member suggested that the “student perception of CRA” (SAS5) could be discussed in future meetings.

Only a few staff responded to the third question Q3) “Any general comments?” Of these, one person requested a further workshop on developing a rubric “maybe dissecting one rubric would be helpful”.

Discussion

Overall, staff uptake of CRA increased from nil in September 2008, to around 70% of staff in SAS using CRA in some, if not all, of their teaching. A combination of political, technical and cultural factors that in part addressed the potential barriers to change (Anderson, 1996) were likely to have contributed to the relatively high rate of adoption of CRA by teaching staff in the SAS. Successful educational reform strategies are collaborative (McChesney, 1998) and the project was well supported at various administrative levels, including the CRA implementation team, the Head of School of SAS and the school champion. While there was recognition from the staff of the requirement to implement CRA within the SAS (Allen et al., 2007), the key drivers of adoption were more likely to include the provision of tools to aid professional development of staff, plus the belief of the majority of staff that CRA had potential benefit for their teaching and student learning.

Teaching staff needed practical assistance to adopt CRA in their already hectic schedules. Peer-to-peer learning has been linked to positive outcomes in solving problems collaboratively, as described by Brookfield (1995). The first survey in March 2009 showed that the teaching staff were in favour of the development of a generic assessment framework as a tool to assist them in writing assessment rubrics. The framework was supported by exemplar assessment rubrics for an essay and a laboratory report in each year group. The process of developing the assessment framework through peer-to-peer learning and access to exemplar assessment rubrics appears to not only have contributed to the adoption of CRA in the SAS, but also resulted in a small yet significant improvement in teaching staff understanding of the structure (i.e. criteria and standards) of assessment rubrics. Most staff indicated that they used three to four criteria in their assessment rubrics, which was consistent

with the generic assessment framework and exemplar assessment rubrics. Some staff, however, used more or less criteria than this. Other research has also indicated that the majority of criteria fall into four categories of knowledge, analysis, practical skills and communication, or their equivalent (Boix Mansilla and Gardner, 1997). It would seem likely that a large number of criteria arise from the use of the various sub-criteria as criteria (Appendix). While the generic assessment framework is not prescriptive, an excessive number of criteria can create practical issues in the application of grading rules for teachers and potentially student comprehension and use of the rubric in self-regulation of their learning (Nicol and Macfarlane-Dick, 2006). Development of the generic assessment framework will be ongoing, as we continue to debate the inclusion of current or new sub-criteria, such as student professional attitude.

An interesting finding of the research was that there was no significant change in staff attitude towards and use of CRA in teaching from the first to second survey. An analysis of the use of CRA across units and years, together with staff feedback from the survey and workshop, provides some insight into adoption by teaching staff. Implementation of CRA in combined third and fourth year units was optional, and used in around 30% of assessment tasks. Presumably, these teaching staff took the option to use CRA due to perceived benefits either to their teaching or to student learning (Biggs and Tang, 2007). Teaching staff had agreed to implement CRA in first and second year units in 2009, yet only around 50% of second year assessment tasks used CRA. One staff member cited a personal preference for holistic assessment. There is ongoing discussion in the literature regarding the use of alternative modes of assessment, including CRA, and their potential benefits to student learning (e.g., Sadler, 2005, 2008). Other staff members considered CRA to be a “waste of time”. The generic assessment framework and exemplar rubrics had been developed with staff to partly address the issue of time. A few staff members also regarded that the generic assessment framework did not help them to develop assessment rubrics. In both of these examples, it is difficult to ascertain what was driving people’s opinions from the available data. Personal beliefs and perceptions about teaching are difficult to change (Anderson, 1996) and are well-known to be a key factor in the successful implementation of educational reform (Johnson, 2007; Van Driel, Beijaard and Verloop, 2001). The way forward is to continue to work with interested staff in the implementation of CRA in the SAS. Demonstrated evidence of improved teaching or learning outcomes for students in the longer term may eventually sway those who at present remain unconvinced of the potential benefits.

The findings reported and discussed in this paper revolve around staff development in the SAS in the use of CRA. Within the SAS, there will be a need for continued support to implement CRA and a repeat survey at the end of 2010 at the completion of the implementation strategy is warranted to assess whether adoption of CRA in the SAS has changed. The process of developing the generic assessment framework may be suited for extension into other schools in the university. There is also a research question around the benefit, or otherwise, perceived by students in response to the implementation of CRA.

In conclusion, the SAS has showed significant advances since 2008 in the implementation of CRA. The generic assessment framework has appeared to have been a successful tool to assist staff in developing and refining their assessment rubrics so to ensure a degree of consistency among units within the school, which aim to improve students’ learning outcomes.

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Appendix

A generic assessment framework for Agricultural Science

The table can be used as a tool to guide teaching staff in writing assessment criteria for their units to ensure a degree of uniformity and progression in assessment within and across year groups in the School of Agricultural Science (SAS). The four generic assessment criteria of (i) knowledge; (ii) analysis of information; (iii) practical skills; and, (iv) communication are divided into sub-criteria. The suggested standard of assessment of sub-criteria for each year group is represented by the width (narrow, basic; broad, advanced) of the shape in the right-hand column of the table. In preparing an assessment rubric, include only those criteria and sub-criteria that are appropriate to the task. Students will have been assessed against all criteria by the end of the course.

1. Knowledge criteria

Knowledge includes factual information and may be in written, tabulated or graphical formats. In a first year unit, breadth of knowledge across disciplines is assessed. As depth of knowledge is not required, it is appropriate that content be sourced from general information (e.g. web pages, books). In subsequent years, knowledge is assessed in one or more disciplines within a unit at greater depth. By fourth year, assessment tasks could be designed to assess student's ability to integrate deep understanding (knowledge) across disciplines that has been sourced predominately from specialist sources (e.g. journal articles).

2. Analysis criteria

The second criteria assesses students ability to analyse information, including literature and/or data. The standard of assessment of student ability to analyse information to inform decisions and solve problems is relatively consistent across year groups. In comparison, higher-level analysis through critical evaluation and integration of information is assessed at increasingly advanced levels in subsequent years. By fourth year, student ability to construct of new hypotheses and understandings from new information and existing knowledge may also be assessed.

3. Practical skills criteria

Standard of assessment for data handling and manipulation (e.g. Excel) increases from moderate to advanced in first to fourth year. Experimental design and statistical analysis are not be assessed until second year, if appropriate, and standards would increase from basic proficiency (e.g. use of simple univariate statistics) to advanced (e.g. use of statistical software) in fourth year. Standard of assessment of student proficiency in laboratory and field techniques and use of databases (e.g. CAB abstracts) and referencing software (e.g. Endnote) would be expected to increase from first to fourth year.

4. Communication criteria

Standard of assessment for English and referencing conventions are the same across year groups. In contrast, standards of assessment of oral communication skills (e.g. in seminars), use of discipline-specific scientific terminology and creativity (artistic flair and artistry) in presentation would increase from first to fourth year.

Generic assessment framework for the School of Agricultural Science			
Criteria	1 st year	2 nd year	3/4 th year
A. Knowledge <ul style="list-style-type: none"> Breadth and depth of knowledge of information Source of information 	<p>The diagram for Knowledge shows four trapezoidal shapes representing skill development over time. Two blue shapes represent 'Breadth of knowledge across disciplines' (widest at 1st year) and 'Integration of knowledge across disciplines' (widest at 2nd year). Two green shapes represent 'Use of general sources of scientific information' (widest at 1st year) and 'Journal articles as source of scientific information' (widest at 3/4th year). A final blue shape at the 3/4th year represents 'Depth of knowledge within disciplines'.</p>		
B. Analysis and evaluation of information	<p>The diagram for Analysis and evaluation shows three shapes. A wide blue shape at the top represents 'Analysis of information to inform decisions and solve problems'. A green shape below it represents 'Critical evaluation of information to draw conclusions'. A light green box at the bottom right represents 'Construct new hypotheses or create new understanding'.</p>		
C. Practical skills <ul style="list-style-type: none"> Data handling & manipulation Experimental design & statistical analysis Proficiency in laboratory & field techniques 	<p>The diagram for Practical skills shows four horizontal bars. A blue bar at the top represents 'Data handling & manipulation skills'. A blue bar below it represents 'Skill in experimental design & statistical analysis'. A green bar below that represents 'Skills in laboratory & field techniques'. A light green bar at the bottom represents 'Proficiency in database searches & use of referencing software'.</p>		
D. Communication <ul style="list-style-type: none"> Written English conventions – (structure, punctuation, spelling, grammar) Referencing conventions Scientific terminology Oral communication Creativity 	<p>The diagram for Communication shows four shapes. A blue shape at the top represents 'Adherence to English and referencing conventions'. A blue shape below it represents 'Use of scientific terminology that is discipline-specific'. A green shape below that represents 'Oral communication skills'. A light green shape at the bottom represents 'Creativity in presentation'.</p>		