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Developing Graduate Attributes through Participation in Undergraduate Research Conferences

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Abstract

Graduate attributes are a framework of skills, attitudes, values and knowledge that graduates should develop by the end of their degree programmes. Adopting a largely qualitative approach and using semi-structured interviews, this paper outlines students' experiences at a national undergraduate research conference over three years and evidences the graduate attributes developed. The students demonstrated intellectual autonomy, repurposing their work for presentation to a multi-disciplinary audience through conversation with and benchmarking against peers. They gained confidence in expressing their identity as researchers and moved towards self-authorship, consciously balancing the contextual nature of their disciplinary knowledge with intra-personally grounded goals and values.

Key words: undergraduate research, graduate attributes, employability, conferences, self-authorship, borderland space

Research context and aims

The growing emphasis on graduate attributes in higher education is indicative of a larger global debate about the nature and purpose of university education (Barnett, 1998, 2000), and the role of higher education institutions (HEIs) in producing employable graduates to feed national prosperity in the emerging knowledge economy (Castree, 2011; Arrowsmith, et al., 2011; Erickson, 2012). According to Whalley et al. (2011, p. 380), universities must now 'validate their social role and purpose more explicitly' than ever before in order to prepare students to recognize and navigate the heterogeneity and change they will encounter in communities beyond their campuses. Graduate attributes are also relevant in debates about disciplinarity and concerns about the fracturing of the academic community into groups unable to communicate across disciplinary divides (Barrie & Prosser, 2004). It is important, therefore, to link undergraduate education with the clear articulation and development of graduate attributes to ensure that GEES (Geography, Earth and Environmental Science) graduates are well prepared for the demands of an ever-changing democratic multi-cultural society (Barnett, 2000).

Graduate attributes have been defined by Bowden et al. (2000, p.3) as:

'the qualities, skills and understandings [that] include but go beyond the disciplinary expertise or technical knowledge that has traditionally formed the core of most university courses. They are qualities that also prepare graduates as agents of social good in an unknown future.'

Graduate attributes are an orientating framework of education outcomes, which a university community agrees its graduates should develop as a result of successfully completing their studies. They may be integrated into both formal curricula and extra-curricular activities and are often used by HEIs to clarify the opportunities that are available to their students through studying any discipline at university, to describe a common experience for students studying across disparate areas, and to provide a coherent framework against which students can identify opportunities and self-assess their personal development.

Due to the growing emphasis on quality enhancement, graduate attributes have become well established in Australian universities over the past two decades. They have been integrated via the Graduates for the 21st Century Enhancement Theme into the Scottish Quality Enhancement Framework and are increasingly being adopted in England following a Higher Education Funding Council for England (HEFCE) skills agenda. There has been renewed interest in graduate skills in the United States and in the discipline of geography this has led to the *Enhancing Departments and*

Graduate Education in Geography (EDGE) project led by the Association of American Geographers and sponsored by the National Science Foundation (see www.aag.org/edge). The aim of this project is to strengthen the preparation of geographers for professional careers. As such, graduate attributes are increasingly being used to inform curriculum design and engagement with teaching and learning experiences at universities around the world (Barrie, 2007).

Graduate attributes help to develop academic, citizenship and career competencies. For the purposes of this paper we regard them as comprising i) generic skills/abilities of students, ii) student attitudes/values to knowledge and learning, their own development and the world around them, and iii) knowledge beyond disciplinary contexts. We adopt the Conceptions of Generic Attributes model developed by Barrie (2004) (Figure 1) to evidence engagement with graduate attributes by GEES students through their participation in undergraduate research conferences. This model integrates an 'enabling' conception of graduate attributes, viewing them as attitudes that have 'potential to transform the knowledge they are part of and to support the creation of new knowledge and transform the individual' (Barrie, 2006, pp. 223-225) with a 'translation' conception, whereby graduate attributes are viewed as 'clusters of personal attributes, cognitive abilities and skills ... that allow students to make use of and apply discipline knowledge' (Barrie, 2004, p. 266). On Figure 1, the sides of the triangle represent the three overarching enabling graduate attributes and these are supported by development of the five translation-level attributes that form the jigsaw pieces. This model is useful as it moves the consideration of graduate attributes from piecemeal and atomistic skills to holistic and integrated human capabilities.

We take this model a step further, identifying self-authorship as an overarching pedagogic concept emanating from the acquisition of multiple translational and enabling graduate attributes. Self-authorship is 'the capacity to internally define a coherent belief system and identity that coordinates engagement in mutual relations with the larger world' (Baxter Magolda, 2004, p. xxii). Self-authorship can be more simply stated as the ability to know oneself, to know what one knows, to reflect upon it, and to base judgements on it. It necessitates skills of critical analysis and evaluation, deciphering of ambiguity, embracing and valuing of diversity and consideration of multiple perspectives. As such, students become self-authors when they begin to reconstruct and enact their beliefs about knowledge, themselves, and themselves in relation to others in a way that recognises and engages multiple perspectives and diversity.

Notwithstanding the diversity of viewpoints that characterises the nature and understanding of graduate attributes (Barrie, 2006; Jones, 2013) and that efforts to foster the development of generic attributes around the world have met with varied success (Drummond et al., 1998; Bowden et al., 2000; Barrie & Prosser, 2004), this paper examines one extra-curricular learning context that appears to facilitate the development of graduate attributes and self-authorship as defined above. The context is the undergraduate research conference and we focus our attention specifically on student experiences of the British Conference of Undergraduate Research (BCUR) (see <http://bcur.org/>). This paper addresses the 'need in the literature for work that ... considers how graduate attributes are ... learnt by students' (Jones, 2013, p.603). The findings are relevant beyond the UK as equivalent national undergraduate research conferences also occur in the United States, Australia and parts of Europe (e.g. the Netherlands). Additionally, universities are increasingly holding their own discipline, faculty or university-wide conferences and the results are of considerable interest to the planning of such events.

Research methods

Adopting a largely qualitative case study approach, semi-structured interviews were undertaken with 22 undergraduate GEES students during or shortly after their participation in BCUR conferences over three consecutive years (2012-2014 inclusive). Students were selected following a review of the titles of all verbal and poster presentations and almost all those approached agreed to answer our questions. We additionally tried to balance the proportions of poster and paper respondents. The research presented in this paper forms part of a larger project, with only those results pertaining to GEES students included here (Table 1). Most respondents were final-year students presenting their dissertation research, but two presented either a university sponsored summer research project or entirely autonomous extra-curricular work. The majority of respondents were students of geography (both BA and BSc courses) and there were roughly equal proportions of students who delivered poster compared to verbal paper presentations. The sample was balanced in terms of gender of participants. Interviews were held face-to-face or via video skype. A set of primary questions and a range of predetermined follow-up probes were designed prior to commencing the interviews. The intention of the interviews was for respondents to reveal their experiences of preparing and presenting their posters or papers and, in particular, the skills they used in both the preparatory and participatory stages. Prompts for the question concerning participation moved students from considering the presentation of their own paper/poster to attending other presentations/posters and to communicating with other researchers. Primary questions also addressed how presenting at

BCUR compared to other learning experiences the students had encountered in their own institutions and how they felt about making their research public.

The research project passed through the risk assessment and ethical review processes of the first author's home institution. This process ensured interviewees were informed about the intent of the research, and that they could refuse to answer a question(s) and withdraw from the research process at any stage. Interviewees were also assured that their comments would be cited anonymously. The respondents thereby offered informed consent to be questioned and to have their responses audio-recorded. The authors received permission from the organising committees to undertake interviews during the conferences.

Interviews were recorded using a portable digital voice recorder and transcribed in full. Transcripts were coded manually and independently by both authors in relation to the five translation graduate attribute clusters of Barrie (2004) (Figure 1). To enhance reliability of categorisation, the process of reading the transcripts and organising statements under codes was repeated several times and cross-checked by the authors. In addition to selecting quotations from students to highlight key themes, the proportions of students making reference to these themes were also calculated. In the discussion, the three enabling graduate attributes from Barrie (2004) are interpreted with reference to the overarching pedagogic concept of self-authorship (Baxter Magolda, 2004).

Results

The results are presented by working through the five translation-level graduate attributes depicted in Figure 1. The attribute statements are sub-divided where diverse responses were received and the results focus on evidencing those attributes beyond the more obvious enhancement of 'presentation skills'.

1. Communication

When the GEES students were questioned about their experiences of preparing for and presenting at BCUR the most frequent responses, unsurprisingly, concerned honing their communication skills. These included specific aspects of oral delivery such as pacing and fluency, not reading from notes, and maintaining eye contact with audiences. Students progressed, however, to include a number of more conceptually advanced skills. They were mindful not only to convey their key messages clearly to a diverse audience, but to keep the audience interested and engaged. These advanced themes will now be evidenced in turn.

Repurposing content: Students were acutely aware of the need to revisit their research, to think critically about its content, and to re-purpose it for a multi-disciplinary external context (Table 2). They were attentive to prioritising and selecting material that would convey their core messages in a way that audiences would understand. They made conscious decisions about content to include or omit in the process of summarising substantial research projects (Table 2a). Respondent 12 described a process of deconstructing an argument and reconstituting it, whilst respondent 18 highlighted the importance of clear personal understanding in effective repurposing of an argument. Students also identified the need to consider the global structure of their presentations in order to construct a narrative that would be accessible to the many disciplines represented at the conference. Respondents referred to the spatial layout of posters and the temporal sequencing of slides (Table 2b) and one student (respondent 13) even linked structural considerations to a desire to draw forth dialogue about his research. The final category identified under this theme was clarifying GEES-specific terminology. Every student made reference to the different and/or diverse context in which they presented, and this prompted them to try and translate GEES technical terms into a form appropriate for a varied audience (Table 2c). Respondents were particularly sensitive to the importance of rendering their research accessible to peers from disciplines far removed from their own.

2. Research and inquiry skills

The GEES students felt responsible for communicating their research findings (n=19) (Table 3). They were proud of their research (n=10) and it had taken them, on average, almost a year to execute it. Participating in BCUR legitimised them as having undertaken research that matters - to their audiences, to their disciplines and to the wider field of science. Their research was afforded meaning beyond the classroom/tutor and this made their efforts worthwhile. The students believed that they might effect change in the academy (respondent 15), wider society (respondent 18), or both (respondent 21) by undertaking research and disseminating their findings.

3. Personal and intellectual autonomy

Self regulation: The majority of GEES students explicitly evidenced self-regulation in their preparation for BCUR. They demonstrated a process of preparation, rehearsal, solicitation of feedback, and subsequent development of their poster and paper presentations (Table 4a). The quotations selected indicate that a continuum of autonomy is apparent in this process. At one end of the scale we see academic staff directing students (respondent 19 and three others). These students interpreted the feedback they received and amended their work for public presentation. Mid-scale

we see students taking advantage of expert and non-expert feedback (respondent 20 and two others), passing through a series of rehearsals. Finally, many students appear more self-directed – they initiated rehearsals unsupervised, practiced on their friends and family, who they selected as generic listeners akin to the BCUR audience (respondent 10 and five others), and then amended in an iterative process (respondent 14).

This process of self-regulation continued beyond rehearsal for many students as they proceeded to benchmark themselves against their peers during the conference (Table 4b). The respondents considered how to improve their poster and paper presentations in the near and distant future. They situated themselves against others and then actively considered how to take forward the best aspects of what they had witnessed to strengthen their own performances. Self-regulation through interaction with peers was taken a stage further by many students who presented posters, or who received relevant questions about their oral presentations/engaged in questioning of their peers (Table 4c). The selected quotes indicate that students were learning to negotiate and verbally organize their thoughts in real time. Engagement through discourse appears to be promoting ‘deeper’ critical thinking. The students were learning from and with each other in a series of reflexive cycles that began ahead of the conference and which reached forward into future work. Importantly, the students seemed to be developing a variety of skills and attitudes relating to self-efficacy.

Expressing self/identity: A facet that 13 students talked about in some depth was the opportunity at BCUR to present their work unconstrained from formal grading and to be judged instead by peers who they described as ‘genuinely interested’ in their work (Table 5). The BCUR process was not constrained by high stakes assessment, allowing freer expression of identity and argument, and students reported this was more creative and more empowering. Five students expressly mentioned identity in their responses, one noting, for example, that ‘with a verbal presentation you’re putting yourself out there ... it kind of gave me a sense of being professional’ (R20). The students were aware that they were portraying themselves and their emerging professional identities.

Self-confidence: Concluding this theme, it is worth noting that the students gained in confidence from presenting themselves and their research successfully at BCUR (n=14). One student noted specifically:

‘it’s just that confidence-building that you don’t get from other experiences at university’ R9

Self-confidence interplays with autonomous learning because striking out alone requires a great deal of self-belief. These attributes must be developed in tandem as they inter-weave in students' personal development.

4. Ethical, social and professional understanding

Ethical understanding: Students commented very little about ethical responsibilities beyond the need to be honest in their research and in communicating the extent of their understanding. As one respondent noted:

'As long as you're honest about how you made the research and you're open about its limitations ... it's definitely a good experience ... for other people to question it and say 'ok, have you looked at it this way?'' R11

The students were not afraid to acknowledge their ignorance. They appreciated that they were still learning how to undertake and present research, and they welcomed different perspectives to challenge and broaden their thinking.

Social understanding: The GEES students were aware of their need to develop social competence (n=18). There were many comments involving the terms 'network(ing)' (n=13) and the key message emerging from responses concerned students meeting with and speaking to peers who were beyond their disciplinary silos. As one geology undergraduate commented, it is important to:

'... meet people and see other disciplines ... because you live in a science bubble, a geophysical bubble at university and it's nice to see what other people are doing and how they're doing it' R12

Another student noted:

'Speaking to people outside of my discipline ... I didn't have much of a skills set in that but I've improved on it since being here' R7

Professional understanding: The development of professional understanding was very much shaped by context. As noted previously, every student interviewed made reference to the novel arena in which they presented and interacted with others. Typical comments were:

'Presenting to people who maybe haven't got that knowledge of your topic ... that's probably the newest element to this whole experience ... you have to accommodate for your context' R1

'It's great to see other people from different universities ... such a general exposure to so much different research' R11

The students went further to link the skills, knowledge and values engaged with at BCUR to the world beyond their campuses (n=16). They were able to connect their academic and operational competencies:

'it's like one step closer to the real world and getting ready for that' R3

Being in a context that showcased a variety of disciplines prompted students to consider diverse perspectives on research (Table 6a). By taking account of alternative perspectives from other academic fields, the students recognised both the opportunities and limitations of their own disciplines. Nine students took their ideas further to consider how multiple viewpoints could impact upon the development of their research and their discipline (Table 6b). They came to realise the relevance of contact with other disciplines in advancing knowledge and thereby began to broaden their own perspectives.

5. Information literacy

As with research and inquiry skills, students made little comment regarding information literacy (the ability to find, manage and use information and data effectively). This is possibly because they were drawing to the close of the research process in the preparation and presentation of their work at BCUR. A minority of students (n=5) mentioned specific skills associated with visual presentation and balancing text, images and verbal information for their oral presentations. Reference was made to PowerPoint for supporting both poster and verbal presentations. One student made reference to developing tables and graphs to communicate his results more effectively than solely using words.

Discussion

The discussion begins with an explanatory overview of the findings concerning the five translational graduate attributes of Barrie (2004) (Figure 1). It then progresses to interpret the three overarching enabling graduate attributes with reference to the concept of self-authorship (Baxter Magolda, 2004) and the nature of the undergraduate conference learning space in which self-authorship is developed.

Translational graduate attributes

The GEES students identified effective oral communication as a key skill they had developed through participating in BCUR. They cited many of the guiding principles for presenting research as listed by Brierley (2009). They referred to the importance of preparation, practice and repurposing of their work, identifying and organising key messages, taking account of audience perspectives and making their presentations engaging. The respondents were acutely aware of translating the technical language of their discipline into lay terms in order to communicate with the diverse multi-disciplinary audience and to encourage inclusivity (Hay, 2002; Spronken-Smith et al., 2013). Geography students possess an extensive vocabulary as they have their feet in both the physical and social sciences (Spronken-Smith, 2013). This helps them to converse across disciplinary divides and perspectives (Barrie & Prosser, 2004).

The development of oral communication skills is a relevant finding as studies in the UK and Australia have shown that geography students more readily identify with the development of written compared with oral communication (Clark & Higgitt, 1997; Mager & Spronken-Smith, 2014). Given the massification taking place in higher education extra-curricular acquisition of graduate attributes may play an important role in developing skills such as oral communication, which are difficult to deliver in large classes.

Students made relatively few comments relating to the research and inquiry process and to information literacy because dissemination falls at the end of the research cycle. They did, however, recognise the importance of disseminating their research findings (Boyer Commission, 1998), with one going as far as to say that research dissemination is 'the missing link' for students in their undergraduate learning experience. The undergraduate research conference allows students to make their research public, hence completing the research cycle (Walkington, 2008). The students embraced this opportunity enthusiastically, perceiving it to afford their work meaning in academia and perhaps wider society.

Students attested to self-regulating their work in preparation for its presentation at BCUR – preparing, rehearsing and amending work dependent upon feedback from peers and academic staff. Students progressed from low level rehearsal to deeper and more meaningful interaction with their work through peer interaction. As an uncontrolled extra-curricular activity, BCUR prompted the students to 'activate and sustain cognitions, behaviours and affects, which are systematically oriented toward attainment of their goals' (Schunk & Zimmerman, 1994, p. 309). In this way, they began to fulfil the disposition of understanding for themselves (McCune & Entwistle, 2011);

demonstrating a sound grasp of disciplinary knowledge, a willingness to apply this knowledge using generic skills, and an alertness to the context in which they were immersed.

The students realised that they must develop inter-personal skills to be able to speak to people outside of the GEES disciplines. Through direct engagement in a multi-disciplinary research context, they began to appreciate that knowledge is partial, continually being created and recreated through research, dissemination and negotiation in response to new ideas and alternative perspectives. This agrees with Su (2014) who notes that students develop personal graduate attributes most effectively in a self-directed and genuinely engaged manner.

Undergraduate research conferences as borderland space: moving to self-authorship

Baxter Magolda (2001) noted that college students were unlikely to develop self-authorship, largely because HEIs do not provide sufficiently novel and productively disruptive (Glasser & Powers, 2011) experiences that compel them to (re)consider and subsequently begin to fashion new conceptions of self – conceptions that are informed by and appropriate to novel contexts. Pizzolato (2003) takes this argument further noting that HEIs are too ready to supply students with formulas for learning and success and, as such, undergraduate students are not challenged sufficiently to self-author their own ways of knowing. As educators of undergraduate students we must therefore create pedagogic conditions in which students become border crossers – transiting from the familiar contexts of their undergraduate experience, delimited by well defined curricula, grading schemes and assessment matrices – to situate themselves in unknown and hence challenging spaces. We define such spaces as borderland spaces, in which encounters with embodied ‘others’ and disembodied ‘otherness’ prompt the fashioning of new identities, permitted by fluid configurations of power (Giroux, 1992).

The GEES students evidenced a movement towards self-authorship as they consciously balanced the contextual nature of their disciplinary knowledge with intra-personally grounded goals, beliefs and values. We see in their responses initial expressions of uncertainty as to what they were letting themselves in for. But the same students, through their encounters with unfamiliar contexts, diverse audiences and internally formulated but externally referenced benchmarks, were compelled to reassess their knowledge, understanding and conceptions of self in order to develop their potential graduate professional identities. The students noted in particular their embracing of freedom and creativity away from the formulaic logic of tutor assigned assessment criteria, to benchmark themselves against an exposition of self and self-directed research appropriate to a diverse audience. The ‘public’ presentation of their research motivated them in ways that other

'assessment' had not (Garde-Hansen & Calvert, 2007; Cuthbert et al., 2012). The borderland space of the undergraduate research conference is not just a space beyond the academy, it is an in-between space in which students express hybrid identities (Huber & Morreale, 2002): a conjoining of undergraduate student and emerging graduate professional. The undergraduate research conference thereby offers students an opportunity to begin to construct their professional identities during their studies, potentially helping them to navigate into their working and wider social lives (Daniels & Brooker, 2014).

BCUR offers a space to develop graduate attributes in a challenging, but safe and supported context. It is a space of evolution, of becoming - students are becoming professionals and nascent authors of their own lives. Through presenting their work, viewing and questioning the work of others, and negotiating answers to questions from peers, the students are balancing alternative perspectives, and creatively reconstructing their own knowledge, understanding and conceptions of/confidence in themselves. Such a context is perceived as meaningful by the students because it connects to 'real-world' situations that they may encounter outside of their universities, both currently and in the future. The important role of questioning and ensuing dialogue comes out in the responses of students. As the students shared alternative interpretations of their research they re-evaluated and sometimes re-framed it, recognising that it assumed a different appearance from diverse viewpoints. The students extracted meaning from participating in and being influenced by conversations about shared research themes (Wahlström, 2010) and they came to realise that there was not one story of, or understanding derived from, their research. Dialogue made explicit the tacit understanding of the students by offering them the chance to clarify and develop their ideas interactively.

Implications for academic policy and practice

Taking part in BCUR supports the 'higher-level' participatory acquisition of graduate attributes (Barrie, 2007: 450), developed when students engage in the broader learning experiences of university, including extra-curricular learning. As a borderland space, BCUR develops translation and enabling graduate attributes (Barrie, 2004). Participating in the conference allows students to apply disciplinary knowledge in what they perceive to be unfamiliar and authentic professional contexts, accommodating multiple perspectives and reflective thinking in the process. Participation also supports future scholarly learning beyond the discipline and its application to new contexts. These skills and attitudes are fundamental tenets of self-authorship (Baxter Magolda, 2004) and they resonate with the idealised identities of 21st century graduates (Barnett, 2004; McCune & Entwistle, 2011). The development of these attributes within extra-curricular contexts might go some way to equalizing the mismatch identified between the generic attributes employers seek and the more

highly developed disciplinary knowledge that graduate students tend to possess (Hennemann & Liefner, 2010).

It has been argued that experiencing an undergraduate research conference is transformative for students (Walkington et al., in review). Academic staff can witness students, as undergraduate researchers and research disseminators, actively constructing new knowledge and identities using skills, attributes and values applied in contexts beyond the originating disciplines and contexts. With these opportunities, however, comes responsibility for staff to encourage inclusivity, particularly for those lacking cultural capital in educational settings (Felten et al., 2013). Students who attend BCUR are largely self-selecting and are already highly motivated with regard to their academic studies. Inclusivity might be enhanced by generating disciplinary and multi-disciplinary undergraduate research conferences within universities, faculties or departments and welcoming all students to participate (Spronken-Smith et al., 2013). Some of these activities might be formally assessed and graded within the curriculum, ensuring that all students can take part, but this research highlights how a setting outside the curriculum offers a less constrained environment in which to develop and practice graduate attributes.

Some researchers state that graduate attributes are most effectively developed in the context of discipline knowledge, embedded within curricula and assessment, rather than addressed as stand-alone strategies (e.g. Bowden et al., 2000; Bath et al., 2004; Hughes & Barrie, 2010). The research presented here, however, highlights the importance of developing graduate attributes not just within existing disciplinary curricula but outside of these formal structures if the development of graduate skills, values and non-disciplinary knowledge are to lead students to self-authorship. The translation and enabling graduate attributes are multi-faceted aspects of human ability, which are difficult to teach or assess explicitly through traditional university experiences. This raises the question of how universities might help students harness the learning potential of their engagement with university life outside of formal classes. Recent work in the UK on developing structured personal profiles and 'graduate passport' opportunities, linked to the Higher Education Achievement Report (HEAR), an electronic document providing a detailed record of students' extra-curricular as well as academic achievements, has the potential to guide both students and academic staff alike. The role of assessment in situating graduate attributes in the learning experience, however, remains an important research topic for institutional researchers and strategists across the world.

There is an important role for academic and other staff within HEIs to make the achievement of graduate attributes transparent to students via dialogue and/or reflective engagement. This is because students are often not able to communicate the generic attributes they have acquired beyond disciplinary knowledge and skills (Spronken-Smith, 2013; Mager & Spronken-Smith, 2014). Whilst graded work might evidence certain skills, knowledge and perhaps values, the students themselves should be able to communicate their competencies directly to employers during interviews and the first probationary months or years of employment. Unlocking tacit attributes for students to articulate confidently to employers, beyond the exposition of graded work, is highly relevant to graduate job-seekers and is possibly the most direct advertisement of any university's accomplishment of graduate capabilities. It is worth stating here that a number of respondents identified the semi-structured interviews involved in our data collection as having a developmental effect. The interviews offered respondents the time and space to process their experiences and to consciously reflect on them, bringing insights to light that they might not otherwise have discovered. It is worth building reflective debriefs into or around events such as BCUR to enable participating students to consider and articulate graduate attributes.

To conclude, participation in undergraduate research conferences provides an extra-curricular signature learning experience (Spronken-Smith, 2013), with the potential to develop multiple translation and enabling graduate attributes (Barrie, 2004) and self-authorship (Baxter Magolda, 2004). Delivering graduate attributes within and outside of the curriculum, and encouraging reflection on and articulation of these attributes via developmental portfolios, can enhance the student learning experience in GEES disciplines and beyond. Students possessing such skills, knowledge and dispositions are enabled to go beyond the confines of the familiar knowledge bases of their disciplines to apply themselves productively to whatever they encounter in the dynamic, uncertain and insecure world beyond education (Barnett, 2000; Harvey, 2000).

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Table 1 Profiles of the sampled undergraduate researchers

Year and location of BCUR (number of student interviews)	Poster or paper	Discipline	Research type	Gender
2012 Warwick (n=5)	3 poster, 2 paper	5 geography	4 dissertations 1 summer project	4 female, 1 male
2013 Plymouth (n=4)	2 poster, 2 paper	4 geography	4 dissertations	2 female, 2 male
2014 Nottingham (n=13)	5 poster, 8 paper	5 geography 3 environmental science 2 geology 3 environmental/wildlife conservation	12 dissertations 1 extra-curricular work	6 female, 7 male

Table 2 Student quotes highlighting repurposing of presentation and poster content for BCUR

Type of repurposing	Example quotations
<p>a) Summarising content (n=20)</p>	<p>‘it was quite hard to get your 8,000 word dissertation into a ten minute presentation ... it’s a skill in its own way, condensing it down and ... putting the main points across to people that have never probably even heard of what you’ve been doing’ R1</p> <p>‘you have to be really selective ... I decided that I would much rather talk a bit more than have too much information on the poster’ R11</p> <p>‘the dissertation’s quite a specific piece of research but you come here to a general conference and it’s quite hard to kind of communicate concisely what the problem is, what the solution to the problem is, but also how you get there in a way that everyone can appreciate and understand. It was really difficult to tick all three of those boxes’ R12</p> <p>‘I found after doing a dissertation, condensing 16,000 words onto a side of A1 was quite challenging, but also I think it really makes you own your research, because you can’t abbreviate that much without really having a firm understanding of what you’re talking about’ R18</p>
<p>b) Organising a global structure (n=13)</p>	<p>‘It was a case of, er, going back through my ... reading and then breaking it down into kind of more bite-size chunks and making what I’d written more accessible for a wide audience’ R6</p> <p>‘how to set out a proper presentation, where to include things, where not to ... laying it out’ R8</p> <p>‘seeing Rebecca’s presentation ... I learned that I had to discuss the outline, just structure it a little’ R10</p> <p>‘it wasn’t very well structured maybe in terms of story, but I did it so I could be stood next to it and explain it and if people are walking around and looking at it, I hoped that they would have questions about it to ask me’ R13</p>
<p>c) Clarifying GEES-specific terminology (n=13)</p>	<p>‘In the geography department, because we’re all doing the same discipline, you can talk in the same way and they understand but it’s quite difficult to speak to say a medical student or someone from English because they don’t understand the specific terminologies’ R7</p> <p>‘I had to simplify quite a lot because a lot of the people here don’t know anything about what I presented on ... it was interesting to see how to communicate science on a more understandable level for the public, rather than other scientists’ R15</p> <p>‘a lot of people were really interested in mine because it wasn’t so technical and I think I explained the technical themes quite well ... it’s one thing kind of doing the research, you have to make it accessible’ R21</p> <p>‘this was presenting to people with a wider range of topics and I think it was quite important to make sure that I didn’t use jargon and hide behind long words that people might not understand’ R22</p>

Table 3 Student quotes highlighting a desire to disseminate their research

Example quotations
<p>'coming here and presenting is a lot better than just kind of writing your dissertation and it being put in a cupboard for how many years. So I feel making it public is worthwhile ... you can feel like oh well it's being heard by other people, not just you and your supervisor' R1</p>
<p>'I don't think science is there just to have ... I think so much work gets done at an undergraduate level which could really help PhD research, academics' research ... It's a way of helping others in their own developments' R15</p>
<p>'I want a platform to showcase my ideas ... because hopefully someone will see it that wants to work on it with me ... That's really enjoyable and really rewarding to give something back, just to be like yeah we're changing stuff' R18</p>
<p>'I think that there's no point in doing research if you're not going to tell people about it ... my research - if it's kind of stuck in one person's mind or changed the way that one person views rainwater harvesting and household water security then that's a really positive thing' R21</p>

Table 4 Student quotes highlighting self-regulation through BCUR participation

Type of self-regulation	Example quotations
<p>a) Rehearsal and amendment (n=14)</p>	<p>‘I practiced on my family and a couple of friends and they ... showed me some areas where I could maybe just explain it more ... I made them ask questions [laughs] just so that I knew that they understood’ R10</p> <p>‘I don’t think I’ve ever really practised a presentation this much to try and get it fluent and know exactly what I’m saying for each point’ R14</p> <p>‘I had mine looked at [by academic staff] in terms of feedback and I completely changed the organisation of it after the first time because it became apparent it was too busy’ R19</p> <p>‘I did about three or four trial runs in front of people and I also did them on my own in my head. We had practise sessions with a couple of tutors, which gave feedback’ R20</p>
<p>b) Peer benchmarking (n=12)</p>	<p>‘it was good to see people’s feedback ... there’s still changes to be made - there’s the questions to answer that people brought up that I might not have thought of’ R8</p> <p>‘Learning what not to do, and what to. When you watch someone’s presentation ... if they have a piece of paper and they’re just reading off it then you fall asleep, even if it’s a subject you’re maybe interested in ... that sort of thing is learning from others I suppose’ R9</p> <p>‘definitely I learnt things by going to the other presentations ... you see people's mistakes so you think well if I am going to do a presentation I'm not going to do that’ R18</p> <p>‘watching other people's presentations ... and seeing maybe ones that weren't so good kind of helped because it let you reflect on how you were going to present yours’ R20</p>
<p>c) Learning from peer dialogue (n=13)</p>	<p>‘it’s just good ... people asking questions that my supervisor never asked, and it’s stuff that I can take away and if I ever took it further I can research more into it’ R8</p> <p>‘you can be asked 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. There’s a difference between that and being in a classroom because it’s more of a controlled environment’ R19</p> <p>‘the posters were really interesting because you got to have quite long conversations with people and so there were a number of times I would be like, could you explain your poster to me? And they’d stand there and explain it for ten minutes and I’d say, well, what about this? And they were just oh, I never thought of that, so the importance of different opinions ... will allow you to be able to attack or solve your problems in a different way’ R21</p> <p>‘I understand something when people come and ask me lots of questions about it and then I have to re-explain it. I find it really clarifies things in my own head - it’s one of the ways I learn best’ R21</p>

Table 5 Student quotes highlighting self-expression, free from assessment, at BCUR

Example quotations
<p>'I think here you're [presenting] for a completely different reason compared to university. At university you're doing it with the mindset that you're going to be marked and you have to meet all these different criteria, whereas here it's more for the enjoyment and because you want to do it - it's your own piece of research, you feel proud of that and you want to express it ... I learnt a lot more about myself as a person' R1</p>
<p>'you don't really have the same sense of pressure here. Obviously you want to do well but it's just for yourself rather than, you know, to get a good grade. When you go into the workplace you won't have the same sense of 'oh I've got to get a first, got to get a 2:1'. You need to just deliver to a high standard' R19</p>
<p>'I think going through the process from doing your research to presenting it is the missing link at university when you're a student because you just do your work and get your mark back and then you never look at it again ... Here there's the cycle of doing your research, you get your work back and then you can reflect on it and represent it' R19</p>
<p>'with this you're presenting something that you've done ... your own work. With this you're not being ticked off as you do things. You have to give a good presentation, the whole thing has to be good and you have to try and get people interested' R22</p>

Table 6 Student quotes highlighting development of professional understanding through participation in BCUR

Type of understanding	Example quotations
<p>a) Multiple perspectives on research (n=12)</p>	<p>‘I’ve learnt maybe that what I’ve written and what I presented is kind of – well in a way it’s been my view and my twist on it, whereas when I’ve been asked questions on it other people have had their own views and it’s kind of made me think oh right, well there’s a wider perspective of this sort of research that can be looked at further’ R1</p> <p>‘you’re understanding other people’s points of view as well because some people ... I might not see their way, I might not see their passion but understanding their passion is important’ R8</p> <p>‘I think as an earth scientist you kind of spend the whole time studying the earth but actually there’s a world out there as well as the earth that’s full of people researching their own things’ R8</p>
<p>b) Holistic thinking across disciplines (n=9)</p>	<p>‘[I have learnt] ways that I could mix my discipline of geography with a different discipline like marine biology. I would be quite interested in doing that’ R7</p> <p>‘It’s important to raise the profile of science I think in general ... you want to get it out to other researchers so they’re aware of what you’re doing and their research can build upon what you’ve done’ R9</p> <p>‘it’s been really interesting to understand how different disciplines perform research and how really every other subject - almost interplays with each other ... you kind of realise actually what you’re doing is just a subset of a higher scientific framework. That brings a more holistic approach to the whole research idea’ R12</p>

Figure 1 The graduate attribute model of Barrie (2004) adopted in this study. The overarching enabling graduate attributes of scholarship, global citizenship and lifelong learning skirt the triangle. The clusters of translation graduate attributes form the jigsaw pieces in the triangle.