

# Students as researchers: Supporting undergraduate research in the disciplines in higher education



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## I. A 'students as researchers' pedagogy

*"The ecology of a university depends on a deep and abiding understanding that inquiry, investigation and discovery are at the heart of the enterprise, whether in funded research projects or in undergraduate classrooms or graduate apprenticeships. Everyone at a university should be a discoverer, a learner." (Boyer Commission, 1998, p. 9)*

*"Undergraduate research is the pedagogy for the 21st century" (Council on Undergraduate Research and National Conference on Undergraduate Research, 2005)*

*"Research and inquiry is not just for those who choose to pursue an academic career. It is central to professional life in the twenty-first century." (Brew 2007, p.7)*

This monograph is aimed at academic staff in higher education institutions interested in developing or enhancing learning through a 'students as researchers' pedagogy. It provides a clear vision of the 'students as researchers' approach to discipline research set within a variety of conceptual frameworks and dimensions. It provides evidence of the benefits of adopting a 'students as researchers' approach and has a particular focus on completion of the research cycle for students through supporting research dissemination. Guidelines are provided for integrating dedicated undergraduate research journals and student research conferences in curricular and co-curricular activity. The monograph drills down into specific student experience outcomes from research-related activities, most particularly relating to the dissemination of undergraduate research through conferences and journals.

### What is a 'students as researchers' approach?

In 2005, the Council of Undergraduate Research and the National Conference on Undergraduate Research issued a joint statement acknowledging undergraduate research as "the pedagogy for the 21st century" where an inquiry-based model is nurtured within a collaborative enterprise between mentee and mentor. Healey and Jenkins (2009, p. 3) argue: "All undergraduate students in all higher education institutions should experience learning through, and about, research and inquiry." For this to be possible it can only occur if the experiences are integrated into the curriculum (Jenkins and Healey 2012). These represent two different but equally valid conceptions of undergraduate research.

Views of students have changed and continue to change as the higher education context responds to external and internal drivers. Students have been described as consumers (Molesworth *et al.*, 2010), clients (Bailey, 2000), producers (Neary and Winn, 2009), co-producers (McCulloch, 2009), change agents (Kay, Dunne & Hutchinson, 2010 with QAA; Dunne and Zandstra, 2011) and pedagogical consultants (Healey, 2012).

Healey, Flint and Harrington (2014) framed the variety of roles which students take under the broad term 'students as partners'. They proposed four overlapping areas where partnership may occur, including: 'learning teaching and assessment'; 'pedagogic advice and consultancy'; the 'scholarship of teaching and learning' (where students engage in pedagogic research) and 'subject based research and inquiry'. It is students' role in subject-based inquiry which forms the focus of this publication. The extent to which student research within and sometimes between /across disciplines forms part of a 'students as partners' relationship, is therefore highly dependent upon the context in which it takes place.

This monograph takes 'students as researchers' in a higher education context to mean a pedagogic approach to supporting students in their engagement with undergraduate research within and/or beyond the formal curriculum with the aim of furthering their own knowledge and understanding, and in some cases contributing to, the broader knowledge base of their discipline. The term is used to describe a pedagogic approach, rather than the students themselves. It is a term used within schools (Fielding and Bragg, 2003; McGregor, 2005) as well as in undergraduate education to describe a pedagogy of participation (Lambert, 2009) potentially with the opportunity to ease transitions from one situation to the other where it is adopted.

The focus of this publication is on students engaging in discipline research and not specifically on the other contexts of the students as partners work (e.g. curriculum and SOTL research), however many of the sections will still be of relevance. It should be noted that student engagement in discipline research is not always carried out in partnership, there are instances where students make strategic choices to work in isolation or where the supervisory relationship breaks down.

### **Undergraduate research: a problematic definition**

There are a broad range of disciplinary interpretations of research and research activity. For example, creative art and design practice itself may constitute research (Yorke, 2005) and in arts-based disciplines practices such as performances, exhibitions, installations and recitals are all part of the discipline definition of research and therefore considered “authentic” to the research context. What constitutes research in literary studies (Behling, 2010) is distinct from the role of undergraduate research in ‘becoming a scientist’ (Hunter, Laursen, & Seymour, 2006). In the sciences, the focus may be on experimentation and observation to generate data. Beckham and Hensel (2009) refuse to define undergraduate research because of the wide variety of interpretations, not only in disciplinary terms, but related to the differences between the contexts in which research takes place. In an increasing number of examples, interdisciplinary research experiences are being undertaken that may bring together multiple disciplinary norms, values, methodologies and perspectives so this publication takes a broad definition of undergraduate research. Defining research *with* students is recommended by Jenkins and Healey (2009), so that staff and students share an understanding of research norms in the discipline.

‘Students as researchers’ is an active pedagogy emphasising the process of undergraduate research and inquiry. Undergraduate research in this style may include ways of promoting research-teaching linkages by developing students’ appreciation of research in the discipline. It can also involve using teaching and learning approaches which simulate research processes and using assignments which involve research or elements of the research process; giving students first-hand experience of research based consultancy e.g. through live projects (Anderson and Priest, 2014); bringing research data into the curriculum for students to manipulate. Staff may wish to place greater emphasis on higher-level thinking skills so that students support their ideas and beliefs with evidence; make critical judgments about the value of information, arguments, or methods by examining how others gathered and interpreted data and as a team evaluate the validity and reliability of their conclusions; synthesise and organise ideas, information, or experiences into new, more complex interpretations and relationships; work on projects that require integration of ideas from varied sources. In order to do this, staff will need to create time and space in the curriculum, providing class time for students to work with others on projects, and create assessments that do not require students to memorise facts and ideas (Hodge et al., 2011). A wealth of examples of ‘students as researchers’ practice can be found in Healey and Jenkins (2009) and Healey, Lannin, Stibbe and Derounian (2013).

## Contexts for developing undergraduate research activity

### Student Voice:

*“The key moment in my experience as an undergraduate student at Nottingham was a field trip to Mexico in my third year. This trip formed part of a module and I went with a Professor, a post-doctoral student, a Masters student and a group of eight undergraduates. This mix of undergrads and post-grads and an established researcher in the field, in an informal setting, was an extremely useful experience as I gained many useful insights into how to undertake fieldwork, laboratory applications and report writing, both as I had to undertake these as part of the module but because I was able to have many conversations that may not have happened had I not been in the field.*

*The experience of writing up research in the format of a paper, using a project that I had devised, with data that I had collected and analysed was an important experience as it was the most realistic encounter I had had with research. It was this experience that encouraged me to approach the module convenor about the possibility of a PhD.”*

As this quote shows, there are many social as well as physical contexts for ‘students as researchers’ in higher education. Students may select, or be allocated to, a supervisor for their dissertation or final year project on a one-to-one basis. Alternatively, they may be selected by a competitive application process for a paid summer undergraduate research experience as part of an academic’s existing research/research group activities. This is the mentored undergraduate research experience most commonly developed in the United States. In some cases students are supervised by postgraduate students rather than academic staff, or work in teams including staff, graduate students and undergraduates. All these permutations allow for a rich diversity of potential experiences, from situations where learners can take a lead in asking and framing enquiry, to where they have little autonomy but potentially build team working skills and learn new methodologies or techniques. Some students experience a heavily directed role modelling style of supervision, for others an extended mentoring relationship arises from their experience, lasting well beyond the period of the research project. What each student can expect to experience as part of their undergraduate research project is highly individualised based on these multiple facets.

Gershenfeld (2014) carried out a systematic literature review in the United States of the impact of undergraduate research programmes and highlighted the range of contexts in which mentoring relationships are negotiated. She used the following categories to make comparisons between institutions:

1. The mentor-mentee ratio (in recognition that some mentors have a group of students to mentor and may do so in individual one-to-one relationships or in groups, whereas other mentors may only have one student. Likewise some students may have more than one research mentor for their project).
2. Whether the mentoring was entered into voluntarily or was mandatory.
3. The presence or absence of compensation offered to staff or students taking part in mentored undergraduate research, for example: the mentor's grade, whether or not students were paid or given course credits.
4. The frequency of meetings and duration of the mentoring relationship.
5. The availability of mentor support, in the form of training and resources.

She discovered that mentoring involved a number of different functions beyond academic support, including psychological/emotional support, goal setting, career paths and role modelling, and made the case for evidence-based research being carried out for each function. She highlighted the fact that in many institutions

mentors are themselves students and that this role has often been overlooked. The research relationship between staff and students can be viewed as a continuum with supervision at one end and mentoring at the other (Johnson, 2002). Most institutions in the UK support undergraduate research as embedded practice and supervision, rather than mentoring, is the mode of support from academic staff. However there has been a growth in summer research schemes, similar to the American model, where students are selected to participate and where mentoring relationships develop. Each institution will need to weigh up the costs and benefits of this approach.

### **Undergraduate research as a high-impact practice**

Kuh's (2008) ten high-impact practices include *undergraduate research* specifically, however a 'students as researchers' pedagogy could be adopted as a vehicle to develop each of the ten practices. For example, *first year seminars and experiences* could be based on research, involving students in framing research questions, generating or gathering data. *Common intellectual experiences* might involve group research projects, outside the curriculum, in mixed disciplinary groups. *Learning communities* can be developed by mentoring undergraduate research in teams, for example involving professors, junior staff, postgraduates and undergraduates working together. *Writing-intensive courses* can be embedded in the curriculum or delivered outside the curriculum to support the writing up of student and staff-student research. *Collaborative assignments and projects* can foster communities of practice between students and staff or between student groups. *Diversity/global learning* is an essential ingredient in understanding the wider applicability of undergraduate research. Working in groups can enhance learning particularly about the different world views that group members hold. *Service learning* opportunities and *internships* are suitable contexts in which to adopt a 'students as researchers' pedagogy, allowing students to take an active role and contribute a piece of research for the placement provider such as the 'Politics in Action' project (Sherington, et al., 2008). *Capstone courses/projects* are usually research based and a diversity of disciplinary models for rethinking the traditional dissertation is provided in Healey, Lannin, Stibbe and Derounian (2013).

## 2. Theoretical framework

“Students ‘co-construct’ knowledge via dialogue with each other and their teacher as part of an academic ‘community of practice’.” (Vygotsky, 1978; Lave & Wenger, 1998)

“Education must begin with the solution of the teacher-student contradiction, by reconciling the poles of the contradiction so that both are simultaneously students and teachers” (Freire, 1970, p. 72)

“Undergraduate research is for **all** students.” (Walkington & Jenkins, 2008)

### A curriculum framework

Griffiths (2004) first created a typology of research-teaching linkages as ‘research-led’, ‘research-oriented’ and ‘research-based’ approaches. Healey (2005) added ‘research-tutored’ as a fourth curriculum style. The four approaches were distinguished on the basis of research focus (i.e. process versus content) and the role of students as (i.e. students as participants versus students as audience).

This led to the creation of four descriptions of curricula:

- “Research-led: Learning about current research in the discipline. Here the curriculum focus is to ensure that what students learn clearly reflects current and ongoing research in their discipline. This may include research done by staff teaching them.
- Research-tutored: Engaging in research discussions. Here the focus is on students and staff critically discussing research in the discipline as, for example, in many seminar-based courses.
- Research-oriented: Developing research skills and techniques. Here the focus is on developing students’ knowledge of and ability to carry out the research methodologies and methods appropriate to their discipline(s) or profession.
- Research-based: Undertaking research and inquiry. Here the curriculum focus is on ensuring that as much as possible the student learns in research and or inquiry mode.” (Healey, Flint and Harrington, 2014: 42).

This is a staff-focussed approach and encourages academics to think about their practice and potential alternative approaches.

The work of Levy and Petrulis (2011) on student experiences of research and inquiry-based learning is relatively easy to nest onto this four-fold classification and provides a student focus. Their research is based on interviews with students who describe their experience in their own words (see italics) and their comments seem to relate well to the four curriculum styles (in bold) as follows :

Students experience **research-led** teaching as “*gathering information*”. This progresses to them being able to critique published research by “*exploring other’s ideas*” in a **research-tutored** curriculum. Being given further autonomy in a **research-oriented** curriculum students understand the research process and methods and are given opportunities for “*evidencing and developing my own ideas*”. But the most enlightening language is reserved for the **research-based** curriculum where students frame their own enquiries, (whether to the extent of exploring existing knowledge or building new knowledge) and their words describe this as “*real research*” which allows them to engage in “*making discoveries*” and to be “*free.*” This journey through the different types of research informed teaching strongly suggests a progressive acquisition of skills.

### Levels of student participation

There are differing levels of participation in higher education research that students can experience as they take increasing control over the research process. Five levels of student participation in research are proposed in Table 1 (the titles of each level are adapted from Hart’s 1992 Ladder of participation in Citizenship) with level 1 at the base, working up to level 5 at the top. Level 4 is not always experienced:

**Table 1: Five Levels of student participation in research**

**5 Student initiated, decisions shared with university staff**

At level 5, students initiate the research themselves, they frame their own enquiry and carry out the research, but all of this is done in consultation with university staff at a level determined by the student. This allows the student to gain ongoing feedback when they want it and allows them to develop a relationship with a university supervisor or mentor. This work is usually carried out for individual final year research and the outputs can vary according to the context, for example while students may be compelled to produce a dissertation or thesis, the research could also be presented in alternative formats, for example as research papers or through undergraduate research conferences.

**4 Student initiated and directed**

Level 4 may be a relatively unusual situation. Students here make the all decisions and do not consult with university staff. Some maverick students adopt this approach to their dissertation or final project and choose to work unsupervised. This lone worker model may have produced more effective results if the student had received feedback during the process.

**3 Staff initiated, decisions shared with students**

At level 3, staff frame the enquiry initially but students have a much greater role to play in decision-making with respect to development of methods, reframing, determining courses of action and taking responsibility for the outcomes and dissemination. An example is a module where the tutor sets up a series of consultancy projects with local community contacts for groups of students to work on. The tutor and community group may have already established research agendas but the students have the flexibility to renegotiate these if necessary. 'Live projects' would fall into this category.

**2 Students are consulted and informed**

At level 2, students are consulted and informed about the research. An example is where students join an existing staff research project, perhaps as part of a summer scholarship scheme. In some cases the results of this style of tutor directed research result in co-authored papers and allow students to work as part of research teams. The research is heavily directed but students may have the ability to influence the project and contribute to its dissemination.

**1 Students are assigned but informed**

At level 1, students are assigned to research tasks, they are informed about the research and why they are doing it. An example of this level, frequently adopted as an initiation into the laboratory-based sciences, is where students carry out routine research tasks, following established methods. Level 1 is an important step in learning the methods of a discipline and practising them. Level 1 activity does not imply a lack of reflection or refinement on the part of the student, but ownership of the assignment remains with a staff member. The staff member also controls the scope of the research dissemination.

## Research skills development

An awareness of the levels of student participation, as well as the four curriculum approaches, allows academic staff to plan work with students in a progressive way to support their development. A model which focuses on the development of research skills from primary school to doctoral level is the Research Skill Development Framework of Willison and O'Reagan (2013) (Figure 1). First published in 2006, it has been revised many times in the light of international feedback and provides a very useful frame of reference. It contains six facets of research, mirroring the research process from initially clarifying a question, through to dissemination of the understanding generated by the inquiry. The research process is linked to the spiral curriculum (Bruner, 1977) so whilst it is applicable at each level of education, the degree of rigour is elevated for higher education students. It allows staff to consider the role of differing research contexts on student autonomy.

Figure 1: Research Skill Development Framework



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What characterises the move from 'search' to 'research'?  
Gathering more information and generating more data is merely a bigger search! Research is when students...

# Research Skill Development Framework

A conceptual framework for the explicit, coherent, incremental and cyclic development of the skills associated with researching, problem solving, critical thinking and clinical reasoning.

## Extent of Students' Autonomy

Facets of Research

		Prescribed Research- Level 1	Bounded Research- Level 2	Scaffolded Research- Level 3	Self-actuated Research- Level 4	Open Research- Level 5
		Highly structured directions and modelling from educator prompt research, in which students...	Boundaries set by and limited directions from educator channel research, in which students...	Scaffolds placed by educator shape independent research, in which students...	Students initiate the research and this is guided by the educator to...	Students determined guidelines for the research that are in accord with discipline or context to ...
Facets of Research	a. <b>Embark &amp; Clarify</b> Respond to or initiate research and clarify or determine what knowledge is required, heeding ethical, cultural, social and team (ECST) considerations.	Curious Respond to questions/tasks arising explicitly from a closed inquiry. Use a provided structured approach to clarify questions, terms, requirements, expectations and ECST issues.	Respond to questions/tasks required by and implicit in a closed inquiry. Choose from several provided structures to clarify questions, terms, requirements, expectations and ECST issues.	Respond to questions/tasks generated from a closed inquiry. Choose from a range of provided structures or approaches to clarify questions, terms, requirements, expectations and ECST issues.	"Generate questions/aims/hypotheses framed within structured guidelines". Anticipate and prepare for ECST issues.	"Generate questions/aims/hypotheses based on experience, expertise and literature". Delve into and prepare for ECST issues.
	b. <b>Find &amp; Generate</b> Find and generate needed information/data using appropriate methodology.	Determined Collect and record required information or data using a prescribed methodology from a prescribed source in which the information/data is clearly evident.	Collect and record required information/data using a given methodology from pre-determined source/s in which the information/data is not clearly evident.	Collect and record required information/data from self-selected sources using one of several provided methodologies.	Collect and record self-determined information/ data from self-selected sources, choosing an appropriate methodology based on parameters set.	Collect and record self-determined information/data from self-selected sources, choosing or devising an appropriate methodology with self-structured guidelines.
	c. <b>Evaluate &amp; Reflect</b> Determine and critique the degree of credibility of selected sources, information and data generated. Metacognitively reflect on the research processes used.	Discerning Evaluate sources/information/data using simple prescribed criteria to specify credibility and to reflect on the research process.	Evaluate sources/information/data using a choice of provided criteria to specify credibility and to reflect on the research process.	Evaluate information/data and inquiry process using criteria related to the aims of the inquiry. Reflect insightfully to improve own processes used.	Evaluate information/data and the inquiry process comprehensively using self-determined criteria developed within parameters given. Reflect insightfully to refine others' processes.	Evaluate information/data and inquiry process rigorously using self-generated criteria based on experience, expertise and the literature. Reflect insightfully to renew others' processes.
	d. <b>Organise &amp; Manage</b> Organise information and data to reveal patterns and themes, and manage teams and research processes.	Harmonising Organise information/data using prescribed structure. Manage linear process provided (with pre-specified team roles).	Organise information/data using a choice of given structures. Manage a process which has alternative possible pathways (and specify team roles).	Organise information/data using recommended structures. Manage self-determined processes (including team function) with multiple possible pathways.	Organise information/data using self-determined structures, and manage the processes (including team function) within the parameters set.	Organise information/data using self-determined structures and management of processes (including team function).
	e. <b>Analyse &amp; Synthesise</b> Analyse information/data critically and synthesise new knowledge to produce coherent individual/team understandings.	Creative Interpret given information/data and synthesise knowledge into prescribed formats. <i>"Ask emergent questions of clarification/curiosity"</i> .	Interpret several sources of information/ data and synthesise to integrate knowledge into standard formats. <i>"Ask relevant, researchable questions emerging from the research"</i> .	Analyse trends in information/data and synthesise to fully integrate component parts in structures appropriate to task. <i>"Ask rigorous, researchable questions based on new understandings"</i> .	Analyses information/data and synthesises to fully integrate components, consistent with parameters set. Fill knowledge gaps that are stated by others.	Analyse and synthesise information/data to generalise or abstract knowledge that addresses self-or-group-identified gaps in understanding.
	f. <b>Communicate &amp; Apply</b> Write, present and perform the processes, understandings and applications of the research, and respond to feedback, accounting for ethical, cultural, social and team (ECST) issues.	Constructive Use mainly lay language and prescribed genre to demonstrate understanding for lecturer/ teacher as audience. Apply to a similar context the knowledge developed. Follow prompts on ECST issues.	Use some discipline-specific language and prescribed genre to demonstrate understanding from a stated perspective and for a specified audience. Apply to different contexts the knowledge developed. Specify ECST issues.	Use discipline-specific language and genres to demonstrate scholarly understanding for a specified audience. Apply the knowledge developed to diverse contexts. Specify ECST issues in initiating, conducting and communicating.	Use appropriate language and genres to address gaps of a self-selected audience. Apply innovatively the knowledge developed to a different context. Probe and specify ECST issues in each relevant context.	Use appropriate language and genre to extend the knowledge of a range of audiences. Apply innovatively the knowledge developed to multiple contexts. Probe and specify ECST issues that emerge broadly.
...spiral through these facets, adding degrees of rigour and discernment. The move from problem solving to problem optimisation and from thinking to thinking critically likewise require adding rigour to these facets.		Research Skill Development (RSD), a conceptual framework for Primary School to PhD, developed by © John Willison and Kerry O'Regan, October 2006/October 2013, with much trialling by Eleanor Peirce and Mario Ricci. Facets based on: ANZIL (2004) Standards & Bloom's et al. (1956) Taxonomy. Extent of Synthesis informed by SOLO taxonomy (Biggs & Collis, 1982). * Framing researchable questions often requires a high degree of guidance and modelling for students and, initially, may need to be scaffolded as an outcome of the researching process (Facet E, Levels 1-3). After development, more students are able to initiate research (Facet A, Levels 4 & 5)*. The perpendicular font reflects the drivers and emotions of research. Framework, resources, learning modules, videos and references available at <a href="http://www.rsd.edu.au">www.rsd.edu.au</a> . Information: john.willison@adelaide.edu.au				

Spronken-Smith, et al (2013) have critiqued the framework in terms of the research dissemination facet of research (see section 4 for an alternative framework for research dissemination).

### Dimensions for framing undergraduate research contexts

A series of dimensions for describing the range of contexts in which undergraduate research takes place can be found in Table 2. The table has integrated and adapted the bipolar dimensions from Beckham and Hensel (2009) and Brew (2013) which help to frame the variety of contexts in which undergraduate research takes place around eight themes of Focus, Motivation, Inclusivity, Setting, Collaboration, Originality, Content and Audience. For each theme (column 2), the ends of a continuum are shown in columns 1 and 3. Undergraduate research can be mapped against these dimensions, so for example, an institutional-funded summer research scheme may be: student learning centred, but on a series of faculty-initiated topics. Because it is funded it is highly selective and occurs outside the curriculum. The research is carried out within a team (the research group) composed of postgraduates and the chosen undergraduate and new knowledge is the long term target. The research group is formed through an academic collaboration between two disciplines and the research disseminated through a campus based conference. Table 2 is useful not only for establishing the dimensions of research contexts against which to compare schemes from the literature, but also if there is an initiative to start a new ‘students as researchers’ project, it provokes the team to consider all the different ways that it could develop.

Table 2: Dimensions for framing undergraduate research contexts		
Student, process centred	<b>Focus</b>	Outcome, product centred
Student initiated	<b>Motivation</b>	Faculty initiated
All students	<b>Inclusivity</b>	Selective
Curriculum based	<b>Setting</b>	Co-curricular fellowships
Team or group	<b>Collaboration</b>	Individual
Original to the student	<b>Originality</b>	New knowledge
Multi-or interdisciplinary	<b>Content</b>	Discipline based
Campus/community audience	<b>Audience</b>	Professional audience

### Self-authorship

A further theoretical construct that has had significant impact on thinking about undergraduate research is self-authorship. Baxter-Magolda (2004; 2009) has argued that self-authorship is the central goal of higher education in the 21st century. She describes self-authorship as being able to balance external influences with internally-generated beliefs and goals. It is an educational aim which strives to allow students to develop a

sense of self through interaction with learning relationships and hinges upon intense reflection so individuals can express how they know something. Self-authorship is a high-level skill that not all students will necessarily attain during their undergraduate education, but a 'students as researchers' pedagogy is an approach that can help to develop this attribute through developing the ability to frame enquiry and to justify opinions and evidence as well as developing a commitment to sharing research findings.

## **Summary**

This section has described several ways in which 'students as researchers' can be framed using dimensions with a particular focus on student participation. Although undergraduate research should include the research process in its entirety, therefore including dissemination, the specifics of research dissemination are such a distinct element that they are discussed in separate sections of this publication (see sections 4 – 6).

### 3. The benefits of a ‘students as researchers’ approach

*“My own undergraduate research experience was a turning point for me. For the first time I understood that learning could be truly active and transferrable to other situations and that I could and should take responsibility for creating knowledge and answering real questions. Along with those realizations came many other habits of mind. Each has served me in all aspects of my life and career.” (Mary Ann Beninger, in Hensel, 2012, p.1)*

In 2008, the Boyer Commission called for American research universities to engage undergraduate students in the research process. The process was viewed as the entire research cycle, with dissemination being an integral part of student activity. Many writers, predominantly from the United States but increasingly from across the globe, have documented the benefits for students in engaging in undergraduate research (for example, Hart, 2012; Hensel, 2012; Kinkead, 2011; Spronken –Smith, et al., 2013; Tatalovic, 2008) and its dissemination (Walkington, Edwards-Jones and Gresty, 2013; Walkington and Hill, 2013a,b). Bauer and Bennett (2003) revealed increased satisfaction ratings amongst students who incorporated an undergraduate research element to their university experience and students reported increased intellectual curiosity and enhancement of research and communication skills.

As a result of recognising the benefits for students who take part, there is a desire to widen participation, allowing a greater diversity of students to experience the research journey for themselves. The benefits from disseminating research findings are described by students in terms of graduate attributes, over and above disciplinary learning, particularly in the area of communication (Walkington and Hill, 2013 a,b) and continue long beyond the student experience.

#### Student voice:

*“I learnt key skills during my time as an undergraduate researcher. The ability to work in a team, with people of different backgrounds and expertise, has been something I have had to do from day one as a teacher. You have to approach a topic from so many different perspectives when doing research, you quickly learn that there is often more than one answer and always multiple perspectives. This taught me very early on that my communication style had to be sharp enough to encompass this complexity. Speaking to such diverse, multi-layered topics has meant I am innovative in my lesson planning – drawing on different media when teaching my classes. The final area that I think was especially developed during my time as an undergraduate researcher was that of adaptability. Undertaking research often requires thinking on the spot and developing multiple alternative plans. My research experiences made me more confident in the classroom and better able to switch tack if things are not working to plan.”*

#### Learner benefits

There are a growing number of systematic studies of the impact of undergraduate research programmes, particularly in the US, but the majority to date are in the science disciplines (e.g. Hunter, Laursen and Seymour, 2006; Seymour, Hunter, Laursen and DeAntoni, 2004). Hunter, Laursen and Seymour, 2006 showed that staff and students agreed on the benefits that students gained from their particular research experience (very much in the scientist apprenticeship model) yet differed in terms of their assessment of gains in the higher order thinking skills. Crowe and Brakke (2008) summarised the findings from 13 whole institution /programme level evaluations of undergraduate research plus ten focussed on student experience studies to call for a more systematic approach to demonstrating the impacts of undergraduate research, particularly in relation to programme level intended learning outcomes and longer term benefits such as career choices, and

changes in cognitive development and attitudes. However, as research into the benefits of undergraduate research participation has become more extensive, there has been a realisation that the context in which it is taking place is important in determining the benefits, therefore comparison across different institutional types is challenging. In some institutions students appear to share similar benefits, whereas in others disparities are apparent:

*“Significant predictors of Undergraduate Research Questionnaire (URQ) factors were grade-point average (GPA), college credits, lab course credits, gender, major discipline, and the frequency of faculty and peer meetings. Men achieved higher URQ scores than women. Students with below-average GPAs and students with average or below-average participation in research showed a decline in research benefits as they moved through their college years. Gains from research varied by major discipline.”*  
(Taraban and Logue, 2012, p. 499)

While Lopatto (2007) reported that students do not benefit equally, his studies revealed no gender difference and interestingly found that undergraduate researchers from under-represented groups reported higher learning gains than comparison students. The areas where students reported particular benefits were: independence, intrinsic motivation to learn, and more active participation in courses taken after the summer undergraduate research experience. His findings, among others, are encouraging institutions in the United States to adopt a ‘students as researchers’ mainstreamed model to improve student retention.

### **Mentoring undergraduate research**

In the United States in particular, there is widely accepted and strongly held belief that undergraduate research experiences attract students to careers in the STEM disciplines and improves them as candidates for careers in STEM. (Schwartz, 2012; Guterman, 2007; Lopatto, 2005; Russell, Hancock, and McCullough, 2007; and Seymour et al., 2004). Ishiyama (2001) showed that for under-represented groups at university (low income first generation college students) an undergraduate research experience was important to their retention on courses and progression to postgraduate study, but that the most significant factor was the mentoring relationship that the undergraduate research experience developed. The mentoring relationship, while highly beneficial to students, can come at a cost of staff time and in some contexts may be perceived to reduce promotion possibilities (Schwartz, 2012). In some institutions involvement in undergraduate research mentoring does enable academic staff to advance their own scholarship at the same time as promoting student learning and development (Magee, 2014) perhaps explaining why many staff members maintain their involvement in undergraduate mentoring throughout their careers. In some settings postdoctoral students and graduate students become mentors or members of a mentoring team and they report significant long term benefits from this activity, despite initially taking on the role for purely instrumental reasons (Dolan and Johnson, 2009). The benefits of mentor training have been recognised (Pfund, et al., 2006), especially where mentors are working with under-represented students (Prunuske, et al, 2013). The context of each individual institution becomes extremely important in negotiating workload time, promotion criteria and resources for academics to support undergraduate researchers.

In the UK, while undergraduate research is certainly not new, the current growth of institutional schemes to support undergraduate researchers over the summer or outside the formal curriculum based on the American model, as well as the embedding of undergraduate research opportunities in the co-curriculum and in modules and courses, needs to be discussed and planned in full awareness of time commitments, infrastructural support and staff reward and recognition initiatives to ensure that the benefits and burdens of the approach are shared equitably and are sustainable.

## 4. The dissemination of undergraduate research

*“Every university graduate should understand that no idea is fully formed until it can be communicated, and that the organisation required for writing and speaking is part of the thought process that enables one to understand material fully. Dissemination of results is an essential and integral part of the research process.”*  
(Boyer Commission, 1998, p. 24)

The student experience of research at undergraduate level is significantly different to that of an academic. Once student research (e.g. a dissertation or final project) is submitted, it may be read only by a marker and supervisor and the summative feedback may be of limited value for the student about to graduate. The findings are often forgotten and rarely developed further. This is the ‘gap’ in the research cycle (Walkington, 2008). In contrast, academics share their research results through publication and a process of peer review provides feedback to the researcher who is able to make modifications to the work before it is disseminated. The findings themselves may spark further research questions.

There is a need to create a range of opportunities for disseminating research to meet the needs of a broad student population with differences in disciplines, backgrounds, types of institution and levels of infrastructural support. The *Rethinking final year projects and dissertations – creative honours and capstone projects* report (Healey, Lannin, Stibbe and Derounian, 2013) summarises a range of different disciplinary approaches to replacing dissertations with more authentic assessment tasks. Changing assessment briefs is an effective way of ensuring that students are presenting work for communication from the outset, rather than having to reformat it in their own time if they want to share it more widely. This section focuses on a framework for thinking about dissemination opportunities for undergraduate researchers and the following two sections focus on two examples of dissemination format, the journal article (section 5) and the conference poster/presentation (section 6) to explore how students benefit from engaging in these research processes.

### Research dissemination formats

There is a growing interest in students going public with the outcomes of their research and inquiry through conferences, websites and undergraduate research journals (Spronken-Smith et al. 2013). However, a multitude of formats and styles of research dissemination exist ranging from informal to formal and professional formats and settings. The box below lists a selection of these.

#### A range of research dissemination opportunities:

- Blogs and video logs
- Podcasts
- Online conferences
- Client presentations
- Competitions,
- Simulations
- Exhibitions and shows
- Displays
- Theatre
- Poster and paper presentations
- Wikis
- Wikipedia pages
- Trail guides,
- Web pages,
- Journals and books,
- Consultancy reports,
- Face to face conferences (e.g. Departmental/ National /International).

Each format has different levels of discoverability, access to new audiences and longevity and this fact can be used to great effect in tailoring research outputs to the most appropriate audience and level to match the style of work and maintain quality control. It is possible to create short, close knit and specialist types of dissemination, or long term, online, highly discoverable formats, according to the nature of the research and its quality. Other dimensions of dissemination include the quality control process and whether this is mediated by tutors, peers or student authors; the potential for multiple formats to be used versus a single format; whether the dissemination is verbal or written, digital or print. The range of possibilities allows a great deal of flexibility to allow all students to share their research in one format or another whilst still maintaining some prestigious outlets to flourish based on selection processes.

### **Widening engagement in research dissemination activities**

Numerous strategies for broadening participation in undergraduate research dissemination have been proposed (Walkington and Jenkins, 2008; Walkington, Edwards-Jones and Gresty, 2013; Walkington, 2014a). They centre on involving students (undergraduates and postgraduates) in the publication process and embedding research dissemination processes and products within the curriculum. In order to maximise the possibilities for all students to engage in research dissemination, the authors have suggested adopting a broad definition of research and propose that a diversity of communication formats are utilised. Table 3 (adapted from Walkington and Jenkins, 2008; Walkington, Edwards-Jones and Gresty, 2013; Walkington, 2014a).

**Table 3: Strategies for enhancing engagement with undergraduate research dissemination**

1. Define 'research' broadly
2. Define 'publication' broadly
3. Build publication into course and programme requirements
4. Build publication into dissertation and honours-level requirements
5. Embed the results of student publication into the curriculum
6. Use digital technology to create a repository of work
7. Involve students in the publication process.
8. Co-create a culture where students want to participate and expect to be involved
9. Highlight the employability benefits of undergraduate research.
10. Link publication opportunities to allow student progression
11. Generate transparent rules on the quality of work necessary for dissemination in partnership with students.
12. Ensure students submit their work before leaving the institution
13. Ensure that the publication format can accommodate a large volume of submissions
14. Invite submissions from partner institutions
15. Allow co-production with staff and/or peers
16. Allow students to retain the copyright to their work
17. Involve all members of the university community in celebrating undergraduate research outputs

Table 3 proposes strategies for increasing engagement with undergraduate research dissemination. In terms of working with journals (real or hypothetical) it is wise to build 'publication' in the broadest sense into the curriculum to initiate a supply of articles. These can then be used to incorporate student research findings in the curriculum (Dellinger and Walkington, 2011). By encouraging student participation in the publication process (for example by providing roles as editors, reviewers and in marketing and promotion), a greater number of students can be involved. Making use of digital technologies obviously keeps costs down but also allows a much greater readership to be developed and makes the university more permeable with research being open to the wider community of researchers and the general public. An example of this is the significant readership that has been created by some undergraduate research journals. Even an institutional journal has created an external readership. Some articles from Plymouth University's e-journals have been accessed over 1,000 times with 40,000 full-access text requests recorded (Walkington, Edwards-Jones and Gresty, 2013).

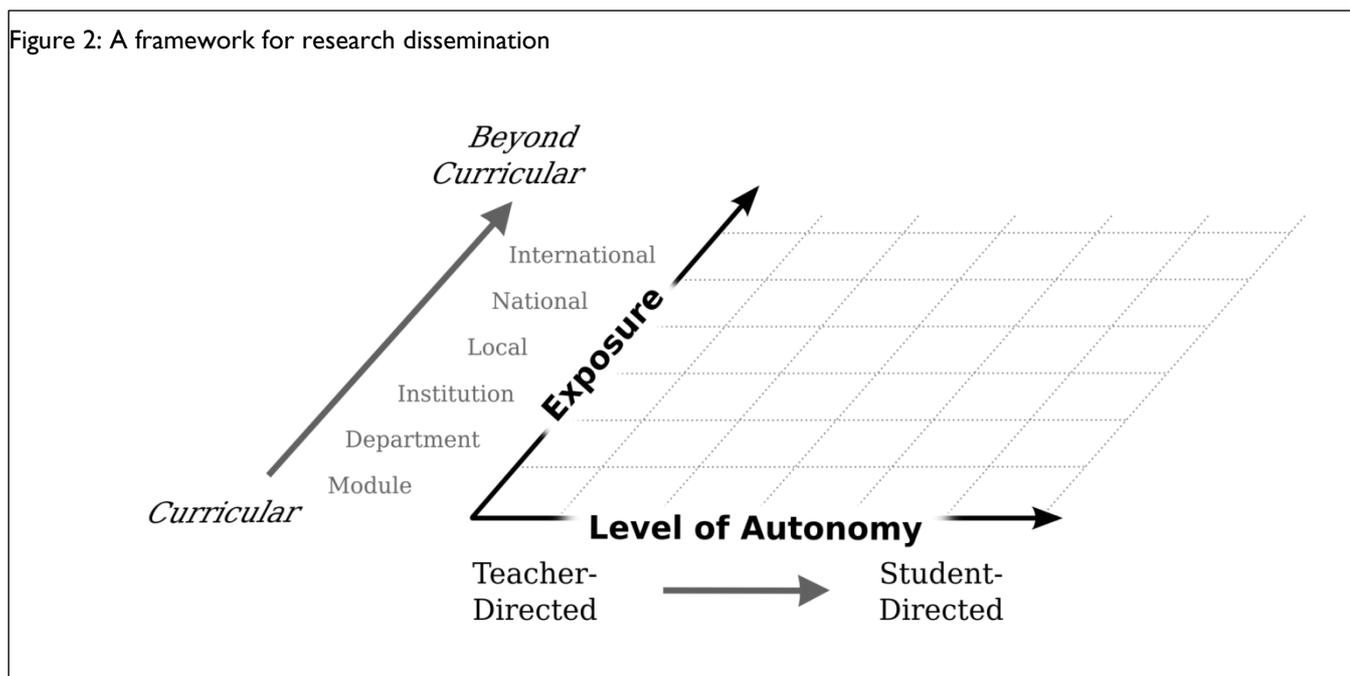
Bioscience Horizons, a multi-institutional national undergraduate research journal published via Oxford Journals, generated 65,000 full text downloads in 2013 alone (Luck, et al, 2014), the journal web page was accessed by people in almost 200 territories with 64 different higher education institutions represented amongst the published papers (ibid). The student-run Journal of Young Investigators, in the US, has 500,000 website visits per year and includes student involvement from around the world.

## Overcoming barriers to participation

One of the biggest barriers to students participating in research dissemination activities is their lack of confidence that their work is worthy of wider dissemination. Students are used to being graded by academic staff and therefore are not often encouraged to develop the skills to reflect on the quality of their own work and judge its merit objectively. Students therefore require structured experiences to ‘scaffold’ their learning, so that they have the confidence to share their research findings. This may mean creating a range of activities for students to practice their skills within the curriculum, so they are prepared to engage with initiatives beyond it. For example, a student who has had the opportunity to present a poster in class to a group of students as an assessment task, could then take up the opportunity to prepare a poster for an undergraduate conference within the department or faculty. As a result of this experience in their second year, they may feel better able to submit an abstract to the British conference of undergraduate research to present their research findings as either a poster or paper. Without the curriculum opportunities students will be much less likely to engage at a higher level. The starting point within the curriculum therefore relates to creating authentic assessment tasks and supporting students to routinely engage in self-assessment and peer-assessment activities.

## A framework for research dissemination

Spronken-Smith, et al. (2013) developed a framework specifically for the dissemination of undergraduate research and inquiry (see Figure 2 below). The framework has two axes, the first indicates the level of autonomy which the student experiences and this includes the extent to which the research being undertaken is teacher or student directed, or somewhere in between. The framework is intended to appear like a horizontal or table top graph with no sense of movement along the axes implying higher quality research.



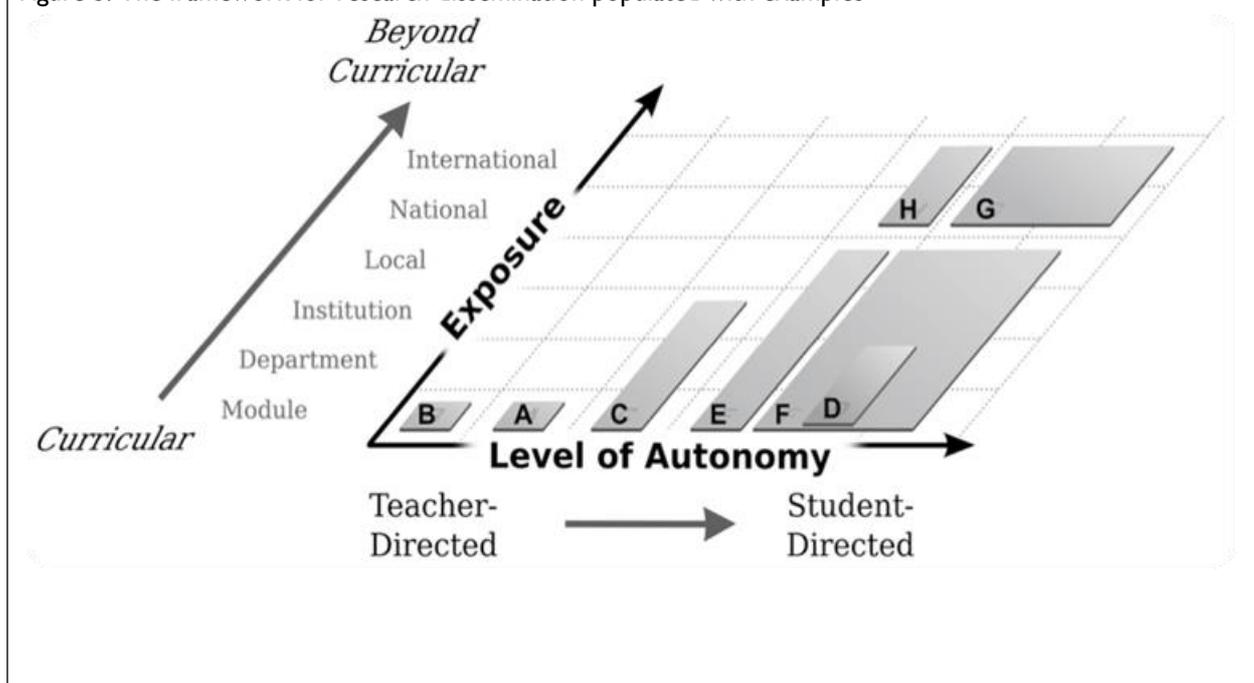
The second axis is the level of exposure that the research is given through the dissemination process. By exposure the authors mean the extent to which a student’s work is made public or given exposure to new

audiences beyond the classroom. Rather like a camera aperture can be controlled to provide different levels of exposure, student work can be publicised to different audiences according to the level, quality and originality of the work and student and institutional desirability. This may range from dissemination of research findings within a module through to international exposure of the research through, for example, publication or presentation in conferences.

The use of digital technology allows students to gather data and collate and share information in the form of photo sharing, via links to social media, wikis, film, editing and burning DVDs, and storing materials in a virtual learning environment or institutional repository. Digital technology means that the aperture can be controlled with wikis being available only to those with a wiki account and video presentations being restricted to subsequent university cohorts, for example. An example where staff and student collaborations over a long period of time exposure of research work to become fully public is the work of Hasok Chang, at University College London. Between 2000 and 2005, undergraduate students at UCL collaboratively developed a wiki-book, created through inheritance of work from one year to the next. With continual improvements and refinements the final work achieved publication standard. *An Element of Controversy: The Life of Chlorine in Science, Technology, Medicine and War*, has now been published by the British Society for the History of Science (Chang, 2005; 2009).

The use of the axes of level of autonomy and exposure provide the opportunity to consider a wide variety of situations where increasing levels of autonomy do not necessarily relate to expanded degrees of exposure. The student included as an author on a research paper in a high-ranking journal for example, may have been heavily directed in their research. In Figure 3, the framework has been populated with lettered areas which relate to different research dissemination activities (Spronken-Smith et al., 2013).

Figure 3: The framework for research dissemination populated with examples



Students are highly motivated by the publication of their research. They raise their attainment when they know that their work is not just for assessment by one or two university tutors but will be seen by a broader range of people, and that it links to authentic exposure (Spronken-Smith et al, 2013; Walkington and Hill, 2013 a,b). At Oxford Brookes University, Year 1 architecture students engage in live projects (Anderson and Priest, 2014) from year 1 and have created a public blog for the local community. With 3,000 hits in the first year, students were highly motivated to contribute. In order to quality control the outputs the tutors mediated student publishing to the public blog and online photo-sharing space (On Figure 3 this could be represented by area E). Formula hybrid is another type of exposure for student research in technology and engineering (perhaps represented by G or H on Figure 3). It is a co-curricular competition developed for

teams of undergraduates and postgraduates who have to secure sponsorship. It is a truly international event with teams from North and South America, Europe and Asia.

## **Summary**

The dissemination of research is an integral part of the research cycle/process. Dissemination allows students to develop graduate attributes. A range of formats for dissemination is available and involving students as much as possible in critically assessing the research outputs of themselves and their peers provides an additional learning opportunity. Increasing levels of participation and exposure are ways in which to motivate students and develop research communities. The following section now introduces undergraduate research journals as a way of disseminating student research.

## 5. Undergraduate research journals

There has been a proliferation of undergraduate research journals to provide a written form of dissemination for undergraduate research. The American CUR website shows an increasing number in the United States and advice on establishing journals has been published in the edited book ‘How to start an undergraduate research journal’ (Hart, 2012). While most journals are institutional showcases, some exist to further the disciplines that they represent. The journal team which developed Bioscience Horizons (see section 4) in the UK has successfully worked with a publisher to become a leader in sharing student research work and student authors attest to the benefits which publication has brought them:

- “Bioscience Horizons provided me with a fantastic introduction to the processes involved in publishing scientific research.” Student author, 2008
- “At an interview my prospective employer searched for my name on the internet, found my publication and offered me the position.” Student Author, 2009
- “The opportunity gave me confidence in my writing, making the publication of further work less daunting.” Student Author, 2011 (Luck, et al., 2014)

Students have also reported a number of perceived benefits from disseminating their own research via institutional e-journals including an “increased understanding of the research process”; “a source of inspiration or ideas for other students”; and “something to aspire to for students who may progress onto similar courses” (Gresty and Edwards-Jones, 2012).

The next section provides an example of the range of impacts which an established journal can provide, from students writing journal articles to the benefits for those who become successfully published authors. Table 4 shows the format and ethos of two journals for undergraduate researchers in Geography. One, GEOverse, is a national journal, the other, Geoversity, a departmental journal at Oxford Brookes University.

Table 4: Comparison of two linked undergraduate research journals		
	<b>GEOverse</b>	<b>Geoversity</b>
<b>Audience</b>	National / International within a discipline	Departmental students, parents, prospective students
<b>Aim</b>	A professional publication for top quality undergraduate research	Showcase the range of research work / publish the best
<b>Process</b>	Rigorous refereeing  Academic staff Postgraduate reviewers	‘Light touch’ refereeing / no reformatting  Undergraduate student editor, Postgraduate reviewers
<b>Purpose</b>	To communicate research findings	A pedagogical tool to benefit university students
<b>Values</b>	Highly selective and supportive	Inclusive and supportive / a commitment to publishing work even if this requires several revisions

The journals show different models which can be adopted from a selective journal publishing top quality research to a showcase developed to enhance student learning about and through the research process.

## Benefits of engaging with undergraduate journals

### Assignment in a journal article format

At Oxford Brookes University, the journals GEOverse and Geoversity were designed to share the same author guidelines and a module in the undergraduate curriculum at level 6 (honours) was aligned to these author guidelines with a journal article as the assessed work. Publication in the journal was therefore not mandatory but was possible for students who wished to pursue this outside the module. Undergraduate authors reported a range of benefits from being involved in writing articles to the journal author guidelines, regardless of whether their work was eventually published; these included the direct benefits of writing skill development which translated into indirect reading skill acquisition.

### The benefits of writing up a research project in a journal article format

#### The benefits of writing up a research project in a journal article format:

*'Writing up .. gave .. this paper a purpose. Being able to see the whole 'journey' from start to finish was extremely worthwhile.'*

*'I feel that I've accomplished something! It was difficult but I'm proud of it!'*

*'It was good to see that you can achieve something to a high standard as a published journal. It gave me a real sense of achieving a good research project.'*

*'It was good to get all the hard work that I did in the field and see it coming together as something academic.'*

*'It was also good to really begin to understand what I had researched last term.'*

*'I enjoyed the freedom of opinions and sources used, it was very interesting following up [previous work] and expanding on it.'*

*'[I enjoyed] the challenge of writing an article that comes from my own experiences.'*

*'The chance to write about something that had never been written about before.'*

(Walkington, 2008)

Those students writing in a new journal article format, with the possibility of submitting to the journal at the end of the module, reported a heightened sense of pride in their work. One undergraduate author said: *"With the possibility of actual publication, it invoked a sense of pride and so I felt that the quality of my finished article was higher than usual"*. Students on the module also mentioned how their understanding of their discipline was developed and how they felt a sense of their knowledge *"coming together"*: *"It has allowed me to bring together all the skills I have been trying to learn throughout the university period."* The freedom of the creative process and being able to think outside the box, and the sense of ownership over their writing were further benefits: *"I enjoyed the fact that I was not just regurgitating what someone else had written. I could draw on my own personal experience. [It] allowed me to go into more detail because it was my work and my findings."* Although one student acknowledged that this had been challenging: *"I found it hard to change between writing as a learner to writing as a teacher."* (Walkington, 2008). In terms of reading skills, students reported a more critical approach to information in the literature: *"You have the knowledge to be critical and the work is more personal so you have a different outlook on other journal articles being used for research."* (Dellinger and Walkington, 2012).

In terms of moving towards Baxter Magolda's self authorship (2004), even those students who were not published highlighted the impact that writing up their research in a new format had on their learning: *"I had my own results to interpret and had to read other sources to get a background on the topic and help form an argument for why my results were what they were, even if it meant they didn't agree with other sources."*

*“I have learnt to be critical not only of others’ work, but also my own work. I found myself doing on-going research, and finding things not only relevant to the specific publication, but for other work that may link in.” (Walkington, 2012).*

It is possible to capitalise on these benefits in terms of developing the writing skills of students. Dellinger and Walkington (2012) have suggested that scaffolding the writing process may take several forms:

1. Group/team writing (wikis and other collaborative writing technologies may further support this process). This provides support from within the group in checking each other’s work prior to submission. With large class sizes this provides a manageable workflow for an institutional journal.
2. For individually authored pieces the option of a peer mentor to swap draft papers with can help to improve the quality of papers.
3. Teaching writing skills during class sessions provides opportunities to discuss reviewing criteria. This might include discussing article reviews, modelling the writing process and giving feedback on draft work.
4. By accepting paper and book reviews, journals can encourage students to write for them from the start of their undergraduate course even before they have generated their own data.
5. Including journal articles as the format for assignments gets students used to writing in an appropriate style.

### **The experience of published authors**

#### Student Voice

*“When a journal for undergraduate research was started I wanted to have a go at publishing my independent study. It was my first experience of publishing and I got lots of useful, but critical feedback, because it was online and anonymous I felt that the reviewers were free to say exactly what they liked (as I wasn’t standing in front of them). It was a longer and more complicated process than I thought it would be at the outset but I was really proud when it was accepted. Later on I became a student editor and tried to encourage other students to engage with a process that had helped me make a significant improvement in my own communication skills.*

*When I completed my dissertation I knew I wanted the work published as I realised how little quantitative data there was on my topic. But it wasn’t easy – it took three years and three different journals before I published the research and this taught me a lot about perseverance and the research process!*

Published student authors from the journal GEOverse described the experience as an **iterative learning process**, where they felt that they were not alone because they could **trust the written advice of others** and receive **detailed feed-forward**. The experience developed their **critical skills**. The publication itself gained them **recognition as a researcher**. On the negative side some did not like the fact that feedback was impersonal as it came via email only and there was no opportunity for face-to-face contact with the reviewer which is something that they appreciate when they receive feedback on their university assignments. This **desire for dialogue** was missing from their experience (Walkington, 2008; 2012). In contrast, undergraduate research conferences are an overtly dialogic format and are discussed in section 6.

## **The experience of students involved in the journal processes**

In addition postgraduate students, who often act as journal reviewers, have reported a range of skills and motivations resulting from engagement with undergraduate journals, including the development of critical skills which benefit their own writing, and the desire to provide a forum for learning for undergraduates as well as a sense of belonging to a research community beyond their own institution (Walkington, 2008).

### Postgraduate reviewer motivations to join the editorial advisory board of the journal GEOverse:

*“Gain experience in reviewing the work of others... working with a publication”*

*“Engage with the wider geography network”*

*“An interest in the linkages between research and teaching to support and improve student learning.”*

*“To improve my own writing ... CV enhancement ... Working as part of a team.”*

*“I think it sounds a fantastic opportunity and novel idea and therefore I would love to be part of it!”*

*“It is something I would have really appreciated as an undergraduate. A great opportunity.”*

*“Interest in the subject and contemporary issues.” (Walkington, 2008).*

The financial sustainability of undergraduate research journals in the long term is a challenge. Many journals are kick-started with small funding grants but become unsustainable if they have relied on paying for administration. Soliciting articles can be a challenge especially at the start, one of the largest barriers to students submitting articles is a lack of confidence that their work is of a sufficiently high standard and often students need to be committed to writing up their work after leaving university, so ongoing communication is essential when graduates may be prioritising new employment or job applications (Walkington, 2014 b).

## **Recommendations for good practice using undergraduate research journals**

- Use journal articles in the curriculum, including articles written by students from the previous cohort as a starting point for further research.
- Use other forms of research dissemination to solicit journal articles such as poster conferences.
- Ensure that journal processes are made transparent by having academics talk about their experience of rejection, rewriting, and redrafting in front of students in order to demystify the process.
- Develop and embed writing opportunities in the curriculum e.g. embedding article writing, instead of writing dissertations or essays (Walkington, 2014b).

## 6. Undergraduate research conferences

Undergraduate research conferences can take many different formats, but most usually incorporate poster-style conference and paper sessions, in order to mirror academic conferences. Student-run conferences are more likely to also include video presentations, demonstrations of interactive websites, performances, etc. As with any academic conference, undergraduate research conferences vary according to the disciplinary or thematic focus and the scale of the event, from simulations such as poster sessions within modules, to departmental conferences, faculty or institutional conferences. National conferences can be hosted by disciplinary societies or academics forming national networks combining many disciplines.

### Student Voice:

*'All the fundamental skills I have needed for my career I learnt as an undergraduate researcher. Communication is a huge part of my working life, I have to do a substantial amount of presentations. I had solid foundations through the numerous presentations I had to do at university, including the undergraduate research conference.*

*The transferability of learning during my time at university was key – my ability to research beyond pressing enter on Google, to pull together that research in an understandable summary and to present confidently to my peers. In my first role I spent a lot of time helping people on a one-to-one basis, a daunting task for many, but all the group work I did at university and my dissertation I had undertaken where I had interviewed loads of local residents, had put me at ease with people from any walk of life.'*

In the UK, undergraduate students have the opportunity to present their research at the British Conference of Undergraduate Research (BCUR) and Posters in Parliament events in order to share their research with a multi-disciplinary, multi-institutional audience. BCUR began in 2011 when Stuart Hampton-Reeves and colleagues at the University of Central Lancashire hosted the first national conference. Since then it has been hosted at Warwick (BCUR 2012), Plymouth (2013) and Nottingham (2014) and is an annual event. Through the creation of a multi-institution steering committee it has become an established event in many university calendars. BCUR's development was modelled on the United States' long-established National Conference (NCUR) which has inspired other national conferences, for example in Ireland, Australia and the Netherlands.

### Benefits of engaging in undergraduate research conferences

#### *Departmental conferences*

The benefits for students in participating in on undergraduate research conferences including departmental, faculty-wide and national events, have been evaluated through coded interviews with student participants (Walkington, 2014a; Walkington, et al., 2011; Walkington and Hill, 2013 a, b). Students describe benefitting from conferences in terms of receiving immediate **in-depth dialogic** feedback and being required to demonstrate **critical thinking on your feet** in response to questions. The fact that students were accepted to present at a conference, coupled with their successful participation, gave students 'recognition as a researcher' as a result of the event being an authentic setting. In fact, students have the potential to become experts and staff become the audience in this setting: *"it has been nice just talking to people in a non-lecturer/student capacity, everyone was very much on **equal terms**, yeah that was the first time that has happened"*. (Student researcher at a departmental conference, Walkington and Hill, 2013 a,b). However, the **timing** is very important in order to realise the full benefits of a conference for student learning. If a conference takes

place when students still have the ability to adopt new ideas into their thinking and final submission of coursework it can raise educational attainment. However, if the conference is timed so that work has already been submitted, the conference has limited value in terms of rethinking ideas, although it still allows students to practice their communication skills. Unlike a journal, conferences often **lack a legacy** in the longer term, although student conferences are starting to hold abstracts electronically and students can still refer to conference presentations on their CV.

Critical self-awareness is a graduate attribute that students describe in their reflections on conference participation. Being able to compare their work with that of others and to discuss their work with others is very important:

*“I think it allows some sort of self-criticality ... it has opened up areas of thought for me that I wouldn’t have considered otherwise.”*

*“It enabled you to become objective, to analyse your own work, to re-read your work.”* (Walkington and Hill, 2013a,b).

The National Student Satisfaction Survey attests to the importance which students place on access to feedback and dialogic feedback is particularly highly valued (Beaumont, O’Doherty and Shannon, 2011). At a conference on undergraduate research, students benefit from immediate **in-depth dialogic** feedback, particularly in the format of poster sessions undergraduate research conferences are spaces for conversation, interaction and reflection, a context for learning that matches the culture of professional workspaces. Students reported gaining **tacit knowledge** of how to communicate in a new scholarly format. Students recognise the authenticity of the task that prepares them for their conference experience *‘I found making the poster rewarding as I could summarise my dissertation in a few hundred words which brought the project into focus’*. Being able to reflect on their research and take it beyond the confines of their module/department/institution into a new setting allowed students to understand how their research ‘maps’ within the **bigger picture** and to gain **confidence** as they became recognised as researchers. Students described their experience in terms of graduate attributes and employability skills:

*“That conference was fantastic ... staff in the department **recognised me as a researcher**, as a result I was a guest speaker in one of the geography modules, I met with a photo-journalist, I’ve gained a lot of **key skills which are important for work** as well.”* (Student researcher at a departmental conference, 2008).

*“The job I’m going into I’m going to be doing a lot of presentations and meeting a lot of unfamiliar people and to a certain extent selling my ideas and my research, so it was good experience for me.”* (Student researcher at a departmental conference, 2009).

*“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.”* (Student presenting at the 2013 British Conference on undergraduate research)

### **Multi-institutional conferences**

Multi-disciplinary national conferences provide the additional benefit to students of encouraging them to present complex ideas in a way that people from a range of disciplinary perspectives can understand. This can be very challenging because recourse to disciplinary language and jargon are no longer appropriate, so communication has to be contextualised and the broader global significance of findings highlighted. Students described themselves as “budding professionals” in this type of venue and reported feelings of empowerment as a result (Walkington and Hill, 2013a). Further evaluations of student interviews from three successive years at the British Conference on Undergraduate Research are forthcoming (Walkington, Hill and Kneale).

## Recommendations for good practice in the preparation of students for undergraduate research conferences:

- Scaffolding within the curriculum to prepare students for co-curricular conferences (e.g. how to create an academic poster, in-class poster sessions/presentations, how to structure a paper presentation).
- Encourage students to create a digital legacy from the conference (even students who have not presented their work can be involved in the conference process, e.g. year 1 students).
- Help students to understand how their research 'maps' within the global picture.
- Allow students class time to practice communicating their research to an audience who will provide constructive feedback.

Undergraduate research conferences give learners the opportunity to engage in formal and informal learning environments which promote their ability to engage actively and creatively in learning, research and professional communities both within and beyond the institution. The undergraduate conference is an authentic professional space, ideal for developing student self-authorship by providing a transformatory experience with the potential to change student self-perception, particularly their awareness of their own disciplinary lens.

## 7. Concluding thoughts

We can *personalise* and *professionalise* the curriculum through adopting a 'students as researchers' pedagogy. Providing research and dissemination opportunities helps to implement this and can be sustained within a students as partners framework, gradually increasing student participation throughout a degree programme.

There are several important challenges to consider when working with 'students as researchers'. Research and its dissemination can raise issues of ownership, ethical practice, equality of opportunity, variations in the quality of supervision, workload issues and more generally reveal resourcing constraints. It is vital to open these themes up for discussion when planning to adopt or adapt a 'students as researchers' pedagogy. Research has the power to transform both the student and staff experience and cultures of inclusion or exclusion can be created depending on the openness to involving students.

Undergraduate research should be encountered early in the student learning experience (Walkington et al, 2011). If it is embedded in the curriculum it can be scaled up and inclusive of all learners. The 'students as researchers' pedagogic approach fits with recent developments in flipped learning and the redesign of assessments in terms of their authenticity and professionalisation of the student experience, such that students can see the employability benefits of their university endeavours and feel a sense of belonging to the their disciplinary or even university research culture. This approach can also help to develop the research culture in universities with the mentoring of students as teaching practice helping to break the long standing disconnect between teaching and research and providing career pathways, reward and recognition for those who support 'students as researchers'.

As academics, we achieve our highest levels of understanding when we carry out research which is then communicated to others through teaching or at conferences and in published work. The challenge of a 'students as researchers' approach is to open the same freedom up to our students.

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