Future physician-scientists: let's catch them young! unravelling the role of motivation for research

Ommering, B.W.C.

11

How does engaging in authentic research at undergraduate level contribute to student wellbeing?

Helen Walkington & Belinda W.C. Ommering
(shared first authorship)

Submitted

Abstract

In the context of rapidly growing numbers of university students reporting that they have experienced mental health problems, this paper argues that doing research as an undergraduate can contribute to student wellbeing. We propose authenticity as a conceptual lens against which to situate student capabilities for wellbeing. The paper explores the way in which research-based learning accesses intrinsic motivation, then looks at a means of fostering authenticity through a framework of competence, autonomy, and relatedness. We argue that a sense of belonging and perceived personal competence are among the many beneficial outcomes of an authentic undergraduate research experience. A research-based learning experience provides opportunities to develop close working relationships with faculty members, and to identify as a researcher, as well as access to inclusive and productive learning spaces. Specific curriculum design approaches and faculty practices to avoid student isolation, overwhelming autonomy or conversely excessive faculty control and sub-optimal levels of challenge are outlined. With case studies drawn from Medicine and Geography, we demonstrate how authentic research-based learning can form an entitlement for all students in an embedded curriculum-based approach. The exemplars are used to tease out broader curriculum design principles and effective pedagogic practice. The paper advocates for research-based learning to begin early in the undergraduate curriculum, in order to establish a sense of belonging for students and healthy learner-centred pedagogy. We conclude that developing nurturing and inclusive learning spaces and the cultivation of high-quality relationships between staff and students are often unrecognised aspects of student wellbeing.

Introduction

Student wellbeing - a growing concern

Mental health issues affect a large proportion of the general population over the course of their life. The 'Health Survey for England 2014' showed 26% of all adults reported having ever been diagnosed with at least one mental illness and a further 18% reported having experienced a mental illness without a formal diagnosis.[1] Higher Education has seen rapidly growing numbers of university students reporting that they have experienced mental health problems in what has been described as a 'campus mental health crisis'.[1,2] In 2015 and 2016, over 15,000 first-year students in UK universities reported that they had a mental health problem, compared to approximately 3,000 in 2006.[3] Lipson et al. (2016) revealed significant disciplinary differences in wellbeing statistics across 48,667 university and college undergraduates in the USA.[4] Undergraduate prevalence rates (at least one mental health problem) ranged from 28% in Public Health rising to 45% in Art and Design. Treatment rates also varied widely from the lowest at 25% in Engineering to the highest rate of 50% in Social Work. Furthermore, a systematic review and meta-analysis of 183 studies in over 40 countries, specifically amongst medical students, showed a prevalence of depressive symptoms of 27.2%.[5] Regardless of discipline, marginalised students are at greatest risk of low levels of wellbeing, with disabled students more than any other group being at highest risk.[6] Feelings of belonging and self-efficacy are essential for wellbeing, therefore relative student attainment can also translate into feelings of belonging or conversely, marginalisation. Persistent attainment gaps across higher education highlight underserved populations, and challenge educational providers to offer inclusive spaces for learning and inclusive pedagogy.[7]

When students were asked to explore wellbeing solutions in focus groups, these included opportunities for: mentoring and networking; finding social spaces; and developing nurturing social environments, and significantly students wanted to have a voice in developing these opportunities.[6] We therefore argue that *learning spaces* as well as the *nature of staff-student and student-student relationships*, are important in creating a healthy learning environment for all. This paper argues that a sense of belonging and perceived personal competence are among the many beneficial outcomes of an authentic undergraduate research experience (particularly a mentored one). A research-based learning experience provides opportunities to develop close working relationships with faculty members, and to identify as a researcher, as well

as access to inclusive and productive learning spaces. Hence, an undergraduate research experience can comply with the need to create learning spaces and support staff-student and student-student relationships in such a way that a healthy learning environment is created and, as a result, wellbeing is enhanced.

Learning spaces

Self-authorship is the ability to know oneself, to know what one knows, to reflect upon it and to base judgements on it.[8] This includes an individual's sense of who they are, what they believe, and their construction of relationships. It is highly applicable to research-based learning where the nature of knowledge is questioned critically through engagement in doing research and communicating research findings. Self-authorship has been linked to borderland learning spaces, those places where learners can develop mature working relationships, embrace and value diversity, and give consideration to multiple perspectives.[9] These spaces are conceived of as unfamiliar physical or metaphorical territories whose novelty and ambiguity offer a challenge, which can seem daunting to students and faculty.[9] For undergraduate researchers this novelty may include the field of data collection, data analysis (e.g. statistics), academic conferences, online journals, or even just doing research or being mentored, where these are unfamiliar pedagogic approaches (albeit sometimes delivered in familiar spaces). According to Bandura's Social Cognitive Theory, these daunting and ambiguous activities pre-eminently accommodate opportunities to increase self-efficacy beliefs through fostering success experiences, in turn contributing to feelings of wellbeing.[10]

Learning spaces dedicated to discuss research with others (faculty and other student researchers), include undergraduate research conferences,[9,11-13] as well as spaces for virtual dialogue, e.g. online journals.[14-16] Engaging in dialogue with other student researchers can lead to a reciprocal and elucidatory student-led pedagogy.[13] Pavlakou and Walkington (2018) elicited surprising responses from students in relation to their experience of a multidisciplinary institutional undergraduate research conference.[17] Students reported that they felt a sense of isolation within their discipline, but during the institution-wide conference were able to break away from the 'bubble' of their discipline and feel part of the wider academic community. A sense of belonging to the institution was also created due to the multidisciplinary nature of the event. Interestingly in terms of space, it was a 'pop up' event in a familiar social space in the centre of the campus, and fully open to the public. Such borderland learning spaces

can be transformatory, with students experiencing a liminal state which can result in an identity change from student to researcher. Barr (2017), writing about a student-run Games Studies journal, noted that the journal's Facebook group has nearly 400 members and beyond developing 'video game scholarship' (including academics citing student research), provides a sense of community, with the most valued aspect of the journal being students learning from peer feedback.[16]

Nature of staff-student and student-student relationships

An undergraduate research experience specifically offers possibilities to develop and support close working relationships with both faculty members as well as peer-researchers. These close working relationships contribute to feelings of being part of a community. According to Chang and Ramnanan (2015) undergraduate research experiences not only benefit research specific skills, but interpersonal skills as well.[18] Their systematic review revealed that interaction with faculty is an important motivating factor and a paucity of mentors or faculty guidance was labelled as demotivating. In line with this, Möller et al. (2015) identified 'independence and collaboration' as one category of salient learning outcomes related to personal development.[19] Furthermore, undergraduate research has been shown to offer particular gains for students from underserved populations,[20,21] with mentoring accounting for the leveraging effect of research as a transformatory experience for students. Therefore, understanding what makes for effective mentoring has become a focus of recent research.[22-24] In short, effectively mentored research experiences can benefit student wellbeing through motivating students and supporting transformatory experiences (e.g. developing a researcher identity and evolving into a research producer instead of consumer). Associated with this, the mentoring of undergraduate researchers can also benefit staff in terms of academic identity and career development.[25]

An undergraduate research experience has multiple beneficial outcomes for a diversity of students,[26-28] underlining the need for experiences to be embedded in the curriculum to reach all students. Yet students most often experience research late in their undergraduate education, for instance first starting by learning about research (the 'research informed' teaching of Healey and Jenkins),[29] and only engage in 'research-based' learning in later years as part of a final year or capstone project. Walkington et al. (2011) and Ommering et al. (2020) called for research-based experiences to be embedded much earlier in undergraduate curricula, while acknowledging that framing inquiry, the first step in the research process, is one of

the most challenging to teach.[30,31] In first year courses, Levy and Petrulis (2012) noted that when students were offered opportunities to frame lines of inquiry and build knowledge themselves, they found this empowering for their intellectual and personal development, but faculty support was necessary.[32] According to Thiry and Laursen (2011) undergraduate research mentors offer three forms of support to students: support for intellectual development, for personal and emotional development, and for professional socialisation.[33]

This paper now explores the way in which student capabilities for wellbeing can be enhanced through engaging in research, using authenticity as a conceptual lens. It begins with the way in which research-based learning accesses intrinsic motivation, then looks at a means of fostering authenticity through a framework of competence, autonomy, and relatedness. Exemplars from medical and geographical education are offered to tease out broader curriculum design principles and effective pedagogic practice to maximise opportunities for student wellbeing through research-based learning.

Theoretical framework

Self-Determination Theory (SDT), developed by Ryan and Deci, is an empirically based theory of human behaviour and personality development. SDT addresses social conditions that aid or obstruct human flourishing, examining how inherent human capabilities for engagement and wellbeing can either be enhanced or undermined. Contrary to other motivational theories, SDT states that the presence of motivation (i.e. quantity of motivation) is not sufficient in order to support human flourishing and feelings of wellbeing. Rather, SDT focuses on the *quality* of motivation, suggesting that some forms of motivation are completely volitional, while other forms are entirely external. A central distinction in SDT is intrinsic versus extrinsic motivation. Intrinsic motivation can be defined as pursuing an activity out of pure interest, benefiting personal feelings of enjoyment. Extrinsic motivation entails pursuing an activity for externally located consequences, like an external reward or social approval. According to SDT, intrinsic motivation can foster academic performance, deep learning, and wellbeing.[34]

SDT suggests that satisfaction of three basic psychological needs is imperative in order to elicit and sustain intrinsic motivation, which in turn leads to feelings of wellbeing. First is the need for autonomy, defined as the need to self-regulate experiences and

actions. Autonomy relates to feeling volitional and self-endorsed, compatible with one's own authentic interests and values. Second is the need for competence, or the need for feelings of mastery and efficacy in navigating within relevant contexts. Third is the need for relatedness, concerning the need to feel socially connected with and cared for by others. However, equally important is to feel significant among and contribute to other people. Beyond the individual, relatedness pertains to being part of social organizations, resulting in feelings of belonging.[34,35] This aligns with much SDT driven research which has shown that educational contexts in which autonomy is supported, structure is provided to aid competence, and relatedness is pursued, foster personal wellbeing.[34,36]

From an SDT perspective, intrinsic motivation to learn can evolve from autonomy, competence, and relatedness, as experienced through engaging in research. Consequently, a valuable avenue for enhancing student wellbeing emerges where this can be embedded in the curriculum for every student. However, in order to flourish, all three psychological needs must be satisfied.[34,35] Feelings of autonomy can be promoted by giving students the freedom to make significant choices within their research project, offering chances to self-regulate the research experience, enhancing compatibility with authentic interests and values. Furthermore, students can be stimulated to take a leading role in carrying out research, adding to feelings of volition and self-endorsement.[31] However, within undergraduate education, most students are encountering research experiences for the first time. This implies that, complementary to autonomy support, competence support should be pursued as well. Specifically, mentoring is of great value for stimulating students to feel effective in navigating the difficult research landscape. While cooperating with students, mentors could create the right environment by setting achievable targets and formulating clear research goals.[24] Furthermore, while the student conducts research autonomously, a mentor can closely monitor progress and offer support when needed.[31] Hereby, the mentor provides social guidance as well, contributing to students' feelings of being cared for by others, one part of the need for relatedness. In order to fully establish relatedness, students need to feel that they are significant members of the research endeavour, so a sense of community can be established in which the students are involved.[22,24] In sum, students' wellbeing can be enhanced through their intrinsic motivation to learn by shaping undergraduate research experiences in such ways that students are given the opportunity to self-regulate their research experience, while being supported and socially guided by a mentor and within a research community.

In their perspective on authenticity within undergraduate research experiences, Wald and Harland (2017, 758) state that "the authentic model of teaching through research should promote students' *sense of ownership over the research, which is achieved by entrusting them with the responsibility for the work and care for their peers*, *while teachers provide expert support*".[37] Here, the sense of ownership over the research and responsibility for the work is an illustration of what distinguishes a research-based learning curriculum from a research-informed curriculum. That is, in order to support an identity shift from research consumer to research producer, students need to own and care about their research. Furthermore, when looking at this statement through the lens of SDT, similarities can be identified with the three psychological needs. Promoting students' sense of ownership and entrusting them with responsibilities is in accordance with the need for autonomy, while the responsibility to care for peers strengthens feelings of social connectedness and of being significant contributors within the research community, which is similar to the need for relatedness. Lastly, teachers providing expert support is in line with the need for competence. For instance by setting appropriate performance expectations, offering students constructive feedback and working towards a public demonstration of competence - all of which were identified by Kuh and O'Donnell (2013) as elements of high impact practices to achieve successful outcomes for undergraduate students - teachers, or mentors, can promote feelings of mastery and efficacy among students.[38] Hence, the psychological needs could be viewed as conditions that foster authenticity as well.

Authenticity in research-based learning – a framework

Wald and Harland (2017) proposed a theoretically-informed and practice-oriented framework for authenticity in the context of research-based learning.[37] Three ways to understand authenticity were identified: 1) authenticity as relating to the real world, 2) the existential authentic self, and 3) a degree of meaning.

The most popular and commonly used perspective connecting authenticity with research-based learning is *authenticity as relating to the real world*, referring to learning that mirrors the real world. It differs from traditional courses as it aligns with how actual scientists do their work and proposes that students should experience how knowledge is produced and utilised in real life, preparing them for future professional practice. Hence, it relates to John Dewey's vision of learning-by-doing.[39]

The second way to understand authenticity in undergraduate research experiences, is that of *the existential authentic self*. It relates to developing a sense of self and self-identity, where the idea of 'ownership' is crucial to becoming an independent learner. Furthermore, it encompasses being true to one's self, both ideas encapsulated in the 'self-authorship' concept.[8] A pivotal point herein with regard to the teacher-student relationship is that teachers and students learn in dialogue and share responsibilities for mutual growth.

The third explanation of authenticity relates to *a degree of meaning*, which is a requirement for perceiving something as authentic. It relates to fostering personal meaning within the learning experience, which is best accomplished by engaging students in their own quest for knowledge. What is regarded as being meaningful depends on what students, personally, deem important or valuable. This sense of personal meaning is, however, created between and shared with others, as students are part of a wider community.

Case studies

The two vignettes below offer insights into how real-world, authentic self, and degree of meaning contribute to authenticity in research experiences, one is within medical education, the other in geography. Both vignettes provide accounts of curriculum embedded experiences early in the undergraduate curriculum and demonstrate the importance of ownership by the student and their own sense of responsibility for both the research and its dissemination, thus completing the research cycle.

Vignette 1: Leiden University Medical Center – Individual clinical research arising from patient bedside experiences

Connecting research with clinical practice is pivotal to involve scientific knowledge in clinical decision making and make advancements within medicine.[40] Subsequently, 'scholar' is one of the roles a medical graduate should master.[41] Leiden University Medical Center implemented a mandatory research course for all first-year medical students to conduct clinical research. Every student individually conducts a small research project, being involved in gathering and processing patient data (i.e. each student collects detailed data from three patients, combining their data into a large shared dataset), formulating an individual research question, analysing data, writing a research report, and presenting their research to a critical audience in a simulated conference setting. As students are engaged in every step of the research process and

gather data from real patients, it mirrors how clinician-scientists perform research in professional practice. Students are mentored by a researcher (e.g. clinician, academic, PhD candidate), but are free to formulate their own research question and have a leading role in the implementation of their research. Hence, the experience aligns with authentic interests, and feelings of responsibility and ownership are supported. Furthermore, by offering students the possibility to formulate their research question 'at the bedside of the patient' (i.e. based on personal experiences within an internship in a nursing home), the research project is deemed personally meaningful.

Vignette 2: Oxford Brookes University Geography – Peer-mentored international research-based learning in the field

Fieldwork is a signature pedagogy for the discipline of geography and field-based research forms an important element of a geography degree.[42] In the three-year undergraduate honours degree in Geography at Oxford Brookes University (UK) students undertake a group research investigation which runs throughout the second year. Students work as a small team to design their research in semester 1, collect primary data on international residential fieldwork in the inter-semester break, then return in semester 2 to analyse data and complete individual written reports. Students are supported through all phases of the research cycle[14,43] by a year 3 student peer-mentor and a faculty mentor.[44] The investigation not only takes place in the real-world but also mirrors being an academic or professional geographer, including the option to publish the results in a journal article for a public audience. The students take part in 'self-authoring,' understanding their own opinions and values as well as eliciting research findings as part of engaging in the research. This combines personally meaningful learning with a strong degree of autonomy.

These vignettes highlight how two disciplines have embedded research opportunities for every student on a programme. However, simply instructing students to go and do real–world research is insufficient to ensure successful outcomes. Students could easily feel overwhelmed or isolated if the curriculum architecture and faculty support are not in place to ensure positive learning experiences for everyone. The examples showed how there was the potential for student research to 'make a difference' in multiple authentic ways: for instance to wider society, or within the scientific project, both of which can promote feelings of care among students, as well as benefiting personal intellectual growth. Next, we outline curriculum design features and salient practices

for inclusive and high quality mentored undergraduate research experiences using Wald and Harland's framework for authenticity.

The design and practice of research-based learning for authenticity

Through extensive empirical study, Kuh and O'Donnell (2013) have distilled the common features or 'elements' of high impact practices from Higher Education settings which translate into successful outcomes for students at undergraduate level.[38] Providing all students with opportunities to access these elements may be challenging and costly, yet they also have the potential to enhance wellbeing through increasing motivation and attainment. Research-based learning, particularly an early experience of research, is eminently placed to foster many of these elements where curriculum design and mentoring are mutually supportive. Ommering et al. (2020) proposed twelve tips to design a research course embedded within large scale education, while still allowing every student to conduct research individually.[31] In order to ensure successful outcomes, effective mentoring is needed and Shanahan et al. (2015) identified ten salient practices (SP) for effective research mentoring.[22] This section explores the way in which curriculum design and mentoring practices can enhance authenticity, and therefore wellbeing, in research–based learning.

Real-world research

Learning-by-doing, which is seen as an effective way to enhance skills and capabilities among students,[45] is a key objective when offering an experiential opportunity within the core curriculum. Passive learning approaches are believed to diminish curiosity,[30,46] corroborating the need for active learning approaches, as curiosity is identified as a prerequisite for motivation.[47,48] Curiosity is especially provoked within the context of real-world problems, elucidating emotion. Thus, in order to trigger curiosity, truly raise motivation, and ultimately promote student wellbeing, learning should mirror the real world.[49] A successful research-based learning approach within the curriculum should use relevant real-world examples to stimulate curiosity (tip 4) and engage students in every stage of the scientific research process (tip 1). In this way, students become acquainted with how actual scientists do their work and a shift from research consumer to research producer can be established. Here, the mentor plays an important role. Teaching the technical skills, methods, and techniques of conducting research in the discipline (SP3), is often seen as the primary responsibility

of a research mentor, particularly relating to ethical and professional practice, but it also affords an opportunity to ensure that research skills match students' aspirations and are personalised as far as possible. This enables students to feel a connection to their discipline (relatedness) through research that interests them and is of wider relevance as a means to contribute to their wellbeing. Creating opportunities for peers and near-peers to mentor each other (SP9) can broaden scholarly opportunities so that students not only see the relevance of their own real-world research but also learn how their discipline is created through the research endeavours of others, and they can contribute in mutually supportive ways. As dissemination of scientific work is the last step within the research process, students should be encouraged and supported to share findings (SP10) by writing a professional academic piece (tip 10), presenting orally (tip 11), and receiving feedback (tip 12) from their mentor. This practice, also reflected in Kuh and O'Donnell's (2013) 'Public demonstration of Competence' element,[38] offers students opportunities to publicly demonstrate new knowledge and skills, which fosters wellbeing through need-satisfaction and motivation.

Existential authenticity through research

For research-based learning to be authentic, students need to *become* researchers.[50] Emerging researcher-identities should be fostered and need to align with a student's own values. This relates to the definition of authenticity by Ryan and Deci (2017), who emphasized that one's behaviour needs to be endorsed by the self.[34] An embedded research course should therefore foster the existential authentic self, especially if the aim is to enhance motivation and subsequently wellbeing. By providing research experiences in large group sessions (tip 6), possibilities are created to reach all groups of students, offering them a solid research-related foundation. Subsequently, smaller group sessions can be used to help students develop more in-depth research knowledge and immerse themselves in research, which contributes to developing a researcher-identity and feelings of becoming a researcher. Furthermore, smaller group sessions allow for hands-on one-to-one mentoring (SP6). Often, mentors are researchers themselves, who can become inspiring role models for students. Using inspiring researchers as teachers of small group sessions (tip 8) enhances positive perceptions of, and motivation for, research among students. It also provides students with a real-world image of a researcher to serve as an example. Becoming a researcher can be an uncomfortable existential leap from being 'just a student',[11] and is strongly associated with identity development and therefore wellbeing status. Students who identify as researchers and even 'mini professionals' as a result of engaging in

research, have been through a challenging process, yet have proven their resilience and this has contributed to a sense of self-efficacy. One of the most fundamental roles of an academic research mentor, therefore, is balancing high expectations and an appropriate sense of challenge with a safety net of support in line with students' need for competence and relatedness.[24] As Ryan and Deci stated (2017, 11) competence "wanes in contexts in which challenges are too difficult, negative feedback is pervasive, or feelings of mastery and effectiveness are diminished or undermined by interpersonal factors such as person-focused criticism and social comparisons".[34] Achieving the balance between giving students freedom and taking too much control of the research is something that takes time to develop and involves good knowledge of, and interest in, individual undergraduates (SP4) who are novice researchers. While it is important to stretch students by providing a sense of challenge,[24] it is also important to provide a scaffolded support structure (tip 7) so that students can build their confidence against an authentic sense of potential for failure in their research project. Academic mentors therefore need to respond to students' varying needs and abilities (SP1) throughout the research process as these may differ between individuals and throughout the research process. Setting clear expectations (SP2) is important, and ensuring that these are progressively raised is something that can only come with hands-on mentoring (SP6). According to Wald and Harland's framework, a pivotal perspective regarding the existential authentic self is that mentors and students learn in dialogue, sharing responsibilities for mutual growth.[37] Existential authenticity in research can therefore be supported through professional socialisation support, personal and emotional support, and intellectual support.[33] This can also contribute to faculty identity development and the wellbeing associated with developing effective mentoring practice.[25]

Personal meaning

In order to perceive an activity as authentic, it needs to have personal meaning or relevance. A requirement to promote deep learning is that students should experience relevance within a real-world environment.[49] Stimulating students to collect real-world data to answer relevant research questions (tip 2) explicitly connects research to practice, which is related to increased feelings of meaning and motivation. Furthermore, students should be given autonomy in conducting their own research project (tip 5). This could be established by granting students responsibilities regarding the implementation of the research project, mentoring students so they can take progressively greater ownership as the project proceeds (SP7). In this way,

students are leading their own quest for knowledge, which plays a significant role in perceiving an activity as meaningful and developing a researcher-identity. The professionalisation of this identity can be enhanced through networking with others e.g. other faculty members, or faculty beyond the university. Mentoring students in the ways they act in professional spaces can be a means of introducing them further to the norms of their discipline (SP8). Moreover, personal meaning is also created between, and shared with others, reflecting the importance of feelings of belongingness and feeling part of a community (i.e. students' need for relatedness). Distributing data collection across all students (tip 3) therefore not only helps to make an embedded research course feasible, but also contributes to feelings of social interdependence among students.[51] A sense of ownership also sustains student engagement with their studies, discipline, and even institution. Students who have presented their disciplinary research in multidisciplinary fora have reported a sense of wellbeing from connecting to those beyond their discipline akin to 'removing blinkers'.[13] This sense of being part of a community that can contribute to knowledge creation is a powerful means to create wellbeing as it relates to connectedness, altruism, a healthy work ethic, and clear sense of purpose. In disciplines where research is team based, as is often the case early in degree programmes, building a sense of community among the research team (SP5) is highly effective, although perhaps one of the most difficult practices to enact in some disciplines, hence the need to create fora for sharing, such a conferences and dedicated student journals. Socially connecting students could be strengthened by implementing peer discussion within the research course (tip 9). Moreover, by giving students possibilities to guide each other and stimulate peer discussion, deep learning is enhanced.[22] In this way, a platform is created in which students help each other, which stimulates the need for relatedness. Lastly, by seeing a peer or near-peer succeed in the same complex task, students' self-efficacy beliefs will be enhanced as well, which is related to higher levels of motivation and wellbeing.[10] Taken together, these strategies help to foster authenticity by increasing the degree of meaning, while also stimulating feelings of relatedness to contribute to students' feelings of wellbeing.

Discussion

This paper has demonstrated how authenticity within research-based learning can be embedded in the curriculum and made available to all students. Active engagement

in research can move students away from adopting a research 'consumer' identity, with higher student-as-consumer orientation at undergraduate level being associated with lower academic performance.[52] Instead a student-as-producer identity, where social learning takes place, can be transformatory,[53] giving students agency and voice. Together the students experience research as it is undertaken by professionals in their discipline, combining a curriculum requirement with an authentic question and output. Both vignettes offered a complete research cycle within a module, ending in authentic research dissemination and outlined authentic research-based learning early in the undergraduate experience. The spaces created for this sharing of research are dialogic, allowing for refinement and reworking in dialogue with academics, peers or near-peers (e.g. postgraduates). The settings are deliberately high stakes and professional, where students can begin to experience an evolving researcher identity and sense of achievement. The research environment is fully collaborative, every individual's data matters to the wider project, and this is important in ensuring inclusivity and avoiding the sense of isolation that individual study could create. The paper has shown how good curriculum design is essential[31] but, in addition, effective mentoring practices[22,24] ensure that all students can achieve positive experiences of the curriculum in a personalised support structure which safeguards wellbeing as students engage with research.

Striving towards a student transition from research consumer to research producer not only makes an undergraduate research experience authentic, it also contributes to need-satisfaction and ultimately wellbeing. That is, within learning spaces that support beneficial staff-student and student-student relationships, wellbeing can be supported through enhancing feelings of autonomy, competence, and relatedness among students. These psychological needs provide the conditions to foster authenticity, but also strengthen inclusive and nurturing environments in higher education in which students can develop their sense of personal fulfilment. Feelings of belonging and self-efficacy can be developed and reinforced in spaces which are continually enriched through authentic participation.

In adopting an authenticity framework this paper has argued for a research-based learning experience for all students in an environment supported by experts to develop ownership, responsibility, and care for peers which contributes to student wellbeing. An important distinction exists between students carrying out research in a group or social setting and the ingredients needed for authentic co-production.

In the latter case, learning by doing research is coupled with reciprocal learning through dialogue with other researchers (peer researchers, near-peer researchers or in research mentoring relationships). In this way, Habermas' 'ideal speech act',[54] where the power differential of teacher and learner is replaced with communication as co-producers, links to the importance of students learning together and from each other in supportive and inclusive learning spaces. The learning spaces, whether real, virtual or imagined are also important from a wellbeing perspective, as they can help to avoid learner isolation, give room to open up dialogue and provide opportunities for students to be truly active in research, guided by curiosity, connecting to others around them and thereby to developing their skills in lifelong learning. This research suggests that in addition to the existing framework for authenticity, further attention should be paid to the quality of learning spaces (novelty, professionalism, inclusivity) and the practice based elements for effective relationships between learners and teachers such as mentoring to ensure the wellbeing of all involved.

References

1. Guthrie S, Lichten CA, van Belle J, Ball S, Knack A, Hofman J. *Understanding mental health in the research environment: A Rapid Evidence Assessment.* Santa Monica, CA: RAND Corporation; 2017.
2. Schwartz V, Kay J. The crisis in college and university mental health. *Psychiatric Times.* 2009;26(10):32.
3. Research IfPP. Not by degrees: improving student mental health in the UK's universities. 2017; Available at https://www.ippr.org/research/publications/not-by-degrees Accessed 12/05, 2020.
4. Lipson SK, Zhou SS, Wagner B, Beck K, Eisenberg D. Major Differences: Variations in Undergraduate and Graduate Student Mental Health and Treatment Utilization Across Academic Disciplines. *Journal of College Student Psychotherapy.* 2016;30(1):23-41.
5. Rotenstein LS, Ramos MA, Torre M, et al. Prevalence of Depression, Depressive Symptoms, and Suicidal Ideation Among Medical Students A Systematic Review and Meta-Analysis. *Jama.* 2016;316(21):2214-2236.
6. Oman S. Student Experience Survey 2017: investigating well-being at university. 2017. Accessed 23 April 2020.
7. Tatlow P. Participation of BME students in UK Higher Education. In: Alexander C, Arday J, eds. *Aiming Higher: Race, Inequality and Diversity in the Academy.* London: Runnymede; 2015.
8. Baxter Magolda MB. Self-authorship as the common goal of 21 st century education. In: Baxter Magolda MB, King PM, eds. *Learning partnerships: Theory and models of practice to educate for self-authorship* Sterling, VA Stylus; 2004:1-35.
9. Hill J, Walkington H, Kneale PE. Borderland spaces for undergraduate teaching and learning in higher education. In: Bilham T, Hamshire C, Hartog M, Doolan M, eds. *Reframing Space for Learning: Empowering Innovation in University Teaching and Learning.* London: UCL IOE Press 2019.
10. Bandura A. *Self-Efficacy. The Exercise of Control.* New York: Freeman; 1997.
11. Hill J, Walkington H. Developing graduate attributes through participation in undergraduate research conferences. *Journal of Geography in Higher Education.* 2016;40(2):222-237.
12. Kneale P, Edwards-Jones A, Walkington H, Hill J. Evaluating undergraduate research conferences as vehicles for novice researcher development. *International Journal for Researcher Development.* 2016;7(2):159-177.
13. Walkington H, Hill J, Kneale PE. Reciprocal elucidation: a student-led pedagogy in multidisciplinary undergraduate research conferences. *Higher Education Research & Development.* 2017;36(2):416-429.
14. Walkington H. Geoverse: piloting a National e-journal of undergraduate research in Geography. *Planet.* 2008;20(1):41-46.
15. Walkington H. Developing Dialogic Learning Space: The Case of Online Undergraduate Research Journals. *Journal of Geography in Higher Education.* 2012;36(4):547-562.
16. Barr M. Press Start: the value of an online student-led, peer-reviewed game studies journal. *Research in Learning Technology.* 2017;25.
17. Pavlakou M, Walkington H. Multidisciplinary undergraduate conferences – A new pedagogy for student learning? 2018. Accessed 06/05/2020.
18. Chang YJ, Ramnanan CJ. A Review of Literature on Medical Students and Scholarly Research: Experiences, Attitudes, and Outcomes. *Academic Medicine.* 2015;90(8):1162-1173.
19. Moller R, Shoshan M, Heikkila K. What is the reward? Medical students' learning and personal development during a research project course. *Medical Education Online.* 2015;20.

20. Brownell JE, Swaner LE. *Five high-impact practices: Research on learning outcomes, completion, and quality.* Washington DC: Association of American Colleges and Universities 2010.
21. Finley A, McNair T. *Assessing Underserved Students' Engagement in High-Impact Practices.* Washington DC: Association of American Colleges and Universities 2013.
22. Shanahan JO, Ackley-Holbrook E, Hall E, Stewart K, Walkington H. Ten Salient Practices of Undergraduate Research Mentors: A Review of the Literature. *Mentor Tutor.* 2015;23(5):359-376.
23. Vandermaas-Peeler M, Miller PC, Moore JL. *Excellence in mentoring undergraduate research.* Washington DC: Council on Undergraduate Research; 2018.
24. Walkington H, Stewart KA, Hall EE, Ackley E, Shanahan JO. Salient practices of award-winning undergraduate research mentors - balancing freedom and control to achieve excellence. *Studies in Higher Education.* 2019.
25. Hall EE, Walkington H, Shanahan JO, Ackley E, Stewart KA. Mentor perspectives on the place of undergraduate research mentoring in academic identity and career development: an analysis of award winning mentors. *International Journal for Academic Development.* 2018;23(1):15-27.
26. Boyd MK, Wesemann JL. *Broadening Participation in Undergraduate Research: Fostering Excellence and Enhancing the Impact.* Washington DC: Council on Undergraduate Research; 2009.
27. Jones MT, Barlow AEL, Villarejo M. Importance of Undergraduate Research for Minority Persistence and Achievement in Biology. *Journal of Higher Education.* 2010;81(1):82-115.
28. Kendricks KD, Nedunuri KV, Arment AR. Minority student perceptions of the impact of mentoring to enhance academic performance in STEM disciplines. *Journal of STEM Education: Innovations & Research.* 2013;14:38.
29. Healey M, Jenkins A. *Developing undergraduate research and inquiry.* York: Higher Education Academy; 2009.
30. Walkington H, Griffin AL, Keys-Mathews L, et al. Embedding Research-Based Learning Early in the Undergraduate Geography Curriculum. *Journal of Geography in Higher Education.* 2011;35(3):315-330.
31. Ommering BWC, van Diepen M, van Blankenstein FM, de Jong PGM, Dekker FW. Twelve tips to offer a short authentic and experiential individual research opportunity to a large group of undergraduate students. *Medical Teacher.* 2020;42(10):1128-1133.
32. Levy P, Petrulis R. How do first-year university students experience inquiry and research, and what are the implications for the practice of inquiry-based learning? *Studies in Higher Education.* 2012;37(1):85-101.
33. Thiry H, Laursen SL. The Role of Student-Advisor Interactions in Apprenticing Undergraduate Researchers into a Scientific Community of Practice. *Journal of Science Education and Technology.* 2011;20(6):771-784.
34. Ryan RM, Deci EL. *Self-determination theory: Basic psychological needs in motivation, development, and wellness.* Guilford Publications; 2017.
35. Ryan RM, Deci EL. Self-determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being. *American Psychologist.* 2000;55(1):68-78.
36. Reeve J, Ryan RM, Deci EL, Jang H. Understanding and promoting autonomous self-regulation: A self-determination theory perspective. In: Schunk D, Zimmerman B, eds. *Motivation and self-regulated learning: Theory, research, and application.* Mahwah, NJ: Erlbaum; 2007:223-244.
37. Wald N, Harland T. A framework for authenticity in designing a research-based curriculum. *Teaching in Higher Education.* 2017;22(7):751-765.

38. Kuh GD, O'Donnell K. *Ensuring Quality & Taking High-impact Practices to Scale*. Washington D.C.: AAC&U, Association of American Colleges and Universities; 2013.
39. Dewey J. *Democracy and education*. Mineola, NY: Dover Publications, Inc. ; 2004.
40. Dekker FW. Science Education in Medical Curriculum: Teaching Science or Training Scientists? *Medical Science Educator*. 2011;21:258-260.
41. Richardson D, Oswald A, Lang E, Harvey B, Chan M-K. *The CanMEDS 2015 Scholar Expert Working Group Report*. Ottawa: The Royal College of Physicians and Surgeons of Canada;2014.
42. Shulman LS. Pedagogies of uncertainty. *Liberal Education*. 2005;91(2):18-25.
43. Spronken-Smith RA, Brodeur JJ, Kajaks T, et al. Completing the research cycle: A framework for promoting dissemination of undergraduate research and inquiry. *Teaching & Learning Inquiry*. 2013;1(2):105-118.
44. Satow C, Medby I, Walkington H, et al. Enhancing wellbeing through collaborative development of a digital, geographical research techniques guide. RGS Annual International conference; 2019; London.
45. Chickering AW, Gamson ZF. Seven principles for good practice in undergraduate education. *AAHE bulletin*. 1987;3:7.
46. Scheyvens R, Griffin AL, Jocoy CL, Liu Y, Bradford M. Experimenting with active learning in geography: Dispelling the myths that perpetuate resistance. *Journal of Geography in Higher Education*. 2008;32(1):51-69.
47. Willison J, O'Regan K. Commonly known, commonly not known, totally unknown: a framework for students becoming researchers. *Higher Education Research & Development*. 2007;26(4):393-409.
48. Amgad M, Man Kin Tsui M, Liptrott SJ, Shash E. Medical Student Research: An Integrated Mixed-Methods Systematic Review and Meta-Analysis. *PloS one*. 2015;10(6):e0127470.
49. Merrill MD. First principles of instruction. *Educational Technology Research and Development*. 2002;50(3):43-59.
50. Thiry H, Laursen SL, Hunter AB. What Experiences Help Students Become Scientists? A Comparative Study of Research and Other Sources of Personal and Professional Gains for STEM Undergraduates. *Journal of Higher Education*. 2011;82(4):357-+.
51. Johnson DW. Social interdependence: Interrelationships among theory, research, and practice. *American Psychologist*. 2003;58(11):934-945.
52. Bunce L, Baird A, Jones SE. The student-as-consumer approach in higher education and its effects on academic performance. *Studies in Higher Education*. 2017;42(11):1958-1978.
53. Neary M. Student as producer: a pedagogy for the avant-garde? *Learning Exchange*. 2010;1(1).
54. Boud D, Cohen R, Sampson J. Introduction: Making the move to peer learning. In: Boud D, Cohen R, Sampson J, eds. *Peer Learning in Higher Education: Learning From & With Each Other*. London: Kogan Page; 2002.