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Learning by doing: an international, interdisciplinary experiment using peer-based learning in an outdoor laboratory

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Interdisciplinarity and international collaborations are widely regarded as beneficial constructs in education. However, challenges can arise when merging disciplines, methods, and cultures. We focus in on the disciplinary and cultural disconnects that can be experienced in the natural sciences, where field-based learning, a resource intensive but potentially rich pedagogical approach, is often not optimised. Here, we address these challenges through an Erasmus+ project that is designing curricular for both student and staff development.

Key learning outcomes and modes of assessment were designed to intentionally encourage connection-making and improve students' capacity for integrative thinking and learning. These had to be broad enough to allow for unpredictable interdisciplinary connections and learning. (Table 1)

On completion of the course students should be able to:
• Work in an international interdisciplinary team to carry out scientific field-based research in a novel field area • Summarise the relevant interconnected scientific features of a field area by making an illustrated sketch/graphic of the important elements of the natural and/or human landscape • Construct a chronology of events related to the field area • Consider scientific, social and economic aspects of the natural environment in the field area by interacting with stakeholders including industry and governmental organisations • Disseminate multiple perspectives of the research topic to diverse audiences

Table 1 Learning outcomes for the Student field course

Assessment aligned with the learning outcomes:
• Participate in data-collection and report on potential of various techniques; engage in and explain the added value of interdisciplinary peer-learning; contribute original field data to an archive for longitudinal analysis; recognise diversity of international approaches to field-based research; • Make a field sketch with detailed explanatory labelling e.g. geological cross-section; 3-dimensional representation of the landscape, map or mindmap • Interpret a life cycle, seasonal cycle or sedimentary cycle; construct a geological chronology of the area • Report on the value of interacting with stakeholders; conduct a survey in the community • Present research progress from multiple disciplinary perspectives; publish work in a blog; make steps towards formal publication; engage in outreach work to schools/community

Table 2 Assessment encouraging connection-making and constructively aligned with the course learning outcomes

Multiple assessment methods were available to let students demonstrate successful learning outcomes (Table 2). Assessment design was informed by Nicol's (2009) principles of good assessment and feedback practice. Formative peer-assessment and feedback was encouraged. Self-selected assessment is beneficial as students display different talents and are comfortable with different methods of performance of the learning outcomes. Equality of opportunity requires a choice when demonstrating achievement. The assessment methods had to allow for unpredictability, as students were working on real global challenges which inevitably brings uncertainty and complexity.

To allow students to achieve the learning outcomes, the design of learning activities emphasised formative peer-learning, facilitated through small-group field-based research projects. Each team included participants from different disciplines (Biology, Geology, Environmental Science, Geography), nationalities (Irish, Portuguese, German) and educational levels.

Students, in groups of 4, were allowed to examine and survey different field sites. This enabled them to devise a research question based on the eco-geological and socio-economic characteristics of the habitat, design a research methodology, carry out the investigation and disseminate the findings. The research question was investigated from multiple disciplinary perspectives, so that all group members had an input. Although challenging, this was crucial to the investigations success. The findings should illustrate the level of interconnectedness involved. Two weeks were available for these activities.

To assess the impact and levels of connection-making achieved in these immersive, interdisciplinary international field courses a number of indicators were used. Student perceptions of achievement were gathered through focus groups and pre- and post-course surveys. Student work was examined for evidence of connection-making and broadening perspectives. This was done using rubrics articulating answers to questions such as 'what would different levels of success look like?'. Here we highlight elements of the project which were effective and those which require improvement. The results have implications for disciplines which seek to collaborate across academic, social, and national boundaries.

What worked best - Students reported a strong appreciation of:
The international and intercultural, multidisciplinary experience;
Working in interdisciplinary teams responsible for our own investigation in the field;
Peer-learning within and between groups, ;
The support of experienced tutors to guide the peer-learning, and provide a conducive, safe and comfortable field-base.
The empowerment felt by students after undertaking the responsibilities of designing and conducting research projects which had potential real-world consequences.

What could be improved - For some groups cross-disciplinary connections were the highest level of achievement. Here, a longer time is needed to devise a research question with a clear purpose, and a research methodology to help keep students on track. Additional tutor support and on-going feedback may be needed for these groups. The mentoring of undergraduate students by postgraduate students was significant to success and confidence building of both mentor and mentee.

Conclusions:

It was only after this analysis that we could begin to see the difference between cross-disciplinary, multidisciplinary and transdisciplinary cooperation and learning. The differences can be significant for levels of integrative learning, which should be considered going forward. This will better prepare participants for work beyond their study, when real-world issues and problems will require multidisciplinary teams to find solutions.

Clear learning outcomes for the course, and the opportunity to discuss these with peers, greatly aided the participants understanding of the *purpose* of the activities undertaken. Those groups that had a clear purpose succeeded in achieving the learning outcomes to a higher level and in multiple ways. Formative assessment by tutors, peers and self, was the most significant mode of assessment. The variety and choice of assessment methods allowed for unpredictability that reflected the challenges of working with real world uncertainty and complexity. Mixed levels of experience within the groups contributed to confidence building by both mentors and mentees.

The findings of the student course are informing the design of future courses and of the staff development course for fieldtrip leaders. This is an iterative process which is currently at the end of year one of a 3-year study.