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ARTICLE

# Student-staff partnership to create an interdisciplinary science skills course in a research intensive university.

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# Student-staff partnership to create an interdisciplinary science skills course in a research intensive university.

This paper reflects upon the development of a multidisciplinary lesson plan aimed at developing science skills for Physics and Astronomy, Geographical and Earth Sciences, and Chemistry students at a research intensive Scottish University. The lesson plan was co-developed with a small group of staff and undergraduate students from these disciplinary areas.

The authors discuss the rationale and process for developing the course, drawing upon literature relating to students and staff co-creating curricula in higher education. It offers suggestions for the academic development community about ways in which this kind of collaboration can be supported at local and institutional levels.

Keywords: co-construction; course design; engagement; interdisciplinary; student voice

## Introduction

We offer a reflective account of developing an interdisciplinary science skills course by staff and students at the University of Glasgow in 2013. The original impetus for devising a new course responded to students wanting to develop their problem solving skills across a range of science-related subjects early in their academic studies. The collaborative materials developed included student-generated content for lectures and laboratory sessions but also material for end of year examinations.

The article focusses on the processes and products of the collaboration, relating it to current debates on working with students as partners in learning and teaching. We explain the curriculum development processes and their rationale and, by exploring personal reflections and recent literature, we examine the potential for co-creating curricula.

We argue that the process and the product of the collaboration was successful and, in part, even exceeded expectations. The decision to use a collaborative approach to develop the lesson plan was based on positive prior experiences of several of the authors. Our project did not involve academic developers and so we critically reflect upon how further enhancements can be made through greater engagement with educational research literature and involving academic developers throughout the collaborative process. Our reflections attempt to shed light on how a variety of personal and disciplinary assumptions and practices influenced the direction of the collaboration.

This article is co-authored by those involved: the students and staff engaged in the research, planning and delivery of the course, and a PhD student researching co-created curricula. Our reflective account has been drawn from a framework of questions, provided by the PhD student, relating to the collaboration. Authors provided individual responses in the first instance. With permission, responses were shared and discussed between all authors and, from this, categories for inclusion in this article were agreed by consensus. The process of gathering individual reflections helped make explicit assumptions that had not previously been discussed collectively. As a result, multiple perspectives from different disciplines and roles provide a rich picture for practitioners and researchers alike.

## Defining the nature of the collaboration

There is growing interest within higher education, particularly in the UK and US, regarding opportunities for staff and students to work in partnership. The focus and rationale for greater partnership working varies but can be seen to promote greater student engagement with learning.

Current literature relating to 'students as partners in learning and teaching' displays an eclectic, and sometimes ambiguous, understanding of the phrase when examining practice. There is also a level of caution about the uncritical use of terms related to this field (Sabri, 2011; Bovill, 2013; Carey, 2013). Healey, Flint, and Harrington's (2014) commissioned report was a response to the need for greater clarity in the sector regarding student engagement and partnership. They argue:

> The field of student engagement – theory, practice and policy – is huge [and] varied….As a concept, "student engagement" is ambiguous and contested. Within learning and teaching it can be divided into two

> broad areas: (i) student engagement as the way in which students invest time and energy in their own learning, and (ii) the ways in which students are involved and empowered by institutions to shape their learning experiences. (2014, p.15)

The term 'student engagement' has been enshrined in higher education policy documents in the UK. Agencies such as the Quality Assurance Agency (QAA) (2012, p.2) dedicate parts of the national Quality Assurance Code of Practice to student engagement, defining it as ‘time spent on a task; quality of effort; student involvement; social and academic integration; good practices in education; and learning outcomes’.

The National Union of Students (NUS) (2012) has developed a Manifesto for Partnership, and Student Participation in Quality Scotland (SPARQS) (2012) has developed a Student Engagement Framework. These, alongside Healey et al’s publications, indicate clear policy intentions to ensure partnerships between staff and students are to be prioritised.

Noting the complexity and inconsistency of terms, Healey et al (2014, p.15-17) consider partnership in learning and teaching as a ‘process of student engagement distinguished by the importance placed on the distribution of power’,suggesting that it ‘raises awareness of the implicit assumptions - about each other, and about the nature of learning and teaching - which would otherwise remain below the surface’. Bovill, Cook-Sather, and Felten (2014) offer a complementary discussion regarding the definitions of collaboration between students and staff. They use the term ‘co-creation’ of learning and teaching, defining this as the space in between student engagement and partnership, where there is meaningful collaboration between students and staff, with students becoming more active participants in the learning process.

Healey et al’s (2014) discussion concerning principles and values of partnership working offer a sound and practical framework to plan intended activity. The activity critiqued here involved some broad aims and learning outcomes but was largely organic and opportunistic in terms of timing, funds and motivation to engage students. We suggest our work falls into the ‘space’ between student engagement and partnership described by Bovill et al (2014). Those involved did not draw upon an explicit model or framework to guide their activities but each individual brought something unique and there was a shared sense of commitment to the task, albeit with limited explicit discussion about this at the time.

**A focus on developing curricula**

As with defining the term collaboration, it is equally important to define the aspect of learning and teaching which our collaboration addressed. A number of complementary models exist which capture various roles and domains of activity in which staff and student work in partnership. Dunne and Zandstra (2011, p.17) propose a matrix which demonstrates students as Change Agents in learning and teaching. Bovill, Cook-Sather, Felten, Millard, and Moore-Cherry (forthcoming) describe four roles: student as consultant, co-researcher, pedagogical co-designer and representative. Healey et al (2014, p.25) offer an integrative conceptual model which combines aforementioned roles with activity type. Their model shows how students can engage in partnership work in four domains: learning, teaching and assessment; subject-based research and inquiry; scholarship of teaching and learning; and curriculum design and pedagogic consultancy.

All of these models stress that the roles and activities are not mutually exclusive. Often collaborative roles and focus of work can be fluid: for example, a student may be a representative as well as a co-researcher. However, Healey et al (2014, p.48) argue in their review of current practice that ‘Students are commonly engaged in course evaluations and in departmental staff-student committees, but it is rarer for institutions to go beyond the student voice and engage students as partners in designing the curriculum and giving pedagogic advice’.  Cook-Sather, Bovill, and Felten (2014) qualify this further and argue that there are areas of the curriculum considered by staff to be ‘unavailable’ for students to engage in the review and design process, particularly areas such as assessment and examination.

Our collaboration in curriculum design demonstrates ways in which staff and students not only generated new content for the curriculum but also assessment and examination material with the added complexity of working across multiple disciplinary boundaries.

A key feature of the success of the project was recognition of the expertise each brought to the collaboration. The academics, although from different disciplines, recognised that their courses all involved students working with numbers and 3D space and that these provided common areas on which to collaborate in curriculum design. Additionally, these academics recognised the importance and expertise students could bring to bear on the development of a science skills course. Cook-Sather et al (2014) suggest that students are rarely disciplinary or pedagogical experts but they are experts in being students. They are ‘closer’ to the experience of learning the material and have an appreciation of what works well and what could be enhanced. In particular:

> ‘[Students] can contribute to their explorations of curricular or pedagogical questions by bringing their backgrounds and perspectives into our thinking and planning as faculty members. This not only expands our understanding of existing student learning and teaching experiences but also can be the beginning of shared dialogue and deeper understanding about learning and teaching content and processes as we exchange perspectives’. (p.16)

Fundamental questions are raised about how theories of curriculum help to situate debates about co-creating curricula. How individuals respond to curriculum design is likely to be heavily influenced by, often tacit, assumptions and values about curriculum: what is valued and the ways in which teachers and students relate to one another.

## Rationale for developing the course

The University admits students to a science faculty rather than named degrees, and a significant number of students change their degree subjects from their original intentions. This has the advantage of enabling students to find their optimum major once they have experienced first-hand the full range of options available to them. One potential disadvantage of this flexibility is that the academic background of any one particular class can be highly variable and that can be difficult to monitor. Developing appropriate pedagogic approaches, especially in large, diverse first and second year classes, can be challenging.

Staff teaching the range of science subjects have been dealing with these issues for a number of years but in 2012-13 they received funding from the University for a project investigating fundamental skill gaps regularly encountered across a disparate range of science degrees (Astronomy, Chemistry, Earth Science, Geography and Physics).

This work expanded on a smaller-scale project that ran in the School of Physics and Astronomy in 2011-12 which set out to define 'problem solving skills' in the physics context, identifying what these skills were, and determining how best these could be, or were already being, taught and assessed. The skills identified from this were equally important to all science subjects, such as being able to make accurate estimations of results, identifying key points in a question and identifying the correct method to help understand particular concepts.

The new project extended the work to Astronomy, Chemistry, Earth Science, Geography and Physics. The goal was to develop a “Problem Solving Skills in Science” course which would provide students with an opportunity to compensate for any gaps in their background science knowledge.

The project had two distinct phases, both of which actively involved student participation. Part one involved online surveying of students and staff from across the three disciplines regarding the key skills required for science, based on their own experiences at University. They were asked to select which of the skills they felt were essential and, separately, which they thought were already being taught well. They were also given the chance to suggest additional skills they felt were essential. Students from all levels were offered the chance to complete the survey, as were all staff. Students who completed the surveys were given the chance to take part in a focus group interview to further explore the results. The same survey was completed by 8 employers of science graduates.

The outcome was a consistent list of key skills for science students:

- Order of magnitude estimations
- Teamwork
- Manipulating equations
- Dimensional Analysis
- Researching topics
- Working with errors
- Collecting and processing data
- Identifying key components in a question
- Working with 3-D models.

The second phase of the project involved students directly as partners in the development of the curriculum and teaching resources for a new course aiming to provide them with experience in each topic. A small group of students were drawn from three participating Schools (Chemistry, Earth Science, and Physics and Astronomy). The students were recruited through a selective process to work over a six week period during the summer vacation and, working from the outcomes from the data collection exercise, they researched the best methods of teaching such skills and developed suitable examples. Staff made regular suggestions and were consulted at various stages, but the work was largely carried out by the students working together in a room with minimal staff involvement.

Early in the process there was consensus between staff and students that the course content would be delivered over ten two-hour workshops delivered one per week over a ten week semester. Most of the students' time allocated to the project was spent researching individual topics, developing or identifying suitable resources for each session. The students divided the work required among themselves, based on their different skill sets, expertise and backgrounds. The course used a wide range of case studies from across the relevant disciplines but was designed in such a way as to be suitable for all science subjects.

The outcomes exceeded all expectations, which is consistent with some other co-created learning and teaching projects in the literature (see, for example, Bovill, 2014). The students created a full set of lecture notes and extensive resources including a large number of projects for team work, laboratory exercises, example sheets and even potential exam questions.

The project has led to a new 10 credit science skills second year undergraduate course which ran for the first time in the 2013-14 academic session. Following extremely positive feedback from students and external examiners, the course has been expanded to 20 credits for first year undergraduates for 2014-15.

**Personal reflections from staff and students involved**

Project students and staff were asked to reflect on their experiences of the work and answer a series of questions provided by a co-author - the PhD student. The questions explored highlights, major issues in the collaboration, prior experiences of collaborative working, motivations, expectations, and reflections on what could be done differently.

Reflecting on the experience, views varied on how widely this approach could be used. Staff felt that it would be most applicable to courses focused on practice, not theory. Students agreed, noting the time pressure to balance studies with opportunities to co-develop curricula.

Students considered their diverse academic backgrounds as one of the highlights of the project. They valued the freedom they were given to carry out the work, using their own initiative and creativity. This was deliberate on the part of the staff. Teachers wanted an informal working relationship – no “them and us”. Two of the students had assumed that the staff would take a more dominant role, but found the more casual, informal relationship a very positive experience. Having a diverse range of expertise amongst the staff was also essential. The staff had worked together before in various capacities, which allowed a swift start to the project.  Whilst prior familiarity is not essential, good working relationships amongst staff enabled an informal working relationship with students to develop quickly.

At the first meeting staff laid out what their hopes for the project were, what the final goal was and gave the students the outline that had been put together when applying for university funds. They then left the students to it, with each staff member available at the end of a phone if their input was needed.  Staff would offer guidance if needed, but generally the students worked well together, in discussing ideas.  Since they each had their own specialities, students could effectively act as teacher for different topics, with peers providing the “student” perspective on topics they were less familiar with.  Nothing was off bounds; the students were encouraged to try whatever they thought would work, and if it would ultimately prove unworkable the staff would let them know, although all student-developed materials in this project were usable.

The students reported no major issues with the collaboration activity. Occasionally compromises had to be made amongst the group about how certain tasks would be carried out, but these were reached easily. Staff had hoped the project would develop the resources needed to teach the course, although it was assumed that further development may subsequently be needed by staff to make them work.  In reality, little additional staff effort was required to make the material ready for use.

Version control of materials was a problem that could have been solved by using appropriate tools. The students felt judging the level and amount of material needed for sessions was difficult, as was finding enough time to do everything to the standard they all wanted to reach.  This is frequently challenging for staff too, but surplus material was easily excised.

The students had little experience of this sort of development initially, and the staff did not offer any formal training, having no formal training to pass on.  The staff had all developed courses before, but had usually done so using a 'trial and error' approach.  There were concerns that students would not feel comfortable developing course material since this was likely to be unfamiliar territory for them. Student-generated material was, however, considered exemplary and the students enjoyed having the creative freedom to brainstorm ideas and develop resources accordingly.

When the staff were recruiting the students for the project, experience was not a critical factor – rather enthusiasm was essential, alongside a familiarity with the course content from their own disciplines. The roles were advertised to all students in their third year of study (of a four year degree). All applicants were interviewed and selected thereafter. Students applied for the role to broaden their skills base and experience, or because they simply wanted to help the university develop new courses. Student motivation and enthusiasm was judged on this basis. For their part, staff wanted students to develop the course material because they were best placed to accurately gauge the skills levels of other students and had experience of what worked and did not work in previous learning. One staff member had worked with students before and had developed a great respect for the creativity of students when they had been given opportunities previously. Having university level funding for co-creation activities was essential as it allowed the students to work through holiday time, ensuring their commitment and focus to the project. Without funding, the science skills course would not have run, as staff alone would not have had the time available to develop the resources needed.

## Lessons from co-creating the science skills class

The experiences described here by staff and students offer a critical reflection on practice as well as insights regarding multidisciplinary collaborations in curriculum design. We suggest areas for consideration in the wider community include:

### *Front-loading time*

Staff spent several months over a two year period surveying students and securing institutional agreement for the development of the science skills course. Given the culture of working with students on other teaching evaluations, the departments were supportive of progressing to work with students to develop curricula. Institutional funding was vital in order to be able to pay students.  There is emerging discussion in the literature about the inclusiveness or otherwise of paying students to be involved in this type of development work (Cook-Sather & Agu, 2013; Felten et al, 2013; Cook-Sather et al, 2014). As this work was carried out over the summer period it was felt only fair that students should receive payment in lieu of other paid work opportunities. Once the students were appointed and work commenced in summer 2012, the nature of staff involvement shifted to facilitation rather than project management. This enabled the students to develop ownership of the work and for the team to develop.

Time commitment was front-loaded for staff with respect to arguing the need for the course and gaining institutional approval. Additional time to supervise and support the students was also necessary, particularly in the beginning as the students established themselves. However, as the students developed more confidence the nature of involvement from staff changed; energies shifted from sourcing and writing materials to critically appraising and discussing student-generated resources. Time investment was slightly higher than usual at the start of the process, but staff found they saved time overall as a result of this collaboration. Most importantly, the investment in the additional time and effort to work with students as co-creators, rather than just evaluators, has resulted in the course being more successful than previous manifestations.

### ***Enthusiasm as well as experience***

As highlighted earlier, the staff were keen to work with students who were enthusiastic. This was prioritised above the students having previous experience or necessarily high academic grades. Enthusiasm and motivation linked with the students' interest in developing their experience and, for one student, to improve a course she had taken in a previous year.

On reflection, this highlights the need to balance enthusiasm with competence as one does not guarantee the other; it was lucky to have both amongst the students involved.

### *Working with professional body requirements*

Chemistry and Physics are regulated by professional bodies and, as such, have a framework of curriculum requirements to address, while Geography and Earth Science need to evidence subject benchmarking criteria. Professional body requirements could be seen as a reason for not involving students in co-creating curricula and as a barrier to innovate within the curriculum. Frequently, professional body requirements stipulate particular knowledge and skills students will develop over a whole degree or during particular years of study. However, they rarely stipulate how these outcomes are to be achieved, leaving a great deal of flexibility within the pedagogic approach and assessment method that can be used. The activity presented here has shown that where there is a clear professional and pedagogic rationale for working with students to revise and develop new curricula then professional body requirements are usually met, if not exceeded.

All professional bodies are interested in developing students as effective and employable graduates. The science skills course, by its very nature of engaging students in its design, helps students develop necessary skills and attributes to engage with their course successfully. Providing an opportunity to be involved in curriculum development enables students to gain exposure to a range of graduate attributes and a thorough understanding of learning and teaching processes.

### *Students as teachers as well as developers*

One student was available to teach the new science skills course in her final year of study. All disciplines involved have a culture of working with students as tutors and demonstrators in laboratory tutorials and seminars. Involving the students from the collaboration in the actual teaching was not planned into the original project scope but arose organically. In her own reflections about teaching the science skills course, one student highlighted how the students taking the new course seemed more at ease in approaching her with questions and less concerned with admitting they needed extra help. A key influence on the project's success was the opportunity for students to teach one another material from across disciplinary boundaries.

### ***Ensuring student voice throughout and beyond the collaboration***

Respect for student input was implicit and an essential part of the development of the science skills course. All parties ensured that individual contributions were heard and counted in the process. The staff are still in contact with all of the students involved. This has had multiple benefits; the students have been able to contribute to dissemination of the work, contribute to teaching, and input to doctoral research. However, these further opportunities have occurred through chance and circumstance. It is suggested that more attention should be paid to what happens to student input and ownership after the collaborative activity is completed. This should be done with an expectation that students can complete work and not feel compelled to have an ongoing commitment. Equally, they should be valued and given credit in dissemination or evaluation activity. Explicit conversations should address issues of incorporating multiple voices in such work and how the editorial process of resulting publications will work.

## **Implications for academic developers**

Bovill, Cook-Sather, and Felten (2011, p.140) suggest that ‘the academic scholarship of the past decade suggests that standard practices fail to integrate student voices’ into academic development practice and they question the role developers can play to ‘encourage students to share responsibility with academic staff and academic developers for analysing and designing pedagogical practices’. Building upon their suggestions, we suggest the following areas for further consideration in the academic development community.

### ***Respecting different types of knowledge and experiences.***

Academic developers work within and across disciplinary boundaries and much has been written regarding the tribes and territories inhabited by academics (Becher and Trowler, 2001) and the challenges of working in multidisciplinary teams across intellectual as well as structural boundaries. Land (2014, p.182) suggests that crossing disciplinary boundaries ‘requires a significant ontological shift at the same time as a conceptual integration of new perspectives and a letting go [of others]’. This includes seeing staff-student collaboration as a ‘shift’ in practice as well as integrating new knowledge from across the disciplines. The collaboration described here grew out of an existing partnership between staff members, developing locally-identified priorities. Staff recognised the benefits of working together, seeing disciplinary overlaps provided opportunity to collaborate on curriculum design as well as build on previous experiences of working with students.

Cook-Sather et al (2014, p.143) suggest that staff should ‘start small’ if they wish to work with students as partners in learning and teaching. The foundation of trust built between staff from previous experiences of working together, as well as with students, meant those involved could afford to be ambitious in their curriculum development plans; working across disciplinary boundaries and scaling-up the teaching materials to a 20 credit course available to all first year students.

Academic developers have a role to play in bringing staff together, and sometimes bringing staff and students together, to facilitate dialogue which helps identify areas of collaboration, enhances confidence and develops trust between individuals involved. Similarly, academic developers have a key role in contributing to developing staff knowledge of education theory and practice to support them in planning, development, delivery and evaluation. This has to be tempered with enabling staff and students within the disciplines to retain their sense of ownership and draw on the variety of knowledge and experiences in a way that they see fit.

### *Finding spaces in the bureaucracy*

The process of course development and validation is often driven by bureaucratic requirements and timeframes. Within this context, staff bring to bear their own priorities and assumptions to the curriculum development process. Professional development courses offered by academic development units provide space for academics to reflect upon disciplinary conventions and personal philosophies of learning and teaching and approaches to course design.

Academic developers have the opportunity to encourage discussion about how best to work with and, where necessary, challenge less helpful processes and conventions in order to provide intellectual as well as temporal space for students to join the conversation. O'Neill's (2010, p.65) research into the role of academic developers in curriculum revision explored the importance of creating dialogue about the rationale for curriculum change. Her research found that educational developers would ask staff questions such as: 'Why are you making changes? What do the students need to know? What are you trying to achieve? What are the essentials for students to be able to do?'

As developers there is scope to elaborate on such questions. For example, stopping to ask 'How and where can students contribute to answering the above questions?' may enable opportunities to work with students in closer collaboration, beyond course evaluation. This was a question asked by staff involved in the science skills course at the planning stages and ensured student collaboration from the start.

***Supporting the process: discuss expectations***

There was little explicit discussion amongst the staff and students involved concerning expectations about the collaboration; neither in terms of the process nor the intended product. The personal reflections shared earlier outline a model of working that was organic and flexible. In hindsight, an explicit discussion about the process as well as the product of the collaboration would have been useful. Academic developers can play an important role in supporting this discussion. Felten et al (2013) present an interesting case study which illustrates how the academic developer involved acted in multiple roles throughout the life of the project, including being adviser, facilitator and mediator.

### *Supporting staff to apply for development funding*

Academic developers are in a unique position of mediating between strategic funding initiatives and 'grass-roots' development projects. In promoting such opportunities, academic developers can facilitate the development of proposals, either as partners or as critical friends. Being involved in this process is important as it enables project-leads to take account of wider institutional and sector-level activity. Raising the profile of such support and, where possible, encouraging student collaboration in projects would be beneficial.

### *Developing capacity of students*

As noted earlier, it has been beneficial to include students from the collaboration in the teaching of the science skills course. Teaching enables students to further understand the cycle of curriculum development, from research, development to delivery. It also helps them input to course evaluation. There are, however, issues about how capacity can be developed and how it would fit in with other arrangements for undergraduate students to teach. Models of students-as-demonstrators is common in the disciplines represented in this article but is perhaps less so in other areas.

Interestingly, the students involved in this collaboration suggest caution with ‘formalised’ training for students as they feel the opportunity to work with a ‘blank piece of paper’ can give more opportunities to be creative. This raises important questions about what support students and staff want when working together to design curricula but also when they might make best use of it.

### *Evaluating impact*

There is also a key role for academic developers to work with staff and students in the evaluation of this type of activity. Engaging openly with issues of ownership and voice is, arguably, as important in the evaluation process as it is in the collaboration itself. Principles of Action Research could inform how academic developers work with staff and students to evaluate collaborative activity of this kind. An area worth further exploration is dialogue between staff and students on what meaningful impact measures may look like.

Equally, opportunities for staff to evaluate and reflect upon practice as part of their professional development should be encouraged along with support to present and publish work in this area.

## Conclusions

An important outcome of this work has been the quality and volume of materials produced. This is the *product* of the collaboration. Although tasked with producing material for one year, the students produced enough material for class and examinations to cover several years.

Through facilitated reflection and engagement with the literature, we have highlighted the multifaceted aspects of the collaborative *process* which, although implicit, were crucial in helping achieve the high-quality product.

It is difficult to point to practical examples in existing literature which focus on supporting students to work as co-creators of curricula; either in terms of the collaborative process or product. This is a gap that should be given further consideration by colleagues in academic development, the disciplines and students' unions.


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