Higher Education Academy

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Innovative pedagogies series: Creating learning experience triangles

Use of three-way partnerships between students, lecturers and external organisations to embed authentic experiences in Biosciences curricula

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Introduction

Students often learn best 'on the job' through holistic real-world projects. Such real-world learning can benefit student experience and attainment, as well as giving students the subject-specific and transferable skills (and networking contacts) needed to improve post-graduation employability. Some initiatives, that see students and staff with collaboratively on a project, also have additional benefits in terms of breaking down the traditional teacher/learner division that develops in schools and that is typically unhelpful in developing students as advanced learners.

One way of facilitating this approach, which also provides additional tangible benefits, is to create 'learning experience triangles': three-way partnerships between students, lecturers and external link organisations that embed authentic experiences into curricula. This approach involves academics working with local, national, and international organisations to develop projects upon which students can work. Such collaborations might focus upon the development of real-world modules with a novel assessment structure whereby the organisation adopts the role of 'client' for student consultancy work using industry-standard approaches. Others options include placement-based dissertations (Level 6), internships (Level 5), or involve students working as partners on staff-led research. The common denominator is that a three-way partnership is created between link organisation, academic staff, and students to make a genuine contribution to knowledge, answer real questions, or solve an actual problem with tangible benefits for the link organisation.

This article discusses the background pedagogic context (disciplinary/institutional/national) to an innovative pedagogic framework that I have termed the 'learning experience triangles' (LETs) approach. It is recognised that to some extent, three-way partnerships are already used within higher education (HE), especially in programmes that offer placements. What this article seeks to do, however, is to showcase the versatility of this approach outside the standard placement model and the way LETs link to wider conceptualisations of learning and teaching. The benefits of the LETs approach, and diverse array of different ways that LETs can be developed and used in practice, will be evidenced through a series of case studies drawn from my own pedagogic practice. It is hoped that these will act as a springboard for other practitioners to put ideas into practice. Finally, practical advice for adopting or adapting this approach within other degree programmes and higher education institutions (HEIs), both in Biosciences and other disciplines, are highlighted.

Innovating in real-world learning: the learning experience triangles approach

Higher education policy statements are dominated by phrases such as 'student engagement', 'subject and transferable skills', 'employability' and – the new buzzword in HE corridors – 'resilience'. With changes in fees, students are becoming more discerning and exacting. They are demanding a curriculum that is increasingly dynamic, challenging, and through which it is possible to gain authentic experience that is valuable in preparing for post-graduation employment. Such demands also have to be balanced institution-led drives to increase retention and student satisfaction, often in the face of reduced contact time and other co-occurring pressures in terms of research output, separable income streams, and knowledge transfer partnerships (KTPs).

Within the Biosciences, more students are graduating than ever before. In the UK, there were 43,580 graduates from undergraduate degree programmes in 2013-14; an increase of roughly 70% on the 25,400 graduates a decade previously (HESA 2015). Competition for jobs is more intense than ever and it is becoming increasingly hard for graduates to stand out in ultra-competitive job markets. Somewhat paradoxically, however, although job competition is very high, graduates often lack real-world skills and require substantial extra training to make them effective employees (Biosciences Federation 2005). There is often a lack of competence in using standard equipment, while more advanced skills, such as ecological surveying protocols and experimental design, are even less well understood (Stafford, Goodenough and Davies 2010; Goodenough, MacTavish and Hart 2013). The magnitude of this problem is underlined by research by the Skills Council for Science, Engineering and Manufacturing Technologies, which found that there were more frequent, and more serious, real-world skills gaps in Biosciences than any other sector (SEMTA 2006). Indeed, students themselves are becoming increasingly concerned that failure to learn key techniques will hinder career prospects (Brown et al. 2005).

These issues partly stem from a reduction in practical work within Biosciences degree programmes (Slingsby 2007), which means that key skills are either omitted or experienced too infrequently for students to obtain professional competency. This is largely down to fiscal and logistical constraints, increasing modularization, reducing opportunities for practical work, and reduced contact time (Wilson et al. 2008). There is also concern that increasing pressure to teach transferable skills explicitly within curricula erodes time for teaching subject-specific skills (Brown et al. 2005), especially given that students are also entering higher education with ever-decreasing skills backgrounds (SBS 2003).

To help address the above problems, I have recently devised an innovative pedagogic framework, which I have termed the learning experience triangles (LETs) approach. This involves setting up three-way partnerships between students, lecturers and external link organisations. Rather than a problem or topic being essentially manufactured for the purposes of education and assessment, LETs involves the external partner bringing forward a real problem for students to work on for mutual benefit. This allows students to gain real-world skills in an authentic way that is also engaging and novel. It also prevents the all-to-frequent situation that student assessments are worthless in any applied sense as the actual content either has no practical value or that value is not realised because it does not reach the eyes of those who can use it to effect change.

The drivers for LETs come from all three partners – students, academic staff, and link organisations (as shown in Fig. 1). From an academic staff perspective, it is also possible to use LETs as a springboard for research outputs – especially through co-publication initiatives, KTPs, and successful grant applications.

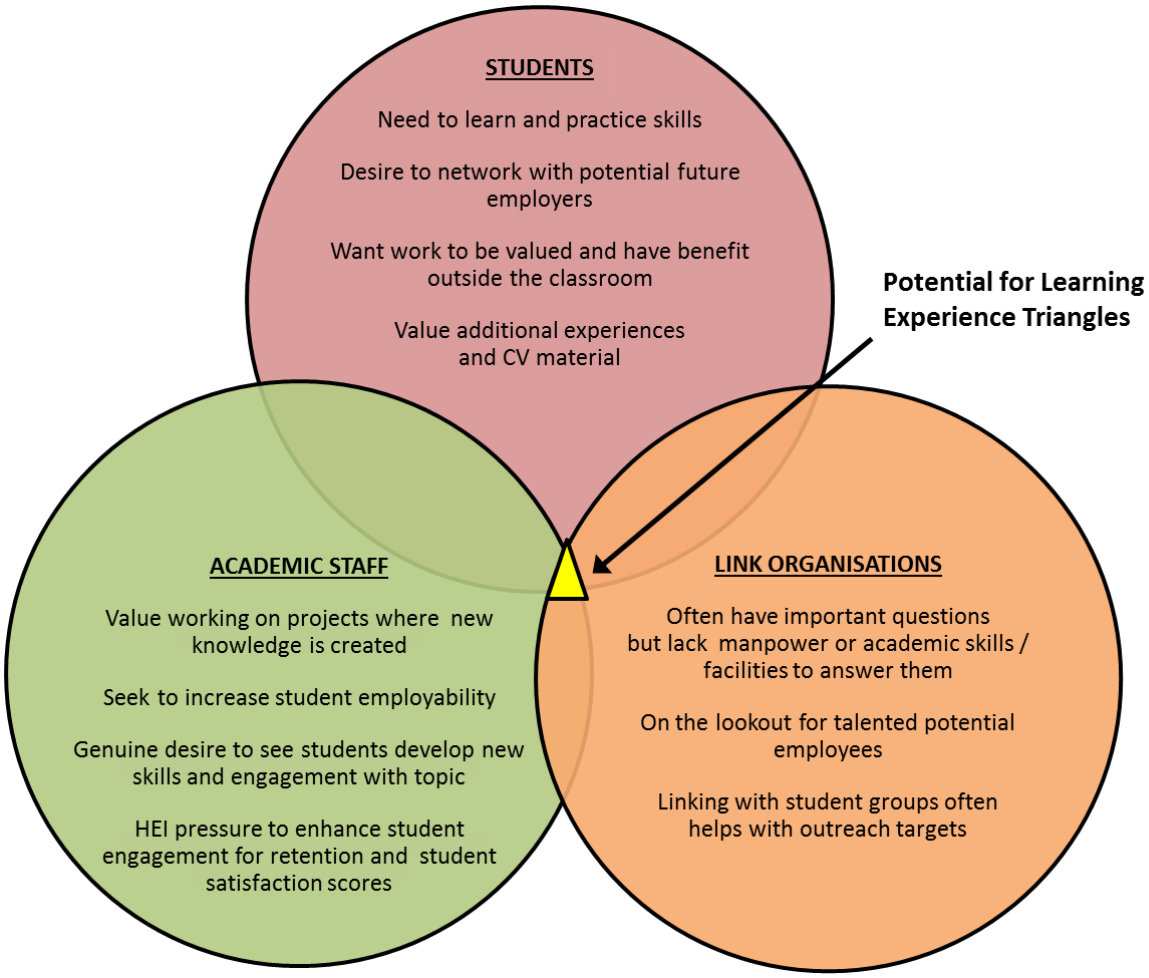

FIGURE 1: THE LANDSCAPE AND DRIVERS OF LEARNING EXPERIENCE TRIANGLES (© A GOODENOUGH)

The LETs framework is both broad and dynamic and can be used in a variety of ways to embed authentic experiences into curricula. Below, I detail how the LETs approach is used in my own professional practice, including in modules with linked assessment, modules without linked assessment, field trips, dissertations and internships. This involves LETs being embedded from induction right the way through to graduation. Within this time, students might undertake ecological surveys, work on animal behaviour projects with local zoological collections, devise management strategies for local nature reserves, work on citizen science or public engagement projects, undertake cutting-edge research with research collaborators, and even co-publish research papers. Such

indicatives can involve students working in a range of environments from the familiarity of the local park to the novelty of sub-Saharan Africa.

Start as you mean to go on: LETs in induction week

The first week or so of student life is daunting: students are vulnerable and the potential for dropout is considerable. From a HEI and course perspective, rolling out induction activities that students find interesting and valuable – in the broadest sense of that term – is important in initial student retention (McInnes, James and McNaught 1995; White and Carr 2005). Activities undertaken by new students during induction week are also important in academic integration and enhancing student outcomes, as well as setting many of the values, norms and behaviours they will come across at University (Hassanien and Barber 2008). However, although the importance of induction activities is widely accepted, it can be very difficult to create activities that on the one hand are enjoyable, relaxed, and able to facilitate the establishment of friendship networks, while on the other hand also being useful, valuable, and not feeling artificially manufactured (Billing 1997).

Case study

Within induction week, new students undertake a mini BioBlitz at a local nature reserve. This involves students identifying species in many different taxonomic groups during a day-long trip. The day ends with a social activity and the opportunity to talk to one another and lecturing staff in an informal way. When identifying species, students work collaboratively with lecturing staff (and often quickly find out that staff don't have all the answers!). This helps break down some of the traditional teacher/learner division that develops in schools and that is typically unhelpful in developing students as advanced learners, where a more collaborative relationship is required (Smith 2004; Hart, Stafford and Goodenough 2011). The event is quite relaxed and provides a chance to do a bit of ecological surveying at a nationally-important nature reserve and see something of the new 'local area' while also chatting to fellow new starters, staff, and students from other years. However, because of tangible benefits of this activity, students get an immediate sense that university is different from school. All the records from the day go to the link partner for this activity – Natural England who are responsible for the management of the site. As the same site is visited each year, students get the sense that they are part of an ongoing project and seeing temporal trends encourages them to think as scientists from day one. All records also go to the county records centre – Gloucestershire Centre for Environmental Records (GCER) – with which the students link throughout their degree, thereby cementing the importance of this link partner.

Real-world modules with external consultancy briefs

One of the most rewarding models for LETs is when they can be developed as lynchpins of real-world modules. This often works best when assessments are built around the three-way partnership so that this becomes an integral part of the module. It is possible to do this in such a way that the overall model remains the same over successive years, but the details change to ensure that the link is always fresh to give maximum benefit for all contributing parties.

Case study

Links with the local Wildlife Trust have proven very effective within postgraduate modules. For example, students on my Level 7 module *Applied Ecology and Conservation* visit a different Wildlife Trust site each year. The field day is co-delivered by academic staff and the reserve manager and focuses on the conservation needs and challenges of the site from both theoretical (academic) and applied (practitioner) perspectives. The assessment is to write a consultancy report critique of the management with the Wildlife Trust as the client. Students' suggestions are frequently trialled and, in one case, resulted in a successful environmental stewardship funding application. This demonstrates the impact that applied teaching and lecturer-practitioner synergies can have outside the classroom.

> I've been taking students around our reserves for the last three years. Their consultancy-based assignments often stimulate new management. *(Jackie Birch, Wildlife Trust Reserve Manager)*
>
> We were able to do actual research and work with external people – things we would not be able to experience properly in a theoretical assessment scenario. *(Student)*

Real-world modules with 'in-house' consultancy briefs

Although partnering with external link organisations can give excellent results, as discussed above, the degree of externality needed for a successful LET can be comparatively small. Indeed, it is possible to develop a model

whereby the partner is internal to the HEI but external to the standard student experience. This approach can also work very well in contributing to broader institutional priorities.

Case study

#ProjectPond is an initiative on Level 5 *Ecological Monitoring* module in which students assess the level of pollution in the University lake. Over five successive sessions, students undertake biodiversity surveys (Fig. 2) and use the resultant data to calculate biotic indices of oxygen levels and nutrient loads. These surveys are complemented by water chemistry testing back in the laboratory. This work is all undertaken in class time with lecturer and technician support and involves students using industry-standard survey techniques and standardised numerical metrics, as well as learning to identify a range of key species. Students then analyse data and devise an annual management and monitoring policy for the University Estates Team as their assessment. Following student advice in 2011, the Estates Team removed autumn leaf-fall from the lake. Rerunning the project the following year showed a richer aquatic insect community and allowed students to see the importance of their work on #ProjectPond first-hand. The initiative also demonstrates the mutual benefits that can arise from taking a problem-based learning approach (Barrett and Moore 2010) when the 'problem' is a real one that genuinely needs solving.

FIGURE 2: #PROJECTPOND SURVEYORS AT WORK (© A GOODENOUGH)

The Level 5 link with the Estates Team is followed up and extended by students on my Level 6 *Conservation Ecology* module who formulate University Biodiversity Action Plans. Students choose a species or habitat from a list of possibilities; this allows them to follow their own specific interests while also ensuring that their work is targeted enough to be useful. The project gives students real-world skills while simultaneously enhancing the University's biodiversity and was a significant contributor to the University being ranked second out of 131 UK institutions in the Green League table for Environmental Performance in 2011, and winning a Wildlife Trust Business Award in 2012.

> The Biodiversity Action Plan assignment was one of my favourites! It was really cool helping Estates, learning so many skills, and feeling a bit like a 'proper' conservationist rather than a student! (Graduate)
>
> To go through the steps with a real-life scenario made a significant difference to my ability to understand ecological conservation. I have already put my experience to good use by adding it to my CV. (Student)
>
> Working with student teams [in learning experience triangles] has been very helpful in forming policies that help the University meets its environmental targets and create a greener environment for everyone. (Andy Simpson, Head of Estates, University of Gloucestershire)

Fieldwork modules with applied student-directed assessment

In the above examples, students respond to a brief set jointly by the academic team and the linked external/internal partner. From a student perspective, this means that although there is some flexibility in possible approaches, the confines of the brief are non-negotiable. This follows a problem-based learning (PBL) philosophy where the problem is clearly defined but the solution is not (Kahn and O'Rourke 2004). Using this approach gives students focus and teaches them skills in responding fully and completely to a pre-defined task; invaluable training for future consultancy work. In other cases, however, it is desirable to take more of an EBL approach, such that students take an active role in determining the aim and scope of the project to be undertaken with the linked partner.

Case study

Each summer I take a group of Level 5 students out of their biological comfort zone into the Savannah grasslands of South Africa on a two-week residential field course. Students and staff stay together at Mankwe Wildlife Reserve for an immersive experience in conservation and wildlife management. The course is split into two parts, the second of which involves undertaking their own research projects in small groups. Other than each project needing to be logistically feasible and safe to run, there is only one main criterion: it has to be useful in an applied sense to the reserve managers by addressing an unanswered question, extending existing knowledge, or developing a new method. Students are given support by academics and reserve staff and projects develop through negotiation rather than edict. This is more akin to an enquiry-based learning (EBL) approach with students co-developing the research topic, question, objectives and methods. Student research projects have included establishing the importance of fire management to tick loads, the wider ecological role of white rhino (Fig. 3), and the importance of termite mounds to animal resting locations, as well as devising new methods of studying vigilance in herbivores.

FIGURE 3: WHITE RHINOS AT MANKWE WILDLIFE RESERVE (© A GOODENOUGH)

> The fieldtrip was the best two weeks of my life. I learnt so much more than I could ever have imagined and taking part in a real project was motivating – it felt we were doing something with real benefits. *(Student)*

Students who attend the field course and undertake the applied EBL assessment tend to attain higher dissertation marks than non-attending peers, even after controlling for each student's mean Level 5 mark to account for naturally higher-attaining students attending the field course relative to the overall cohort (Goodenough et al. 2014). They also have a better grade trajectory, being more likely to improve their degree classification between Levels 5 and 6 (Fig. 4). This is likely due to the immersive and challenging nature of the applied EBL assessment at the end of Level 5 (essentially a mini-dissertation) and as a result of piquing students' enthusiasm.

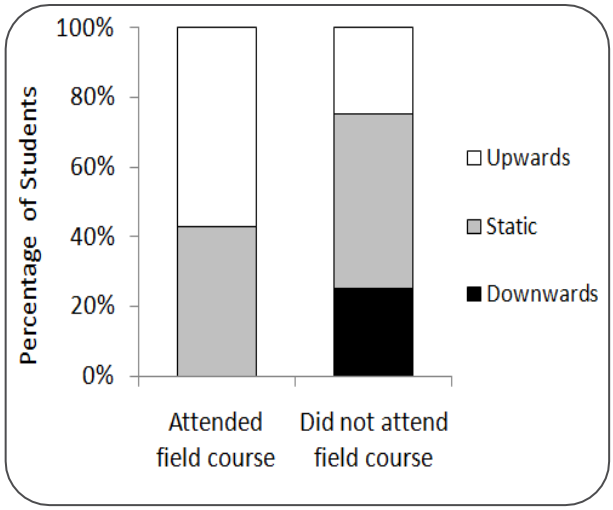

FIGURE 4: GRADE TRAJECTORY FROM LEVEL 5 TO LEVEL 6 FOR STUDENTS FIELD COURSE ATTENDEES (*N* = 14) COMPARED TO NON-ATTENDEES (*N* = 12) (FROM GOODENOUGH *ET AL*. 2014; © HEA, REPRODUCED WITH PERMISSION).

Creating LETs when there is no (obvious) three-way partnership

There is no denying that some topics lend themselves more easily than others to creating an effective LET. However, with a little bit of creativity, it is possible to forge meaningful links even in modules that are, on the face of it, very theoretical.

Case study

I run a block of session on multivariate statistical analysis within a Level 6 module entitled *Advanced Scientific Skills*. Teaching statistics can be hard because the material is often fairly dry and it is very difficult to make it anything other than hoop jumping. When I was planning the sessions, they did not seem the most obvious place for a LET until the realisation that a lot of organisations hold such large datasets that they do not have the time, expertise or software to analyse. To address this, I set up a link with the Royal Society for the Protection of Birds (RSPB) to allow the use of their long-term dataset on breeding birds for the assessment. Students are now tasked with coming up with a biological question that they could answer using part of the dataset (which contains more than 200,000 separate data points) and then answering that question using a multivariate approach and writing

the results up as a scientific paper. In the three years this has run, more than 80 students have completed this task and no two investigations have been identical. All findings are fed back to the RSPB to help inform management.

Using LETs in modules without linked assessment

Lecturing staff often bemoan students being highly assessment driven. The oft-asked student question of 'Do I need to know this for the exam?' – and the lack of student engagement that ensues if that question is answered in the negative – is something with which many academic staff will be able to identify (see also Godfrey 2008). Although LETs can be used very effectively when linked to assessment (as noted above) one of the advantages of giving modules currency outside the classroom is that students become less assessment-driven.

Case study

An activity that was embedded within the Level 7 module *Citizen Science and Public Engagement* was to create an interactive nature trail around one of the University campuses. The plan was for students to identify points of nature interest around the campus and think about how to communicate relevant information to a general public audience. This was intended to be more of a "think piece" and was not assessed. However, because there was a tangible benefit, students took the project seriously and brought the project to fruition, creating sound bites for each point of interest that visitors can access by scanning a quick response (QR) code. Students worked with a range of different University staff outside their normal contact, including the Vice Chancellor, and gained some excellent skills in communication and project management by taking this project forward. The success of this project showcases the potential for students to be inspired by a LET and take it far beyond what had been intended, despite the lack of linked assessment.

Dissertations

There is an increasing tendency for students to be handed "off the shelf'" dissertations that are easy to supervise. To me, this is a travesty: the world is full of unanswered questions and dissertations provide a unique opportunity to answer some of these. Students who feel that their research matters take ownership of it and invest more in it (Exley and Dennick 2009). I have established collaborations for dissertation students with local and national organisations such as West Midlands Safari Park (WMSP), Channel 4's *River Cottage*, Ecotricity, the RSPB, and the Wildfowl and Wetland Trust. All projects involve training/advice input from the link organisation and answer real questions raised by that organisation.

Case study

My longest established dissertation link partner is West Midlands Safari Park (WMSP). Each year, WMSP produce a list of questions raised by their keepers. One question has been how to reduce pacing in tigers and this has been the topic of ongoing study. The first project was largely descriptive to quantify the amount of pacing relative to other behaviours and build up an understanding of when this occurred. Subsequent projects examined the success of initiatives to reduce pacing, including visual screens between enclosures and distractive enrichment activities. This demonstrates how long-term links can offer additional benefits over single-year partnerships.

> We had genuine questions about tiger behaviour, but no time to undertake a long-term study so a student project was ideal. The students were fantastic and their research is helping us improve animal husbandry. *(Katie MacDonald, Research Officer, WMSP link partner)*

> Doing my dissertation at the Safari Park was a great opportunity. It was brilliant doing something that was actually useful, not spending months working on a project just for the sake of it. *(Student)*

Internships

Although dissertations present a great opportunity to link with partner organisations in a research setting, in some cases, it is beneficial to have a link that can be more practically driven and end in a non-research output. To this end, I was a key part of an *Internship* module, which was being expanded Department-wide in 2013-14. Through this, students work on real projects in placements as diverse as with Cheltenham Science Festival, Mammal Society, Bee Guardian Foundation, and local schools. In some ways the model is similar to work shadowing, but the key difference is that the student takes ownership of a specific project with a tangible output, upon which they are assessed. That tangible output might be an education pack; an interpretation board for a nature reserve; a nature walk leaflet; a method protocol for an ecological survey; or designing and running a questionnaire survey,

etc. In many cases, findings have been used by the link organisation to change practice (e.g. bat survey methods used by Ecotricity at wind turbine sites).

> I obtained a work experience internship with Gloucestershire Wildlife Trust, which allowed me to prove my worth on an actual proper project on conservation funding and that led to a full-time job! If it hadn't been for that opportunity, I am sure I wouldn't be where I am today!!! *(Graduate)*

How the LETs approach evolved … and is continuing to do so!

I remember being extremely frustrated within my own degree studies that the work that I had spent a huge amount of time on would be read by one or two people, and only for the purposes of marking. I deliberately chose an applied dissertation topic – researching methods of optimising wetland habitat for birds – as I was determined not to 'do research for research's sake.' Ultimately, and somewhat inevitably, however, even though the topic was applied and I had some intriguing results (sufficient to pass with a first class mark) my work had no actual impact.

Within my own professional practice, devising the LETs approach dawned slowly but has grown substantially over the last decade (although not always in a particularly planned or strategic way). The concept started – probably spurred on by my own experience – with trying to make a handful of dissertation projects more valuable in the applied sense, usually by me exploiting pre-existing links or building on my own knowledge of gaps in work, knowledge or provision that students could fill. After seeing the effectiveness of this policy, both academically for the students and in applied terms of the link organisations, I then sought to expand the initiative in two ways: (1) to increase the number of linked organisations to create more opportunities and give students more potential networking experiences; and (2) to increase the diversity of LET 'models' away from dissertation-only opportunities to include modules with linked assessment, modules without linked assessment, internships, field trips, and staff research projects.

A recent extension of the LETs approach involved working with colleagues to launch a bursary scheme outside the formal curriculum. This involves students working collaboratively with staff on projects funded by small University stipends and 'in kind' contributions from external bodies. One such project involved two students working with my colleague, Dr Matt Wood, and I at Portland Bird Observatory who provided free accommodation (Fig. 5), on the effect of climate change on migrating birds. A current project involves analysing the feathers of migrant birds. The link practitioner (a British Trust for Ornithology licenced bird ringer) provides feather samples, and laboratory analysis involves students and academic staff. Because students apply for 'positions', submit CVs and cover letters, and attend an 'interview'. This also helps personal development planning (PDP).

FIGURE 5: STUDENT RESEARCH ASSOCIATES AT PORTLAND BIRD OBSERVATORY (© A GOODENOUGH)

Pedagogic context

Discrete skills-based modules are often unsuccessful because skills are taught in the abstract or are regarded as hoop jumping. Students can fail to engage because they do not see the relevance of the skills being taught at the time (Barker *et al.* 2001) or feel, incorrectly, that they already have the requisite skills (Allan and Clarke 2007).

One popular way around this issue is to embed skills development in other modules using either a problem-based learning (PBL) or an enquiry-based learning (EBL) framework. PBL and EBL approaches are not new and indeed they have been reviewed extensively (e.g. Wilkerson and Gijselaers 1996; Duch, Groh and Allen 2001; Kahn and O'Rourke 2004; Schwartz 2013; Savery 2015). Both approaches involve student engagement with a complex problem, scenario, question or research topic that is sufficiently open-ended to allow a variety of responses or solutions (Kahn and O'Rourke 2004), either set by the tutor (PBL) or that is more student-driven (EBL). The approaches can be used within a particular session, over a series of linked sessions, or constitute the entire module. One example from my own institution is setting students the problem of creating a homemade water

purification system using plastic bottles, pebbles and sand to teach microbiology. Students test water going into the filter to determine microbial load and presence of coliforms, and repeat the tests on the filtered water before writing up results as a scientific paper. This group project helps develop academic skills (use of academic literature, scientific writing, numeracy, referencing), subject-specific skills (serial dilutions, plating up samples, microscopy, biochemical tests, aseptic technique) and transferable skills (teamwork, time management).

Although PBL and ELB can be used very effectively in the Biosciences, they are far from being a silver bullet (Hung 2011). Students can fail to engage with these approaches because the problem is manufactured, such that students view trying to 'solve' it as being worthless (Hudspeth and Jenkins 2001). This is particularly true if there are no (obvious) real-world benefits or it is clear to the students that although the project could have real-world benefits, this is unlikely to happen as results will not be widely disseminated or acted upon to change policy or practice. The success of PBL thus often relies on students finding motivational function in realizing the relevance of the content knowledge to their *future* professional or personal contexts (Barrows 1996; Hung 2011).

In addition to the potential shortcomings of 'traditional' PBL/EBL approaches, there are rarely any tangible benefits over and above those that should be implicit in high-quality teaching (viz. engaging students, imparting knowledge and skills, enhancing employability and resilience). In other words, the approach is focused exclusively on learning and teaching quality rather than having broader foundations or benefits. This narrowness of focus goes against recent drivers to ensure that work undertaken in HEIs has beneficial impact outside of academia. For example, in the UK, the periodic assessment of university research quality (Research Exercise Framework, or REF) considered the impact that scholarly research had outside of academia for the first time in 2014. Examples of external impact (for instance by changing policy or practice) were sought, and this evidence comprised 20% of the overall score. Thus, not only is there untapped potential for student research to have impact outside the classroom, but failure to capitalise on this is out of step with wider changes in the HE landscape. In short, the LETS approach effectively extends the PBL/EBL approach from a pedagogic perspective, but also has tangible benefits outside of academia.

Practical hints and tips for adopting the LETs approach

Improved student learning is a powerful incentive for implementing the LETs approach in teaching practice, especially when coupled with the added advantages of improving resilience and employability. The LETs approach is very versatile and there are plenty of possibilities for academics that want to adopt the approach within the Biosciences and beyond. However, in order for the approach to work, the practicalities must be thought through in advance to ensure that any barriers are overcome and the *opportunities* are maximised.

Finding partners: the biggest potential barrier to LETs is difficulty in finding (suitable) link organisations. However, in my experience, practitioners from external organisations are very keen to work in collaboration with HEI staff and students as long as the initial approach is pitched correctly. The key here is to make the benefits to that organisation, and the specific practitioners, clear at the outset so that the opportunities that a particular collaboration affords are obvious. Assurance that the link organisation will get all data collected, copies of any student work based on those data, and authorship on any publications arising from the project, are all essential, as is reassurance that all of the academic supervision will be undertaken by the academic staff. This avoids any concerns from practitioners that they lack the necessary academic skills to supervise students or any thought that students are being 'offloaded' in any way. It is also important to ensure that once partners are in place they remain happy to be involved year-on-year. This can be achieved by ensuring projects are well managed; problems are resolved quickly and professionally; and by simple actions, such as regular email contact and ensuring that the involvement of all parties is appreciated and acknowledged throughout.

Project design: in terms of designing projects, opportunities can best be maximised to all parties by ensuring that there will be real tangible (and important) benefits to the link organisation. That involves working with the link practitioner(s) in project design and understanding the confines in which they operate so that these do not become barriers to ultimate implementation. For example, it might be important for there to be understanding of the management budget of an organisation to ensure that student' suggestions on altering management are fiscally realistic. In some cases (usually module-linked projects), the initial ideas come from the link organisation and are refined with the academic. In other instances (often dissertations) it is the other way around. Long-term projects, whereby students in successive cohorts monitor the same area or build upon previous results, are especially valuable (and thus attractive) to link organisations.

Selecting students: for LETs that link to dissertation options, internship options, or staff research, it can often make sense to ask students to apply for the positions. This gives students practice in applications and also means that positions can be awarded following a competitive process that is transparent. This gives academics a degree of selectivity to put forward students that are most suitable to work on a particular project or with a particular partner who has the necessary skills, organisation, and work ethic. It is important to consider equity of opportunity here so that there are no discrimination barriers. If a LET is outside the formal curriculum, then as long as the person specification is clear, and is based on attributes that students will have had the opportunity to acquire within their formal studies, this should not pose a problem. (For example, asking for knowledge of computer mapping software when this is covered in a module would be fine, but asking for prior experience of working abroad during a gap year would be unfair.) If a LET is within the formal curriculum, the process might need to be managed differently: (i) with students either stating why they want to undertake several different projects so staff can ensure all students undertake a project that they are interested in and skilled for; or (ii) for longer running and bigger projects such as dissertations, students can be supported in finding their own LET. In my own practice, this has worked well in the past, with students being instrumental in devising LETs for dissertation research both in the UK (including plant survey work for a local community nature reserve) and abroad (including cave bat research in Ghana). In such cases, the project design element (above) and learning contract concept (above) are especially important.

Learning contracts: in order for LET-based internships and dissertations to work well, it is vital that all parties know what is expected from them, and what they can expect from others. To ensure this happens, it can be useful to ensure that a three-way learning contract is drawn up to state who is responsible for academic supervision, provision of field equipment, data security, on-ground training and so on. This also helps to ensure that potential barriers are identified at the start of the project, when there is ample time to devise suitable solutions or redirect the project as necessary. It is worth noting that there is no 'one size fits all' approach to LET dissertations. For example, one of the link partners that I work with asks students to submit a full draft of their dissertation to them two weeks before their University submission date so that the work can be checked for accuracy and to make sure that the work has been written up in a sensitive manner. Students need to be aware of this requirement from the start and agree to their initial deadline being earlier than the cohort norm to work with that organisation. In another instance, a second link partner requires that the final dissertations are only seen by University staff directly involved with supervision and marking, as well as the external examiner, rather than being made publically available in the University library as is standard procedure. This is because such dissertations frequently contain sensitive information such as locations of rare species. Any requirements or constraints such as these are also noted on the learning contract.

Co-publication: one way of ensuring that the results that come from a LET are shared as widely as possible is through publication in peer-reviewed journals and at conferences with student and practitioner co-authors. Although students being co-creators and co-disseminators of knowledge is not new, it is still relatively uncommon at undergraduate level. Even less common is a triangle of authors, including student(s), academic(s), and practitioner(s). The academic effectiveness of this opportunity is demonstrated by many projects evolving into co-authored papers published in high-impact journals (21 peer-reviewed papers in five years; e.g. Stafford et al. 2012; Williams et al. 2012; Goodenough et al. 2015; Goodenough et al. forthcoming) and posters at conferences. Although this approach is time consuming and requires substantial effort, especially on the part of the lead author, there are benefits for all concerned, as outlined below:

Student(s): excellent CV material; especially useful for applications for further study; showcase for the quality of work undertaken within a student's degree.

> Our field project was then developed into a published paper, something I had never thought I would achieve in a million years. It was a truly rewarding experience to be able to work in a team alongside my mentor. *(Graduate and student co-author)*

Practitioner(s): good for personal and professional development; seen positively by employer and can help promotion; external verification for the academic quality of practice.

Academic(s): external verification for the quality of work undertaken within teaching practice; contributes to personal research aims; contributes to HEI research agenda and so viewed positively by employer.

One potentially difficult question is authorship order, which can become a barrier to publication (Clowes and Shefer 2013). Again, this is something where up-front discussion can prevent issues further down the line. My personal policy is:

- any/all students involved in the research must be co-authors;
- any/all practitioners directly involved in the research must be co-authors;
- if a paper is based on an undergraduate or taught postgraduate student-driven project, such as a dissertation, the student should be the first author even if the original idea was not the student's own and/or a lot of the work to get the work to publication standard is done by the academic;
- if a paper comes out of a module-based project designed by an academic, that academic is normally first author unless there is mutually agreed benefit in changing this (for example, for a student applying for PhD candidacy for whom a first-author paper would have substantial extra benefit);
- if a student contributes to ongoing staff research as a research associate, they must be recognised in authorship but would not normally be first author;
- at undergraduate or taught postgraduate level, the academic would normally be corresponding author, unless a student particularly wants this experience;
- if a paper is written based on an MSc by research or PhD project, the student should be both first author and corresponding author.

Blue skies thinking: part of the power of LETs is the diverse range of ways it can be used, within different learning and teaching frameworks, at different academic levels, and in different disciplines. Once the basic framework is in place, discussing and debating possibilities within teaching teams under a 'blue skies thinking' philosophy is a very effective way of identifying opportunities appropriate to that set of circumstances and discipline context. If potential partner organisations can be involved at this early stage, this can be useful in ensuring that their aspirations, ability to identify opportunities for collaboration, and capacity to support LETs, grow alongside increasing demand and expansion for LETs from an HE perspective.

Conclusion

The LETs approach requires considerable time investment: it is not an 'easy win' or a short-term strategy in any way. However, the benefits of the approach can be profound, both academically and in terms of work having tangible benefits outside of academia. The approach has strong potential to engage students, help retention, improve student satisfaction, and teach new skills. Ultimately the LETs can help facilitate the development of employable and resilient graduates, which arguably is the most important thing any innovative pedagogy can do.

> [LETs] … create opportunities for students to develop subject-specific and generic employability skills through real-world projects by working with a broad range of partners to identify challenging problems. This builds student's confidence and raises awareness of skills that future employers will value. *(Nicki Castello, Head of Careers and Employability, University of Gloucestershire)*

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