

Reciprocal elucidation: a student-led pedagogy in multidisciplinary undergraduate research conferences

* corresponding author.

Dr Helen Walkington*
Oxford Brookes University,
Department of Social Sciences,
Oxford
UK
hwalkington@brookes.ac.uk

Dr Jennifer Hill
University of the West of England
Department of Geography and Environmental Management
Bristol
UK
Jennifer.Hill@uwe.ac.uk

Professor Pauline E. Kneale
Plymouth University
3 Endsleigh Place
Plymouth
UK
pauline.kneale@plymouth.ac.uk

Abstract

There is no previous study of the benefits of attending a national multidisciplinary conference dedicated to undergraduate researchers, despite the growing number of such conferences internationally. This paper addresses the gap in knowledge of the learning gains from these conferences, and reveals a student driven learning process, a multidisciplinary signature pedagogy. . It presents the results of 90 in depth interviews with student conference participants conducted over three consecutive years of a multidisciplinary National Conference of Undergraduate Research (2012 - 2014). This paper uniquely captures the student voice on their perceived learning gains from this experience. The results reveal that some students co-create a pedagogy of Foucauldian reciprocal elucidation, through a sense of 'unfinishedness', allowing them to reflect on their own learning in the light of divergent perspectives, questions and frames of reference. Bidirectional exchange of ideas and insights enabled students to ask and answer questions that transformed each other's thinking, allowing them to arrive at understandings they could not have achieved by themselves. The opportunity to present research in an authentic setting beyond disciplinary and institutional contexts developed students' skills and confidence, giving additional value over and above the recognised benefits of engaging in research. The undergraduate research conference is framed as a threshold experience for the development of self-authorship. Significant implications for practice include supporting constructive dialogues between students and the creation of authentic and professional multidisciplinary contexts for sharing research.

Keywords: undergraduate research conference; self-authorship; empowerment; transformation, reciprocal elucidation, pedagogy, quality enhancement, student experience.

Reciprocal elucidation: a student-led pedagogy in multidisciplinary undergraduate research conferences

Introduction

The value and efficacy of undergraduate research in student learning is well evidenced as a high impact educational practice (Kuh, 2008) promoting critical thinking and reflection, increasing motivation and confidence, and for many the intention to pursue post-graduate study (Hunter, Laursen and Seymour, 2007; Lopatto, 2006; Russell, Hancock and McCullough, 2007; Spronken-Smith, Walker, O'Steen, Matthews, Batchelor, and Angelo 2008). While undergraduate project work has featured in higher education learning for the last 200 years, the emphasis on research has grown and is fore-fronted, for example, in the statement that undergraduate research is the pedagogy of the 21st-century (Council on Undergraduate Research, 2005). Undergraduate research is now an internationally recognised endeavour (Jenkins & Healey, 2010) with studies from around the world demonstrating the benefits for student learning (see for example Sandover, Partridge, Dunne, and Burkill, 2012 in Australia and the UK; Alamodi et al., 2014 and Ibnouf, Dou, and Knight, 2014 in the Middle East; van der Rijst & Visser-Wijnveen, 2011 in the Netherlands; Padmaja, Laxmi-Ramana and Reddy, 2015 in India; and Yuhao, 2014 in China). Despite the level of student engagement in research, the outcomes largely remain within the University as part of the assessment process (Spronken-Smith et al., 2013).

Dissemination of research findings can take place in a variety of formats (Walkington, 2015), but there is growing participation in large scale events to provide an authentic and prestigious setting for sharing findings. The framework for dissemination of undergraduate research (Spronken-Smith et al., 2013) posits that a national undergraduate conference can reach one of the highest levels of student exposure (potential sphere of influence). Undergraduate research conferences are growing in number at institutional, national and international level and student participation in conferences and meetings within the disciplines is also increasing. Conferences enable students to view their research findings in a wider context, allowing recognition of their own disciplinary perspective for understanding the world as they are about to graduate. Multidisciplinary undergraduate research conferences are a relatively recent innovation. The National Conference on Undergraduate Research (NCUR, 2013) started in the USA in 1986, and in 2013 attracted over 2000 US and international students. At NCUR 2014, 8 countries were represented with 3331 student presenters and a total attendance of 4133. 'Universitas 21', an international network of

research universities, have run a conference for undergraduates annually since 2005. Other national conferences which have started more recently have shown rapid growth. The UK British Conference of Undergraduate Research (BCUR) started in 2010. At its 2013 annual conference there were 215 delegates and by 2014 this had grown to 363 delegates, with 17 countries represented. The first Australian conference was held in 2012 with over 150 presenters (ACUR, 2012). A massive open online course (MOOC) to share expertise in developing undergraduate research conferences was held at the University of Windsor, Canada in 2015. These multi-disciplinary conferences represent a growing realisation about the importance of disseminating research in order to complete the research experience for student learning (Boyer Commission, 1998).

In a large scale survey of summer research experiences across America, Lopatto (2007) noted that 13.5% of undergraduate students participated in a talk or colloquium at a conference or professional meeting. Informal conversations at conferences are the places where students 'construct the research process and negotiate the social framework of their disciplines' (Mabrouk, 2009: p. 1335) in a marketplace of ideas (Hersh, Hiro, and Asarnow, 2011).

Using an online survey to understand the student experience of the American Chemical Society Spring National Meeting Mabrouk (2009) correlated gender, sessions attended, perceived benefits, ethnicity, and other variables. 4,000 undergraduates attended the meeting in 2007 and in 2009 more than 100 students presented their work in a dedicated poster session. The research showed that the benefits derived from a conference differed according to ethnicity, supporting research findings that engaging in undergraduate research can significantly benefit underrepresented groups (Brownell & Swaner, 2010; Gregerman, 2009). Presenting at conferences increases the professional confidence and identity of students (Seymour, Hunter, Laursen and DeAntoni, 2004) and provides a broader perspective on science (Hunter, Laursen and Seymour, 2007).

There is no previous study of the benefits of attending a national multidisciplinary conference dedicated to undergraduate researchers, despite the growing number of such conferences internationally (e.g. The United States, Canada, Australia, UK, Ireland, Netherlands), the time and costs invested in attending, and the benefits of a 'students as researchers' approach in Higher Education generally. This paper addresses this gap in knowledge of the learning from such conferences, and reveals a student driven learning process, a multidisciplinary signature pedagogy framed here as Foucauldian 'Reciprocal Elucidation' - a form of bi-directional knowledge building. This paper presents the first large scale and qualitative analysis based on the student voice of learning gained from multidisciplinary conferences at national level.

This research analyses the reflections of 90 undergraduate conference presenters over three years of the British Conference of Undergraduate Research (2011, 2012, 2013) across the full range of disciplines (including STEM, social sciences, medicine and allied health disciplines, law, arts and humanities) in order to understand the value of conference participation to the student learning experience and its place in student learning. The research explores the students' experiences through three overlapping lenses: liminality (Turner, 1967; 1974; Cook-Sather and Alter, 2011); transactional communication (Foulger, 2004); and self-authorship (Baxter Magolda, 2004; 2009). **The liminal space challenges the individual, but in dialogue with peers students simultaneously develop personal and social judgements and responses.**

Liminal space foregrounds inbetweenness and ambiguity (Turner 1967; 1974), with an emphasis on the process of students who inhabit such space evolving and becoming, rather than simply expressing pre-defined identities established within the constraints of institutional curricula. Two key aspects of liminal space **experienced when students present their work at national multidisciplinary conferences** are that social hierarchies are broken down allowing individuals to draw more freely on their personal experiences and evolution of identity from a singular point of reference to something more expansive. As a consequence, liminal spaces are often transformative (Mezirow, 2000). They can act like a threshold, and by crossing this students can change the way in which they view themselves and their knowledge (Meyer and Land, 2006; Meyer et al., 2010). Palmer, O'Kane and Owens (2009) used liminality to look at turning point experiences as students' transition into HE, and we argue that the undergraduate research conference, representing a novel and authentic educational setting, represents an experience of the outward transition into employment or further study. Students who enter liminal spaces can be inspired to recognise shortcomings in their existing understanding, perspectives and mind-sets. They can reformulate their taken-for-granted frames of meaning by engaging in critical reflection, through a process of dialogue with others. **Such dialogue is a central element of transactional communication.**

Shannon's (1948) linear model of information flow reflects the normal, unidirectional communication from student researcher to lecturer assessor. More sophisticated communication models emphasise the role of transactional, interactive, mass communication, where the creator of the original material has an effective engagement with feedback that allows the researcher to further develop themselves and their ideas (Foulger, 2004). In effect, participants in dialogue co-create understanding and perceptions of identity through the reciprocal exchange of ideas and insights. The conversations associated with oral and poster presentations at conferences provide valuable feedback that encourages further thinking and development of research ideas and identity. When presenting in a

discipline context, the audience can be expected to respond with insights that are framed by the subject. In contrast, a multi-disciplinary conference tests participants' ability to present complex ideas to an audience that holds diverse perspectives and ways of seeing the world and to respond to feedback appropriately according to shifting viewpoints. This paper **examines how the liminal conference space creates opportunities for dialogue that promote the development of self-authorship.**

As students develop self-authorship (Baxter Magolda, 2004; 2009), they are able to consider what they know and how they came to know it, to judge the suitability of their knowledge as applied in particular contexts, and to be able to reframe their knowledge purposefully for different contexts. Promoting self-authorship at undergraduate level requires learning to assume the form of a collaborative exchange of perspectives. This necessitates interaction between a diversity of individuals in order for learners to reflect on alternative viewpoints, to shape self and to help shape others. Self-authorship is enhanced by learning in contexts perceived as authentic by students; reflecting real life practices. Presenting research in a professional arena may serve to validate the ability of students to construct their own knowledge, to communicate that knowledge, and to redefine it via social interaction. Their role in such arenas is to exchange and compare perspectives, to think through problems, and to integrate and apply knowledge. Presenting and subsequently defending a poster or paper in a conference setting **can** situate students as experts, whilst simultaneously requiring them to adapt their knowledge fluidly in response to audience questions. This paper explores **the way in which** conference settings, **in offering** spaces for dialogue, interaction and reflection, **promotes the development of** self-authorship.

Viewing student experiences of multi-disciplinary undergraduate research conferences through these three **interconnected** lenses, our results revealed that some students developed a multi-disciplinary signature pedagogy (Schulman, 2005), through their engagement with each other in the liminal conference space. While students gained recognition as researchers they also developed a sense of unfinishedness, their presentation or poster was no longer viewed as a final product but as a starting point. Likewise, some students recognised they were on a journey of becoming, as nascent researchers, academics or professionals. Participants began to construct new meaning from the authentic context and conversations supported by the undergraduate conference, enabling them to assess and justify their assumptions and to explore new ways of acting and being. A multidisciplinary undergraduate research conference is therefore framed as a threshold experience for the development of self-authorship.

Methodology

A total of 90 interviews, averaging 30 minutes in length, were undertaken with students who had presented either a poster or a paper at a national multidisciplinary undergraduate research conference (Table 1). **Using the published conference programme to gain access to a range of disciplines, students were approached during the event by members of the research team and interviews were conducted at the close of the event, allowing some time for reflection.** The interviews focused on three main areas: the experience of preparing for the conference; of presenting a paper or poster; and of being a conference participant. **The interviewer asked open questions so students could elaborate on their experience during each stage, teasing out the skills developed and feelings about presenting to a multi-disciplinary audience. (For example: Can you tell me about your experience of preparing for the conference? Can you tell me about your experience of presenting your poster / paper? What motivated you to take part? How would you rate this experience compared to other learning experiences at university?)**

In the UK final year undergraduate students are working at honours level and a dissertation or equivalent is a normal expectation. Thus 95% of participants were final-year students presenting their dissertation, summer research project or independent research. Five percent of respondents were in their second year and a few had carried out research for their own interest, or solely for the conference.

Table 1: Conference and interview details [BCUR is the British Conference of Undergraduate Research, held in the UK but open to international delegates].

Conference location and date	Number of interviews / Number of students presenting (% sample)		
	Poster	Paper	Total number presenting
BCUR 2012 University of Warwick	17 / 71 (24%)	18 / 98 (18%)	36/169 (21%)
BCUR 2013 Plymouth University	19 / 94 (20%)	13 / 81 (16%)	32/175 (18%)
BCUR 2014 University of Nottingham	13/154 (8%)	10/136 (7%)	23/290 (8%)
Total number of interviews by type of presentation	49 / 319 (15%)	41 / 315 (13%)	
Total interviews and sample			90 / 634 (14%)

Following a constructivist research approach (Denzin and Lincoln, 2011), interviews aimed to elicit participant interpretations of their experiences through extended reflective dialogue. Interviews were audio recorded, transcribed, and entered into the qualitative analysis software NVivo to assist in coding the data based on interpretive readings of the text (Denzin and Lincoln, 2011; Mason, 1996). The use of double blind coding was employed to reduce bias. Such constructivist grounded theory enables salient themes to surface from data during the analytical process. The approach also concedes, however, that the categorisation of written text derives in part from the representation of issues as identified by the researchers. Resultant themes are coloured by researcher positionality, leaving them situated in particular social constructions of knowledge (Charmaz, 2009). The results must therefore be interpreted within these limitations.

Findings

This paper presents the results with respect to three interrelated themes: a learning space characterised by liminality, developing transformative learning; a transactional form of communication (bi-directional knowledge construction) resulting, for some, in reciprocal elucidation; and developing self-authorship. Representative quotes are offered followed by respondent numbers (R1-90).

1. Liminal space and transformative learning

The undergraduate conference space was recognised as unfamiliar by the students, offering different learning opportunities to those commonly encountered in university settings:

*it's a completely different world ... it's not anything like we experience in university (R39)
It feels like it's not artificial... it provides that realism that you don't get very often on a degree course
(R42)*

As a liminal space the conference represented an authentic, novel, challenging and initially disruptive space for students, exposing their vulnerability and uncertainty. They often spoke of being pushed beyond their comfort zone. But there was also consensus that persisting in this space gradually dissolved their concerns, most often due to the nurturing environment, and this led to relevant challenge:

I was a little bit nervous taking my research into a field where other people that I didn't know might have been in a position to criticise it and that's always a little bit scary but thrilling and helpful at the same time (R65)

They can ask you a question and it can put you off kilter and then you have to think on your feet a bit which is quite a good experience (R79)

The genuine interest that was evident in the audience altered students' perceptions of themselves. The students were acutely aware that they were communicating their research to an attentive audience with no barrier to hide behind. One student commented:

to be there as me, with my work, felt very vulnerable (R13)

Students frequently referred to power relations, often reinforced by gesturing with their hands at different levels during the interviews, but indicating the conference made this relationship more equal, largely because it was 'beyond assessment' which has an inherent power relationship:

At university there always seems to be that student - teacher barrier and you feel like they are assessing you. At something like this, you feel more on a par with people and you can just discuss things (R15)

Initially I just thought it was an undergraduate project (they always treat us like babies anyway), I didn't realise it could be so significant. It's not just a dissertation, it [the findings] could become a therapy for cancer (R39)

This demonstrates the transformational nature of the conference experience for students who have found their 'voice' and are clearly finding recognition as a researcher:

I feel like a mini professional, it's really strange, not feeling like a student ... it's just feeling respected rather than 'oh no, not another lazy student' (R14)

You can become who you want to be, rather than what you think a piece of paper says you should be (R 80)

I can see myself in the future, thinking of how I could build on my own research in a way that really adds to the discourse of environmentalism' (R74)

At the conference ... what you've got in common is that you're there as a researcher, it's about the knowledge, the research and that's your common touchstone' (R65)

An increase in self-esteem was common to all interviews and provides evidence of the transformative experience of the research cycle being completed.

The conference can be conceptualised as a liminal space (Cook-Sather and Alter, 2011) which involves risk and uncertainty and in which there are changes to power relationships with participants recognising that their understanding is in a state of contested flux as well as promoting reflections on identity and feeling like a 'proper researcher'. Transformational learning is 'unsettling' in that it leads to questioning of accepted assumptions and views and to new ways of knowing and understanding.

2. Transactional communication

In the three BCUR conferences studied, the cyclical flow of ideas - with students rethinking and refining their understandings, was very evident for a large proportion of students. One student encapsulated this idea:

It is completely different to presenting within university because you can be questioned by people you are not studying with, who are likely to have expertise in other areas relevant to your research. This can result in bidirectional exchange of information in which both myself presenting, and the student asking the questions, gain greater knowledge of the subject area (R52)

The conference environment allows students to advance their thinking and perhaps to take more risks in what they say because 'In the serious play of questions and answers, in the work of reciprocal elucidation, the rights of each person are in some sense immanent in the discussion. They depend only on the dialogue situation' (Foucault, 1997). Situated in the space of the dialogue there are rights and responsibilities, therefore a form of conference 'citizenship' evolves. The responsibilities of presenters to accept engagement in dialogue and to answer what may be difficult questions are balanced by the right of delegates to ask questions, to withhold judgement until convinced and to propose alternatives, adopting the responsibility to do so constructively. This is a learning partnership.

difficult questions move you forward ... If you're just thinking for yourself you just continue to strike forward in a line, but if someone stops you and asks 'what's going on here?' Then you ask yourself and you improve (R26)

Being able to ask questions you have to think about your own words and the point of view outside of yourself (R48)

The students recognised that engaging with different perspectives offered them an enhanced learning experience catalysing a shift towards reciprocity in learning for a number of students:

The questions people give me, give me a different insight into my topic. It's nice to be able to listen to what they've said and format a question that in turn will help them (R20)

... I like having people come over and say 'have you thought about this' or 'how does this impact on your work?' It's opened up areas of thought for me that I wouldn't have thought of otherwise (R60)

Thus, engaging in an UR conference drew out the desire in many respondents to help others. Students recognised the utility of questions and comments on their work and they wanted to give back altruistically to the research community. This desire to help others is a step towards mutual respect and empathy across researchers:

People need to respect each other's disciplines for what they are because everybody's research has value in different ways (R15)

Being able to mix with people who are doing completely different things ... it's just made me so understanding and appreciative of what people do (BR7)

Some respondents described how the bidirectional exchange of ideas and insights improved their ability to ask and answer good quality and sometimes difficult questions that

could transform each other's thinking, describing this as empowerment. **Reciprocal elucidation characterised instances where students were engaged in transactional communication at a sufficiently high level to afford a challenge to each other's knowledge or way of thinking, promoting the development of self-authorship.**

3. Developing Self-authorship

The cognitive, intrapersonal and interpersonal development of learners (Baxter-Magolda, 2009) are described in turn.

There is a strong message that the UR conference experience broadened the students' cognitive horizons by offering greater exposure for their research (Spronken-Smith et al., 2013). Participants spoke of 'escaping from their cocoons', leaving the safe and familiar contexts of their modules, courses and disciplines, to 'cast off their blinkers' and gain a synoptic view of their research, its disciplinary context, and of inter-linkages across subjects. Many responses highlighted the interest and enjoyment in engaging with researchers from different disciplines. The students became aware of the bounded nature of their discipline, but, equally, how permeable boundaries and outward-looking scholars in disciplines can enable cross-fertilisation of knowledge, methods and ideas.

It's interesting how everything overlaps ... you think you're doing one set topic and it's fascinating when you start talking to people about how everything sort of is a big Venn diagram (R1)

In a seminar [at university]... I don't think people are necessarily bringing different perspectives to the table, whereas when you're ... colliding with other people in a conference environment ... it can be more dynamic and more fruitful because there's a higher amount of diversity (R2)

Speaking to people in other scientific disciplines, seeing the kind of parallels, what you're doing is actually just a subset of a higher scientific framework (R70)

The internal communication process involved in clarifying concepts, reflecting on ideas and analysing information forms the basis of intra-personal development. The transition to research being seen as a process, rather than a finished product was reflected in many student interview responses:

There are still changes to be made, there are still questions to answer that people brought up that I might not have thought of, but it's given me great confidence in my work knowing that it is a good basis to move forward (R45)

It's good in that it's helping you develop your own thoughts. But it's also testing you to come back with the answers ... then you just feel the development in your work and making it stronger and coherent. You don't really get that in the classroom whereas here, you're expecting the critique, you're expecting the questions. There is a definite sense of community that I felt, especially when you're discussing ideas and being critical, there's this sense of helping each other develop (R74)

In their responses, students mentioned the benefits of dialogue to enhance their own critical self-reflection. Students were prompted to make reflective judgments about their own research (King and Kitchener, 1994), viewing their work from different perspectives and realising the transferability of their skills into other contexts as a result.

Interpersonal development was fostered through dialogue, whether this was a conversation at a poster or paper 'question and answer' sessions. All students, regardless of their discipline, understood the importance of matching their language to the audience and reflected on the way their use of language changed during their conference preparation. Students giving paper presentations had to decide on their language in advance, whereas the conversational nature of the poster presentations gave immediate feedback from facial expressions and body language, allowing presenters to tailor terminology to individuals. Willison and O'Regan (2007) created a research development framework which theorised a shift from the use of lay language to disciplinary language as student autonomy in research increases. The multidisciplinary undergraduate research conference setting reverses this relationship because disciplinary discourses can reduce the accessibility of ideas to people who do not share the same language. Therefore conveying complex ideas in simple language becomes a significant capability. Students begin to objectify knowledge (Popper, 1972) in order to describe their research findings without recourse to the terminology of their discipline.

... it requires a lot of skill...It teaches you how to actually present data and how to try to make things accessible for people who don't have that much of a background as you do in a particular subject. It takes some time to think how to put it...you learn each time you present it to someone how to put it in a more understandable way (R3)

I've learnt how to use language to target the same piece of research at different levels so everybody can understand it (R42)

As soon as you can start simplifying complex theories, making it understandable to the general [audience], it tests your true knowledge of what you've studied (R 29)

The responses revealed that external dissemination contributes meaning to research presentation, not always achievable within one's own university context. Students reported that assessment of presentations coloured their experience at university, whereas in the conference context, being able to express the research in an interesting and engaging way was more important than being graded. Respondents expressed a desire to move 'beyond a grade' awarded by one or two tutors, to the communication of a message to a broad audience where the clarity and relevance of their work mattered:

*I don't do research just to get grades. I do it to tell people about it. It's meant to go out into the community **so other people can build on it**. I don't see the point in doing science if you're not going to tell people about it (R42)*

Many students highlight the importance of the work being seen rather than being 'filed away' or put 'in a cupboard' after faculty assessment.

Here it's not about getting marks, it's about knowing what's important for your field, for yourself and for whatever innovation you think you've made (B R22).

Even if I'm completely wrong, I've added to the discussion (B R90).

People asking you questions that are genuine, rather than a lecturer or superior asking you questions after they've been involved in the project for months, it's kind of exposure to intelligent people who are going to peer review it, without being fatigued by 30 other people they've got to talk to (B R90).

Conference settings encouraged students to co-create understandings through presentation, dialogue and reflexive adjustment of explanation to suit diverse disciplinary perspectives. Peer review served to legitimise them as 'more than' students – as agents constructing knowledge, situating learning in their own experience, but mutually constructed with others.

Summary

The data have highlighted the academic and social development value of Undergraduate Research conferences to students. Participants were constructing personal values and opinions, using the perspectives of others to do so. Increased self-awareness and confidence to participate in research and wider academic communities provided the opportunity for students to demonstrate the developmental maturity of self-authorship (Baxter Magolda, 2004). Through attending the conferences the students escaped their identity as 'just an undergraduate'. The conferences offered liminal spaces of opportunity rather than static being, in which students were able to cast off the fixed identity of 'student' to become nascent research professionals.

The students described their conference experience as a series of conversations with a bi-directional exchange of knowledge and ideas. The differences in learning gain came from the quality of the dialogues that students experienced, the quality of questions they were asked and how thought provoking this was. An undergraduate research conference is an authentic setting in which students can experience a step-change in cognitive and affective processing, becoming critically self-aware and committing to enhancing the thinking of other students by developing the *confidence to ask the difficult questions* (R45).

Responding to the liminal space through developing internal and external dialogues (the cognitive, intra and interpersonal characteristics of self-authorship) students facilitated their own and their peer's learning.

Freire (1998) argued that the ability to be educated is linked to consciousness of our unfinished state. Freire's commitment to co-operative knowledge construction and democratic dialogue can be replicated in a conference space and ensures that with each

encounter the outcome will differ. Students met others from a variety of different disciplines and experiences and recognised their disciplinary positionality.

Related to this, the bi-directional flow of information and ideas to develop a shared understanding was a crucial element of the experience for some students, and there was clear acknowledgement that we need *multidisciplinary* settings to forefront activity that we have framed in this paper as reciprocal elucidation (Foucault, 1997). The findings strongly suggest a shift from the prevailing transmission model of education to one focussed on the development of conscious dialogical elucidation (Foucault, 1997).

Conclusion

A sustained research investigation is an authentic learning experience and as a result students are intrinsically motivated to communicate their research findings - beyond any opportunities or constraints related to assessment (grading) and the curriculum. Students recognised that the communication of findings is a fundamental part of the research experience.

Through analysing a large and detailed data set from 90 undergraduate conference participants across the full range of undergraduate disciplines we capture a collective 'critical event' or threshold experience for students. Deepened learning is recognised by the students as a transformational experience (Meyer and Land, 2006; Meyer et al., 2010). We therefore conclude that multidisciplinary conferences are providing valuable learning, skills development and research spaces, significantly *more than just another opportunity for students to present their results*, indeed a liminal space, where knowledge is contestable, allowing genuine dialogue to take place between students in order 'to arrive at a point one would not get to alone' (Lodge, 2005: p. 134).

The evidence from these students is that an undergraduate conference can offer a transformatory experience (Meyer et al., 2010), and that the opportunity to present outside one's own department or University is highly advantageous. Stepping beyond the cultural norms of the classroom, the students repositioned themselves in a new and unfamiliar role as research disseminators and they emerged as incipient professionals demonstrating self-authorship (Kegan, 1994; Baxter Magolda, 2004). Creating alternative constructions of their identities and defying a fixed and singular point of classification as undergraduate student, researcher identity becomes ambiguous and transitional, bridging what is and what can be (Cook-Sather and Alter, 2011). For many, the authentic, multidisciplinary conference provided insights into a future professional life.

It must be acknowledged that the participants at all the conferences *chose* to attend. The students were highly motivated and it is perhaps unsurprising that there were very few negative comments on the experience (these focused on the logistics of travelling, finding accommodation, lack of awareness of conference processes and, in two cases, inadequate preparation). The conference space is therefore an opportunity for students to be recognised as professionals, researchers and experts. It is also a risk laden space where expectations and identities are changed. Managing these changes on return to university courses therefore needs to be considered.

There are clear implications for practice. Early embedded research-based learning opportunities (Walkington et al., 2011), followed by institutional conference experiences, provide an important scaffold to participation in national conferences which can provide a deeper level of enhancement. The results here suggest that further development of these opportunities, particularly in a multi-disciplinary context, would have significant value for students not only in terms of closing the 'gap' in the research cycle (Walkington, 2015) but also in communication and lifelong learning skills. Many of the benefits seemed to accrue from the conference being multi-disciplinary and prestigious, with quality control provided by the abstract submission process. So long as an authentic and professional environment is created, where students have the time to develop conversations with those outside their disciplines, many of the learning gains outlined in this paper could be achieved for a much wider proportion of the student population within an institution.

The sense of unfinishedness that many students experienced at the conference challenges us as academics to think of ways in which this process oriented approach can be embedded within the curriculum, providing a space for thinking to develop (Savin-Baden, 2008), allowing students to move beyond a focus on grades to a focus on building connections for their future and developing knowledge through reciprocal dialogue with each other, enabling access to new ways of seeing and gaining a broader perspective on the purpose of research and their understanding of the world.

Although the contexts of their work were very different, the problematisation of Foucault and the conscientisation of Freire are perhaps the key to understanding the power of the student-led pedagogic approach which emerged in the conference setting. Problematisation is based on developing questions and generating a 'work of thought.' An inherent power relation between faculty and students is difficult to escape and therefore a student driven pedagogy allows students to pose problems and questions in a way that achieves a deeper understanding of the world, allowing for the first elements of conscientisation i.e. the perception and exposure of contradictions.

Conferences are just one way in which undergraduate students can disseminate their work (Walkington, 2015) and not all students will be able to access national events, but the

learning gains from interdisciplinary dialogues which are reciprocal and developed between students in a spirit of learning partnership can be scaffolded, practised and facilitated within every higher education institution.

Acknowledgements

We gratefully acknowledge the support of Andrew Edwards-Jones, Plymouth University and Plymouth University student researchers who helped with selected interviews.

References

- Alamodi, A.A., Abu-Zaid, A., Anwer, L.A., Khan, T.A., Shareef, M.A., Shamia, A.A., . . . Yaginnuddin, A. (2014). Undergraduate research: An innovative student-centered committee from the Kingdom of Saudi Arabia. *Medical Teacher*, 36(S1), S36-S42.
- ACUR 2012. First Australasian Conference of Undergraduate Research (ACUR) [online] accessed on 26 February 2014 from: http://mq.edu.au/ltc/altc/ug_research/acur2012/index.htm
- Baxter Magolda, M.B. 2004. Self-authorship as the common goal for 21st century education. In . *Learning partnerships: Theory and models of practice to educate for self-authorship*, ed. M. Baxter Magolda and P. M. King, 1-36. Sterling, VA: Stylus.
- Baxter Magolda, M.B. 2009. Educating students for self-authorship. Learning partnerships to achieve complex outcomes. In *The university and its disciplines: Teaching and learning within and beyond disciplinary boundaries*, ed. C. Kreber. 143-56. London: Routledge.
- BCUR 2013. British Conference of Undergraduate Research [online] accessed on 26 February 2014 from: <http://www.bcur.org/>
- Brownell, J. E., & Swaner, L. E. (2010). Five high-impact practices: Research on learning outcomes, completion, and quality. Association of American Colleges and Universities.
- Boyer Commission on Educating Undergraduates in the Research University 1998. *Reinventing Undergraduate Education: A Blueprint for America's Research Universities*. Stony Brook, NY: State University of New York–Stony Brook.
- Charmaz, K. (2009). Shifting the grounds: Constructivist grounded theory methods. In J.M. Morse, P.N. Stern, J. Corbin, B. Bowers, K. Charmaz, and A.E. Clarke (Eds.), *Developing grounded theory: The second generation* (pp. 127–154). Walnut Creek: Left Coast Press.
- Cook-Sather, A. and Alter, Z. 2011. What is and what can be: How a liminal position can change learning and teaching in higher education, *Anthropology and Education Quarterly*, 42: 37-53

- Council on Undergraduate Research 2005. Joint statement of principles in support of undergraduate research, scholarship, and creative activities 2005, http://www.cur.org/about_cur/history/joint_statement_of_cur_and_ncur/
- Denzin, N. K and Lincoln, Y. S. (Eds.) 2011. *SAGE Handbook of Qualitative Research Fourth Edition* London: Sage
- Foucault, M. 1997. Polemics, Politics and Problematizations, In *Essential works of Foucault 1954-1984 Vol 1 Ethics: Subjectivity and Truth*, Ed Paul Rainbow, trans Robert Harley and others NY: New Press.
- Freire, P. 1998. *Pedagogy of freedom: Ethics, democracy and civic courage* (Lanham, Maryland, Rowman and Littlefield).
- Foulger, D. 2004. Models of the Communication Process [online] accessed on 26 February 2014 from: <http://davis.foulger.info/research/unifiedModelOfCommunication.htm>
- Gregerman, S. R. (2009). Filling the gap: The role of undergraduate research in student retention and academic success. In M. K. Boyd & J. L. Wesemann (Eds.), *Broadening participation in undergraduate research: Fostering excellence and enhancing the impact*. (pp. 245-256). Washington, DC: Council on Undergraduate Research.
- Hersh, C., Hiro, M. and Asarnow, H. (2011). The Undergraduate Literature Conference: A Report from the Field. *Pedagogy* 11(2): 395-404.
- Hunter, A-B., Laursen, S.L. and Seymour, E. 2007. Becoming a scientist: the role of undergraduate research in students' cognitive, personal, and professional development. *Science Education*. 91: 36-74.
- Ibnouf, A., Dou, L., & Knight, J. (2014). The evolution of Qatar as an education hub: Moving to a knowledge-based economy. In J. Knight (Ed.), *International education hubs: Student, talent, knowledge-innovation models* (pp. 43-61). Dordrecht, Germany: Springer Science and Business Media.
- Jenkins, A. & Healey, M. (2010). Undergraduate research and international initiatives to link teaching and research. *CUR Quarterly*, 30(3), 36-42.
- Kegan, R. 1994. *In over our heads: The mental demands of modern life*. Cambridge, MA: Harvard University Press.
- King, P.M. and Kitchener, K.S. 1994. *Developing reflective judgment: Understanding and promoting intellectual growth and critical thinking in adolescents and adults*, San Francisco: Jossey-Bass Publishers.
- Kuh, G.D. 2008. High impact educational practices: what are they, who are they, who has access to them and why they matter, Washington, DC: Association of American Colleges and Universities. Available at: http://www.neasc.org/downloads/aacu_high_impact_2008_final.pdf

- Lodge, C. 2005. From hearing voices to engaging in dialogue: problematising student participation in school improvement, *Journal of Educational Change* 6, no. 2: 125-146.
- Lopatto, D. 2006. Undergraduate research as a catalyst for liberal learning. *Peer Review*, 8 no 1: 22- 25.
- Lopatto, D. 2007. CBE- Life Science Education 6, 297-306.
- Lopatto, D. (2009) *Science in Solution: The Impact of Undergraduate Research on Student Learning*. Tucson, AZ: Research Corporation for Science Advancement .
- Mabrouk, P. A. 2009. Survey study investigating the significance of conference participation to undergraduate research students. *Journal of Chemical Education* 86, 1335-1340
- Mason, J. 1996. *Qualitative Researching* London: Sage.
- Meyer, J.H.F. and Land, R. (eds) 2006. *Overcoming Barriers to Student Understanding: threshold concepts and troublesome knowledge*, London: Routledge.
- Meyer, J.H.F., Land, R. and Baille, C. (eds) 2010. *Threshold Concepts and Transformational Learning*, Rotterdam: Sense Publishers.
- Mezirow, J. (Ed) 2000. *Learning as Transformation: Critical Perspectives on a Theory in Progress*. San Francisco: The Jossey-Bass Higher and Adult Education Series.
- NCUR 2013. National Conference on Undergraduate Research, http://www.cur.org/conferences_and_events/student_events/history_of_ncur/
- Padmaja, A., Laxmi Ramana, V.S.V., & Reddy, P.R. (2015). Importance of research at undergraduate level. *Proceedings of the International Conference on Transformations in Engineering Education*, 631-632.
- Palmer, M., O’Kane, P., and Owens, M. 2009. Betwixt spaces: Student accounts of Turning point experiences in the first year transition. *Studies in Higher Education* 34 (1) 37-54.
- Popper, K. R. 1972. *Objective knowledge: An evolutionary approach*. Oxford: Oxford University Press.
- Russell, S.H., Hancock, M.P., and McCullough, J. 2007. Benefits of undergraduate research experiences. *Science*, 316 no 5824: 548-549.
- Sandover, S., Partridge, L., Dunne, E., & Burkill, S. (2012). Undergraduate researchers change learning and teaching: A case study in Australia and the United Kingdom. *CUR Quarterly*, 33(1), 33-39.
- Savin-Baden, M. 2008. *Learning spaces: Creating opportunities for knowledge creation in academic life*. Maidenhead: Open University Press.
- Schulman, Lee S. (2005) Signature pedagogies in the professions. *Daedalus*, 134, 52-59.
- Seymour, E., Hunter, A.-B., Laursen, S. L. and DeAntoni, T. (2004). Establishing the benefits of research experiences for undergraduates in the sciences: First findings from a three-year study. *Science Education*, 88: 493–534.

- Shannon, C.E.A. 1948. Mathematical Theory of Communication. *Bell System Technical Journal*, 27: 379-423 and 623-656.
- Spronken-Smith, R. and Walker, R. 2010. Can inquiry-based learning strengthen the links between teaching and disciplinary research? *Studies in Higher Education*, 35: 723-740.
- Spronken-Smith, R.A., R. Walker, W. O'Steen, H. Matthews, J. Batchelor, and T. Angelo. 2008. *Reconceptualising inquiry-based learning: Synthesis of findings*. Wellington, NZ: Ako Aotearoa, The National Centre for Tertiary Teaching Excellence.
- Spronken-Smith, R. A., Brodeur, J. J., Kajaks, T., Luck, M., Myatt, P., Verburch, A., Walkington, H., and Wuetherick, B. 2013. Completing the Research Cycle: A Framework for Promoting Dissemination of Undergraduate Research and Inquiry. *Teaching and Learning Inquiry: The ISSOTL Journal* 1 no 2:105-118.
- Turner, V. (1967) *The Forest of Symbols: Aspects of Ndembu Ritual*. New York: Cornell University Press.
- Turner, V. (1974) *Dramas, Fields, and Metaphors: Symbolic Action in Human Society*. New York: Cornell University Press.
- van der Rijst, R. M. & Visser-Wijnveen, G. J. (2011). Undergraduate research and inquiry in the Netherlands. *CUR Quarterly*, 32(2), 32-36.
- Walkington, H. 2015. Students as researchers: supporting undergraduate research in the disciplines in higher education York: HEA [online] available from: https://www.heacademy.ac.uk/sites/default/files/resources/Students%20as%20researchers_1.pdf
- Walkington, H., Griffin, A. L., Keys-Mathews, L., Metoyer, S. K., Miller, W. E., Baker, R. , France, D. 2011. Embedding Research-Based Learning Early in the Undergraduate Geography Curriculum. *Journal of Geography in Higher Education* 35 (3), 1-16.
- Willison, J., & O'Regan, K. (2007). Commonly known, commonly not known, totally unknown: A framework for students becoming researchers. *Higher Education Research & Development*, 26, no 4: 393–409.
- Yuhao, C. (2014). Student development in undergraduate research programs in China: From the perspective of self-authorship. *International Journal of Chinese Education*, 3, 53-73.