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Co-creation Across Spaces of Uncertainty: Interdisciplinary Research and Collaborative Learning

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ABSTRACT: Broad Vision was a program for art / science collaboration that adopted a model of interdisciplinary learning, teaching and research. It brought together students and tutors from art and science subjects to work collaboratively on emergent projects based around a different theme each year. In this case study, we discuss the critical success factors and learning gained from an interdisciplinary co-created curriculum. This includes looking at how collaborative learning and working at the intersections of the disciplines enabled students to develop new knowledge and understanding in both, their own, and other subject fields.

The Background

Broad Vision was an art / science learning and research program which ran across the faculties of Media, Art and Design and Science and Technology at a London University from 2010–2015. Each year, the program brought together six tutors, three teaching assistants and approximately thirty second year undergraduate students from disciplines including Biosciences, Contemporary Media Practice, Illustration, Imaging Science, Photographic Arts and Psychology. The program created an interdisciplinary space for collaboration and co-creation, as well as the exchange and exploration of different research and working practices. (details of the program in supplementary file 1)

The scope of Broad Vision has offered many opportunities to look at the program from numerous positions [1, 2]. In this case study, we explore the critical success factors for learning within an art / science program and the learning gained from a co-created emergent curriculum. We focus on aspects of interdisciplinary learning and the role of the student as co-creator of the curricula.

Research Design

Throughout the five-year life of the program, a series of observations and semi-structured discussion groups were conducted. Observations focused on the physical environments, the range of teaching methods and the social interactions between students and tutors and students

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and their peers. During separate semi-structured discussion groups with either students or tutors, participants' perceptions and experiences of working within this interdisciplinary and collaborative educational model were identified. Data was gathered from multiple sources, including weekly feedback on post-it notes, capturing students' reflections on their learning experiences at the end of scheduled sessions, and students' critical evaluation of their learning at the end of the module. An in-depth qualitative analysis of all material collected was conducted to identify the critical success factors of the program and the learning gained from a co-created curriculum.

Interdisciplinary Learning

The program encouraged interdisciplinary learning by introducing a core stimulus, such as the use of a microscope, a set of images, or a theme - establishing a central focus for interpretation and exploration. This mode of learning created a liminal space, inviting students and tutors to synthesise methods and procedures. For example, an artist sculpting with scientific material, leading to unfamiliar working practices. This approach challenged preconceptions of the various disciplines involved and led to new ways of interpreting and representing the world around them. Furthermore, it introduced both, artists and scientists to a new set of materials, enhancing individual practice by embracing working methods of the other disciplines. (see supplementary file 2 for more detail of interdisciplinary learning)

During the initial phase of the program students from each discipline collaborated with each other to design and deliver a series of 30 minutes taster activities. These introduced students to the ways of working in each other's discipline areas. For example, the biomedical science students ran a taster session in exploring histological tissue section viewed under a microscope, allowing students from outside of the sciences to experience working in a scientific laboratory. Conversely, science students were introduced to the functions of a large format camera by the photography students in a studio. During this phase students became teachers sharing their disciplinary knowledge, communicating to non-specialists and reinforcing their confidence in their own disciplinary knowledge. Likewise, tutors switched roles, becoming learners, enabling students to take ownership of the learning process, as commented upon by a science student: '*It's really valuable to have the opportunity to try and teach others what you have been taught, helps to condense and revise.'* The taster activities introduced students informally to a collaborative mode of learning which established a foundation for their interdisciplinary learning.

A second set of activities encouraged students to share their initial thoughts and ideas in response to the theme set that year. Activities such as silent brainstorms and collaborative mind mapping created discursive spaces, inviting students to view ideas from different disciplinary perspectives. Tutors created an environment that encouraged openness and supported students in finding ways to articulate their thoughts to students from other disciplinary backgrounds as

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illustrated by this student comment: *'There were as many interpretations, points of view, as there were people who took part. Each person's brain is wired up differently and although we can reach consensus, it is incredible to hear how someone else sees something'*. (more detail on the pedagogic approach in supplementary file 2)

Research project ideas emerged from the creative conversations allowing students to self-organise into groups based on their common interests. These ideas were further explored, making use of different tangible and online resources using information technologies to research and share artefacts with peers and tutors, rather than the lecturer dominating the provision of knowledge. This approach to teaching, which begins with the student's experience, tallies with Vygotsky's suggestion that the teacher ought to construct the learning environment so that the student teaches themselves: '*Education should be structured so that it is not the student that is educated, but that the student educates himself'* or, in other words, *"...the real secret of education lies in not teaching"'* (Vygotsky, 1997; as cited in [3]).

The merits of this mode of interdisciplinary learning was evidenced by students demonstrating a fueled sense of curiosity and motivation. Jackson and Shaw referred to such notion as: 'the great engine of academic creativity is intellectual curiosity - the desire to find out, understand, explain, prove or disprove something or simply to imagine something different' [4].

Students looked for different patterns and meanings in the materials they were exposed to. Further benefits of this approach were the opportunities to expand one's knowledge base, and develop confidence and openness in working across the disciplines. The use of different disciplinary languages contributed to the development of enhanced negotiation and communication skills, as expressed by this photography student: '*Collaborating with a scientist has added new meaning to my work and the process of sharing ideas and thoughts has enabled me to feel more confident working with others*'. Moreover, the experience of working in different ways, researching, capturing and presenting 'data' exceeded the skills acquired within a single discipline as commented upon by a science student: '*Today I saw evidence of how science and technology related to the real world. Studying theories is not enough, one should engage with people of different backgrounds and dare to explain the theory behind the living world*'.

Broad Vision enabled students to produce new knowledge during the process of experimentation by bringing together the unfamiliar and the untested. Students situated '...themselves within a pedagogical process, whose meaning and purpose they understand, production of knowledge is revealed not as something that is already discovered and static (i.e. dogmatism) but as uncovered as "*dynamic context of its own appearance"'*. (Vygotsky, 1997; as cited in [5])

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As observed by one of the science students: *"Felt very good today. Getting hands dirty, so careless…It is exactly the opposite of my course, where to start with, we wear gloves and more often than not, there is only one way, a right way, to do something."*

This statement reflects on the traditional way science is taught: students learn the rules and follow them, not break them. Scientific practical classes are usually designed so that experimentation results in predictable outcomes. This is exemplified by Michael Brooks (as cited in [6]) 'the politics of a curriculum which keeps to the rules and excludes elements of risk or imagination is about persuading us that science is safe'. Through encouraging science students to explore scientific materials and processes in an undefined way, Broad Vision changed the way in which science students looked at science itself.

Throughout the program students drew on the knowledge and expertise of each other, forming a 'community of discovery' [7]. Through the collaborative process students learnt how to articulate their own thoughts and communicate their disciplinary knowledge to a non-specialist, helping to reinforce their confidence in the subject. Central to the collaborative learning process was the students' openness and willingness to explore different disciplinary practices and cultures. A safe learning environment was created by building trust between participants, and by using assessment methods that focused on the collaborative learning process rather than outputs. According to Klebesadel and Kornetsky (2009), a core expectation of such learning processes is the need for 'experimentation and risk-taking with permission to learn from mistakes…' (as cited in [8]). In order to explore the world around them from a different perspective, students were encouraged to embrace the notion of 'successful failures', as well as being comfortable with uncertainty. New meaning-making required students to collaboratively 'develop fluency in multiple literacies...to be able to model, to experiment, to visualize, to verbalize, to write, and to film…' through cross-disciplinary cultural exchange [9].

Students were encouraged to draw on the disciplinary expertise of others rather than attempting to master other disciplinary positions themselves. This is in accord with Murray et al., who observed that successful interdisciplinary collaboration occurs when: '…work is produced not by one researcher foraging from other disciplines, or several researchers operating in parallel, but by several researchers together in collaboration, each rooted in specific knowledge and methodologies' [10]. Or as expressed by one of the psychology students: *'The benefits of interdisciplinary group work however, is that each individual comes with unique knowledge in terms of theory, methodology and thinking style. I believe, that this uniqueness offers the individual a particular role in the group, which is highly beneficial for productivity and sense of individual responsibility'.*

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Student as Co-creator

Recent educational literature has introduced higher education to various models of the student as co-creator. These include students as 'change agents', 'partners', 'active collaborators' and 'co-producers' [11, 12, 13, 14]. Whilst the models might differ from each other in their focus, they all place the student at the centre of learning and teaching; they also share the common goal of giving students a voice in the design of their education and potentially transform student experiences.

The way in which Broad Vision was structured facilitated co-creation between students and tutors at various stages. Each year students participated in early planning sessions of the program, generating the theme and developing initial activities for the week-by-week schedule. During the planning and delivery of the taster sessions students generated content and teaching methods for the workshops. This ranged from health and safety instructions to setting up laboratories and studio spaces, to preparing material and resources required.

The teaching approach adopted during the program was student-centred and interactive. This encouraged students' engagement and autonomy by using their ideas and creations as starting points for developing critical thinking and practice. This approach is echoed in Graham Gibbs' observations in regards to supervision of student projects:

'The starting point is what the *student is doing*, not what the *teacher knows*. As a result, the relationship between teacher and student is profoundly altered. Students can find this change of relationship and roles–the shift from dependence to autonomy, and from an academic focus to a focus on practice–both exciting and disorienting.' [15]

During the evaluation of the program students commented on how relationships and roles shifted. Arts students predominantly welcomed low hierarchy in their working with tutors and embraced the freedom to initiate and develop their own ideas. From this approach, another interesting form of co-creation emerged which was that of co-creating projects with tutors. For students to fully realise their ideas, the experience and expertise of the tutor was necessary, yet their input was requested by the student rather than imposed by the tutor. Many of the science students were less prepared for this form of self-directed study, as they were more familiar with instructive teaching methods, as confirmed by this psychology student: '*In ...science, one must follow instructions and rules or their work is not valued and is considered meaningless*'.

The Broad Vision program's ethos of providing authentic learning opportunities for students led to students co-authoring articles, co-editing books, co-curating exhibitions, co-leading workshops for the public and co-presenting at conferences and symposia [16]. The impact of these engagements on the student experience could not be better summarised than by this

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photography student: *'I have never been part of an exhibition before, or had something commercially printed, or spoke at a symposium, or been included in a book. Not to be melodramatic, but that's life changing.'* For tutors the experience of working with students across a range of co-created activities was incredibly positive and invigorating. The level of commitment from a student when invited to contribute to a real life event; such as embracing the opportunity to collaborate with a scientist or artist in producing artwork for a public exhibition exceeded the tutors' initial expectations.

The module assessed the students' individual contributions to the collaborative project by producing a research journal and a critical evaluation, focusing on their learning gained through interdisciplinary practice. When collaborating with each other, students and tutors had to discover their own way of negotiating different research practices and disciplinary languages as shown by this quote from an art student: '*The difficulty for us all is not being able to use technical words, work as fast or even have a hugely ambitious project. Primarily this is down to the fact that we are working with people who know nothing or very little about our discipline. This, however, was also a benefit as I personally felt like I learnt how to explain my ideas and the technical elements of our project'*.

Encouraging some students to be rigorous when documenting their research was a challenge. A balance had to be struck between how much direction to give and how much structure to impose whilst allowing students to take ownership of the process. The variety of documentation styles used added another layer of complexity to the assessment process due to the need to align different disciplinary styles to a single set of assessment criteria (Additional detail in supplementary file 3). Furthermore, tutors approached the assessment process from the perspective of their own disciplines, requiring careful moderation of grades. These observations are similar to those of Carl Gombrich [17]:

'Interdisciplinary work challenges notions of rigour. On the one hand, it can generate new ideas, create new ways of working and generate new products which stand outside standard templates and procedures of assessment. And, by definition, it crosses boundaries so that established disciplinary experts may not know what they are looking at and be hard-pushed to say whether a piece of work is rigorous or not.'

One of the criticisms of interdisciplinary practices is the depth of engagement with individual disciplines and methods. W. J. T. Mitchell questioned whether interdisciplinarity is 'a grab bag of problems left over from respectable, well established disciplines' (as cited in [18]). This was reflected in the approach taken by some participants on Broad Vision who 'played safe' by not moving outside of their field, nor engaged with other disciplines in a meaningful way. In some cases, this led to unequal contributions when working on collaborative projects. However, when students embraced the risk of the uncertain terrain, the work produced was enriched by its

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breadth rather than being diminished by a relatively limited understanding of disciplinary languages and tools.

Conclusion: In this case study, we have explored the critical success factors for learning within an art / science program and the learning gained from a co-created curriculum. We focused on aspects of interdisciplinary learning and the role of the student as co-creator of the curricula, working in partnership with tutors, and how they switched roles between learner, teacher and researcher.

Broad Vision brought together participants from the arts and sciences to work collaboratively at the intersections of each of the disciplines. By having no predefined curriculum students were expected to explore unfamiliar practices and territories. The co-creation of taster sessions at the start of the program opened up a space for collaborative learning, enabling students to explore each other's disciplines and engendering increased levels of curiosity amongst students. This departure from conventional curriculum design was critical to encouraging openness to new ways of working and challenging preconceptions when developing ideas for emergent projects during the creative conversations. This led to students self-organising into project teams enabling them to take full ownerships of their learning. Through this process a foundation for co-creation of new knowledge and understanding was formed resulting in the production of novel artefacts which encouraged students to question their own practice and that of their peers.

The transformational impact of the learning gained from participating in Broad Vision was particularly emphasised in the critical evaluations completed by students. Reflections highlighted: consolidation of own disciplinary knowledge; learning to look at your own discipline from a different perspective; use of different disciplinary languages and development of enhanced communication and negotiation skills; developing confidence and self-awareness, embracing uncertainty; being open to new forms of communication, new materials and working in new environments. This list of attributes confirms the value of the model of learning explored during Broad Vision and highlights how it prepares students for twenty-century working practices which are inherently multi, trans or interdisciplinary.

We hope that our case study has sown a seed of inspiration to consider how this model could be adapted to other disciplinary fields and intersections.

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Biographical Information

Prof. Mark Clements is the Director of Education/Chair in Science Education within the College of Science at the University of Lincoln. His scientific research background is in microbiology and stem cell biology. Mark’s educational research focuses on creative approaches to science education, interdisciplinarity and co-creation within the curriculum and he was the Bioscience lead on Broad Vision.

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