GUIDELINES FOR ONLINE LEARNING IN SOIL SCIENCE: A SYNTHESIS OF IDEAS FROM ACADEMICS, STUDENTS AND EMPLOYERS

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ABSTRACT

As part of an ALTC-supported curriculum development project, we engaged teaching staff, employers, current students and recent graduates in the discipline of soil science, to develop a set of guidelines for online learning in our discipline. During a one-day Forum, three experienced practitioners in online learning design in engineering, science and health presented and discussed their approaches with the forum participants. The forum attendees then developed guidelines for online learning in soil science based on their personal experiences together with the presentations. The resulting guidelines were compared with the literature and a very good match found in assessment, content, communication and feedback, motivation and groupwork. Two additional aspects that apply particularly to teaching soil science in Australia were identified, namely the importance of defining agreed outcomes that take into account regional differences across academic institutions and accommodating the broad range of prior knowledge that students of soil science bring to online courses.

BACKGROUND AND RATIONALE

The study reported here is part of an ALTC-supported project that aimed to develop a national curriculum for soil science in Australia. One of the project's objectives was to address issues of student access to academic expertise by making high-level courses available online to students from multiple institutions. This paper reports on the process we used to ensure that the format and delivery of our online courses would be aligned with best practice in online learning. The process of involving teaching staff "from the ground up", rather than applying principles from another source, was also intended to ensure that the resulting guidelines were discipline- and context-appropriate; and that staff had ownership of them.

Our project activities included three academic forums attended by a range of teaching staff including technical and postgraduate staff as well as employers and current students. During these we reflected on current teaching approaches, responded to survey feedback from current and former students and employers (Jarrett, Field, & Koppi, 2010; Jarrett, Koppi, & Field, 2011), created a set of teaching principles for soil science (Field, Koppi, Jarrett, Abbott, Cattle, Grant, McBratney, Menzies, & Weatherley, 2011) and generated ideas for the format of future courses to help graduates acquire the skills that employers require. Following our second forum in September 2010, we developed two topics for cross-institution online delivery, and drafts were made available online using *Moodle* (2011).

Three academics experienced in online learning in areas outside soil science, shared their experiences and advice with Australian soil science academics, students and employers during our third Forum. Attendees then worked in groups to distill their reflections into sets of guidelines specific to online learning in soil science. Following the Forum, the guidelines were compiled into a single list and evaluated in light of published literature to determine the degree of alignment. We used this process rather than finding and applying existing guidelines for three reasons. First, the above process involved 22 stakeholders in a process of collaborative refection on, and analysis of, three perspectives on online learning and teaching; which grounded our guidelines within the discipline and ensured they took account of the perspectives of all stakeholders. Second, the Forum activities were part of an ongoing process to promote scholarship of teaching among academics, and forge closer

working links with employers to enhance the work-readiness of graduates. Working together with the Forum participants to create our own guidelines rather than being asked to accept a set of existing guidelines was considered more appropriate because, as suggested by McIntyre (2008), this approach built positive staff perceptions of online learning through a formalised approach to course development. Finally, we wished to consult students to incorporate the learners' experience and enhance alignment between delivered and received curricula (Bath, Smith, Stein, & Swann, 2004; Bruinsma & Jansen, 2007; Harden, 2000).

METHODOLOGY

The activities which led to the development of our guidelines formed the focus of our project's third one-day Forum. The Forum was attended by eight academics from the five partner institutions, with varying levels of prior experience with online learning; six employers; four students, one recent graduate; invited speakers; members of the project's reference group; the project evaluator and the researchers. The speakers were Chris Daly from the University of New South Wales, who described Mining Engineering Australia's rationale for, and approach to national teaching; Manjula Sharma from The University of Sydney, who discussed principles of online learning, curricular alignment and different alternatives to face-to-face teaching with a focus on science; and Iain McAlpine from LaTrobe University, who focused on online educational design with emphasis on Problem Based Learning. Each speaker gave a 45-minute session, divided equally between presentation and questions. Attendees and presenters were then divided into four groups, each comprising at least one employer and one student, and given 40 minutes to formulate criteria against which the draft online topics of study could be evaluated during a subsequent session. Each group then presented a poster to summarise their ideas. Group discussions and presentations were audio-recorded and these recordings, in addition to the posters, were used to compile a list of guidelines for online learning in soil science. To combine criteria from the four groups into a single list, inductive qualitative analysis (Boyatzis, 1998) was used to categorise the criteria. The audio-recordings were used to ensure that information from the posters was correctly interpreted and appropriately detailed. The resulting guidelines are shown in Table 1, along with an indication of their alignment with guidelines for online learning from the literature.

Figure 1 presents a flow-diagram showing how our guidelines for online learning in soil science were derived from the presentations and group discussions described above, and how these activities fit into the wider context of our project.
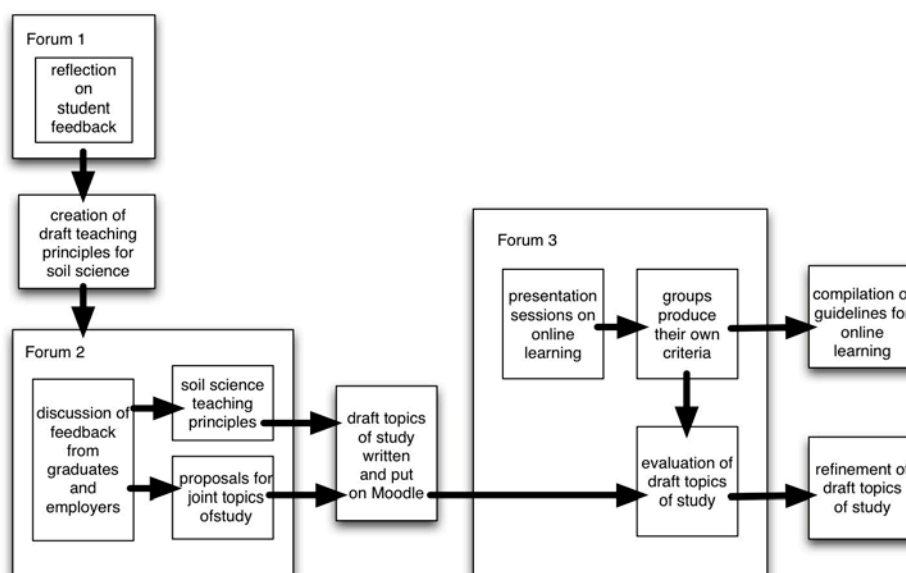

Figure 1: Project map showing selected activities and resulting documents

RESULTS AND DISCUSSION

ONLINE LEARNING GUIDELINES GENERATED BY OUR PROJECT PARTICIPANTS

Table 1: Guidelines for online learning in soil science and alignment with literature

Guidelines for online learning developed by project team	Alignment with Herrington et al.	Alignment with COFA
Outcomes: 1. Unit outcomes must be well-defined. 2. Different institutions need to agree on shared goals for units. 3. The opportunity exists for appreciation of regional differences, for example in soil/climactic conditions and their impact on land use, to be an outcome.		✓
Assessment: 1. Assessment must be outcomes based 2. Assessment of group-work needs to be fair to all group members. 3. Freeman and McKenzie (2002), or similar tool to enable the confidential rating of self and peer contributions to teamwork, used to allow moderation of group marks based on individual contribution. Possible confrontation issues must be managed. 4. Self-assessment should be incorporated for a variety of purposes 5. Assessment tasks need to address the needs of staff, students and employers	✓ ✓ ✓	✓ ✓ ✓
Content: 1. Content must be authentic and workplace-relevant. 2. Delivery should be non-linear with multiple-pathways to learning as well as opportunities for revisiting and integrating with prior knowledge. 3. Courses must include some laboratory work and it must be assessed. 4. High-level courses should be developing generic skills.	✓ ✓	✓
Prior knowledge: 1. Courses are high-level (fourth year/honours, postgraduate) and students are entering from a variety of degree programs so required knowledge must be explicit. 2. In order for group-work to be effective, all members must have a minimum level of prior discipline knowledge. This issue can be addressed through provision of pre-entry testing so students can self-exclude if they lack the required knowledge AND/OR Scaffolding and support material provided for required knowledge.		
Communication and feedback: 1. Effective resources are required for communication between students in groups and between students and academics. 2. Students at different institutions must have equitable access to academics with particular domain expertise. 3. Communication between staff and students must be regular and must be verbal. 4. Conversations with people who are assessing students' work (staff and peers). 5. Student feedback should be used to continually improve units of study.	✓ ✓ ✓	✓ ✓ ✓
Timing: 1. When planning synchronous activities time zones must be taken into account.		
Stakeholders: 1. Course outcomes should align with employers' needs. 2. Employers should be involved in providing material for case studies.	✓	✓
Accreditation: 1. Cross-institution courses open up opportunities for benchmarking for accreditation purposes.		
Motivation: 1. Both staff and students must be motivated to participate in new ways of teaching and learning. Student expectations of courses must be managed. 2. Students must be motivated to participate in units through good design as well as their perceived relevance (including employer involvement) and value. They must also be motivated to work in a team, through the intrinsic factor of being able to tackle a larger, more authentic problem and the extrinsic factor of group assessment (e.g. Freeman and McKenzie 2002).	✓	✓ ✓
Groupwork: 1. Group members should be randomly chosen rather than selected by students. 2. Groups should only be cross-institution if this serves a clear purpose. 3. Group work must involve tasks that cannot be done by individuals so teamwork is not contrived.	✓	✓

COMPARISON OF OUR ONLINE LEARNING GUIDLINES WITH THOSE IN LITERATURE

Although we wished to develop a set of guidelines grounded in the discipline, we also wished to ensure that they did not deviate inappropriately from established best practice in online learning. Therefore we compared our guidelines with those from the literature to determine the degree of alignment and establish whether our process had created any guidelines unique to the discipline. We based our comparison on two sources of advice on online learning: Herrington, Oliver and Herrington's (2006) (HOH) and UNSW COFA's "Learning to teach online" website (COFA, 2009). HOH's list of course design guidelines enabled a direct comparison with our guidelines; in order to compare our guidelines with the advice contained in NSW COFA's website, the videos and associated documents were qualitatively analysed using the same categories shown in Table 1. The results of the comparison are indicated in Table 1 and detailed below.

Outcomes:

HOH did not explicitly discuss outcomes; however COFA (2009) emphasised the importance of well-defined outcomes by describing how all aspects of the course must align with them. Our guidelines emphasised the necessity of institutions agreeing on shared goals, and the opportunity for course outcomes to include the appreciation of regional differences: these are specific to our application of online learning to multiple institutions in the different States and Territories of Australia. McIntyre (2008) stressed it is important to establish a common direction when developing online learning within a Faculty.

Assessment:

Our guidelines agree with COFA's advice on alignment between outcomes and assessment. Both COFA and HOH referred to assignments based on group work but were less specific about how marks should be allocated. Our guidelines (and those of COFA) recommend allocating marks for individual contributions to group work, whereas HOH recommended only "appropriate criteria for scoring varied products" (p. 2). Further, both COFA's and our guidelines note that conflict may occur in allocating marks for group tasks, and that procedures must address this. Angeli, Valanidea and Bonk (2003) found that where the quality of online interactions was not assessed, participation gradually declined. The authors advise that assessment strategies be developed that address quality in students' online contributions.

Content:

There was a striking correlation between our guidelines for content and those of HOH: both focused on the importance of authenticity and real-life application of knowledge. They also recommended non-linear approaches to delivery, thereby allowing students to revisit knowledge from different perspectives. The opportunity to revisit knowledge and integrate it with new learning was considered particularly important by our participants, given the interdisciplinary and interconnected nature of soil science. HOH also advised that tasks should be open-ended and student-centred, while COFA argued that content and structure must be designed specifically for the online environment rather than being transplanted directly from face-to-face courses. According to McIntyre (2008), well-structured online learning environments provide opportunities for students to develop collaborative and communication skills. Our guidelines prescribed the development of generic skills, reflecting the fact that they were written with reference to high-level courses. They also specified laboratory work.

Prior knowledge:

Neither COFA nor HOH discussed prior knowledge. Its importance for soil science reflects the fact that our cross-institutional courses will be open to students from a variety of degree courses across Australia and at different levels from third year undergraduates, Honours students and postgraduates.

Communication and feedback:

According to McIntyre (2008), formative assessment and peer review help students to understand and achieve course objectives. Our guidelines emphasised the importance of equity of access to academics from other institutions, reflecting the fact that they were written for cross-institution courses. Similarly, HOH emphasised the importance of access to discipline expertise. All three guidelines specified the importance of communication between students, whether for group work (our guidelines and those of HOH) or simply for feedback (our guidelines and those of COFA). McIntyre asserted that Moodle's (2011) increasing popularity is due to the complexity and restrictions of proprietary software, and stressed that software must meet the needs of the course design rather than course design being dictated by the capabilities and limitations of the software. Similarly, our

participants argued that resources should enable rich forms of communication between academics and students as well as between student groups; and that software used for moderating group assessments should deliver marks that are seen by all stakeholders as fair.

Our participants recommended that student feedback be used to continuously update and refine courses so they continue to meet learners' needs. Similarly, McIntyre (2008) argued that "good learning and teaching practice requires ongoing evaluation and refinement" (p. 287).

Timing:
COFA's guidelines provided more detail on timing than either ours or HOH's. COFA advised that as online interactions are usually shorter and more frequent than face-to-face interactions, tasks should accordingly be more frequent and designed to be completed in less time. COFA also differentiated between synchronous and asynchronous tasks: asynchronous tasks allow more time for reflection while synchronous interactions are good for decision-making at certain milestones.

Stakeholders:
Collaboration with employers is a feature of all three sets of guidelines. Our guidelines emphasised the importance of asking employers to contribute to course content. Such contributions motivate students because the content is current, tasks are authentic and courses are seen as relevant to future employment. McIntyre (2008) reported that academics collaborated with industry to apply for a "Course Author Fellowship Program" (p. 285), and advised that academics developing online courses should seek to collaborate with people from outside their discipline, to gain new perspectives on course content and design. HOH advocate expert involvement to allow students to compare their performance with those of experts and to enable an "apprenticeship" approach to learning.

Staff who interact with students online play a key role in the success of courses. According to Angeli et al. (2003), staff who moderate online discussions must maintain the quality of discussion by modeling critical thinking. According to Salmon (2002), students must be supported through a structured process of development, with moderators requiring different skills at each stage of the process. Training may therefore be required to help staff gain the necessary skills.

Motivation:
HOH noted that student motivation derives from authentic content, while COFA stated that tasks must be engaging. McIntyre (2008) stressed the importance of motivating academics who might have a negative perception of online learning due to previous online courses not being developed on the basis of sound principles. Our participants similarly acknowledged the importance of motivating staff. COFA recommended making clear to both staff and students the rationale for introducing online teaching. Our guidelines and COFA both discussed motivation in relation to group work. Our guidelines identified two factors which motivate students to participate: the intrinsic motivation of a more authentic task than could be achieved working alone; and the extrinsic factor of peer-assessment and moderation of group assessment marks: the latter is also cited by COFA, who recommended setting clear expectations for participation.

Groupwork:
HOH and COFA agree with our participants that group work must not be adopted for the sake of it: group work must involve tasks that students could not have completed working alone. Similarly, although our courses are designed around group work, our participants advised against setting up cross-institutional groups unless they served a clear purpose. COFA also emphasised the importance of staff guiding collaborative work, and of ensuring that students understand and agree to expectations for individual contribution. Software can assist in this by providing records of interactions. Finally, COFA pointed out that written interactions lack cues to meaning such as facial expression and tone of voice, so clear written communication is crucial. Our guidelines stipulated that communication between staff and students should be verbal and that students should be able to have "conversations" with people assessing their work. Although our guidelines did not make this explicit, there is clearly a suggestion that more than just written communication is required.

CONCLUSIONS
In keeping with the design of previous project Forums, the activity reported here was designed to enable participants to create guidelines based on their collective experience rather than to uncritically adopt published materials. The strategy included groups evaluating expert opinion introduced via

presentation and discussion sessions. It was found that the recommended outcomes from the group activities were similar to published literature.

According to McIntyre (2008), COFA Online's approach to design is based on the principles of constructivism (Bodner, 1986) and the provision of scaffolding (Salmon, 2002); and incorporates a number of established pedagogical theories such as constructive alignment (Biggs, 1996). These principles align closely with our groups' outcomes and validate the guidelines for online learning in soil science that were developed by the group. HOH focused on situated learning and the provision of authentic contexts and open-ended activities that require collaboration and separation of relevant from irrelevant information. Their model aligns closely with our vision of high-level courses which involve groups working on open-ended problems.

It is noteworthy that non-experts in online learning design were able to create a set of credible discipline-specific guidelines through collaborative analysis of information by experts in the field. The process was also engaging and worthwhile, as indicated by participants' highly positive forum evaluations.

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