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Cotton, DRE

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Breaking boundaries: a model of student-led knowledge exchange for higher education

D.R.E. Cotton , S. Bloxham, S. Cooper , J Downey and M. Fornasiero 

Lifelong Health and Wellbeing Research Group and SCION Research Group, Plymouth Marjon University, Plymouth, UK

ABSTRACT

Knowledge exchange (KE) is increasingly important in higher education internationally, yet relatively little attention has been paid to it as a pedagogic opportunity for students. This paper draws on 26 interviews with stakeholders within and outside HE to develop a model of student-led knowledge exchange as a guide for learning through KE. The model includes the following elements: Preconditions, Prior Knowledge, Planning and Place, Pedagogic Context and Product, and offers an analysis of different forms of KE which occur between individuals in a learning triad consisting of student, facilitator and external participant. The research foregrounds a social view of learning where valid knowledge comes from diverse participants in the exchange, including students themselves. Students act as a catalyst for multi-directional KE – a finding which challenges the implied hierarchies evident in much of the literature on this topic. The model is offered as a starting point for developing a pedagogy of KE in higher education.

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Introduction

Knowledge exchange (KE) is increasingly important in higher education (HE) contexts internationally, as universities are asked to demonstrate their social and economic benefits in the wider world. Every year, millions of pounds are spent funding new research and yet more millions of research papers are produced and disseminated to the small group of academic researchers with the financial and intellectual resources to access them. University research has significant potential to influence policy and practice – but this can only happen if evidence is translated into usable resources which can be adopted and embedded by decision-makers and practitioners (Prihodova et al. 2019). An increasing focus on 'mode 2' knowledge production (Gibbons et al. 2010), which is interdisciplinary and cooperative, has led to an emphasis on approaches such as collaborative or participatory research (Balcazar et al. 2004; Fazey et al. 2014) as routes to KE. These practices focus on research collaboration among academics from different disciplines, alongside non-academic stakeholders, to address challenges and co-create solutions. Traditional approaches to research where researchers generate ideas for projects, define methods and interpret outcomes are reversed, and the community is empowered to shape the research agenda (Balcazar et al. 2004). Despite this democratisation of the research process, there has been little consideration in the KE literature of the possible role of students in the process. As key stakeholders in universities, their omission from this discussion appears to be both a gap in the literature and a limitation of the approach. In this paper we explore the potential role students

CONTACT D.R.E. Cotton  dcotton@marjon.ac.uk  Lifelong Health and Wellbeing Research Group and SCION Research Group, Plymouth Marjon University, Derriford Road, Plymouth PL6 8BH, UK

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could take in university KE activities, focusing particularly on points at which their HE experience intersects with the wider community. We argue that students can act as a catalyst for KE and we present a model of student-led knowledge exchange as part of a pedagogy of KE.

Literature review

Knowledge exchange forms part of the 'triple helix' of university-industry-government relations (Sedgman 2019, 105). Relationships between these three sectors build capacity for the flow of knowledge and talent, often in the form of researchers trained in a university environment who seek employment in partner institutions. Increasingly, universities are expected to fulfil this third mission alongside their traditional functions of teaching and research 'to strengthen dialogue with stakeholders outside academia and thereby fulfil their obligation towards being a socially accountable institution' (Jongbloed, Enders, and Salerno 2008, 310). The terminology employed to describe how knowledge circulates in the triple-helix model is frequently one of transfer or exchange (Moreton 2016). In the UK, Knowledge Transfer Partnerships are a major way in which organisations can improve competitiveness and productivity through use of knowledge, technology and skills that reside within universities (Innovate UK 2015). For example, technology transfer involves a technology (such as a tool, a set of studies, or practices) being moved from one institution to another (Bozeman 2000). In this way, knowledge is transferred through codified outputs (patents and copyrights), shared approaches and ideas, expertise (such as the movement of personnel), and interactions within innovation networks (Döring and Schnellenbach 2006).

Knowledge exchange is generally considered to be a wider concept than knowledge transfer, encompassing multi-directional knowledge sharing. As Fazey et al. (2014) write: 'Traditional assumptions of researchers as the sole producers of knowledge are increasingly being supplanted by activities that include multi-way interaction and co-production of knowledge between researchers, decision-makers and other beneficiaries' (p. 205). Research England describe KE as 'the wide range of activities HEPs [Higher Education Providers] undertake with partners', and they lead a series of national assessments of universities' KE activities, under the banner of the Knowledge Exchange Framework (KEF). The KEF aims to help universities understand, benchmark and improve their own performance, as well as increasing the visibility of university research to external users (Johnson 2022). A similar exercise, entitled 'Engagement and Impact Assessment' takes place in Australia, and other national systems exist to evaluate universities' relationships with the wider world. KE is thus becoming an issue of increasing importance to many HE institutions.

Universities employ specialist staff to promote and encourage KE activities – knowledge brokers, such as research administrators or selected academics (Lomas 2007). Yet the links between teaching, research and KE have been little explored and other activities in HE which might provide a fruitful context for KE remain overlooked. Arguably student engagement with employers through placements, work experience and service learning offers one under-exploited route. Students have the potential to offer a doorway to university research which allows external partners to participate in dialogue on a more equal footing – and enables democratisation of research findings by making them accessible to the wider public or specific groups. Students are often key points of intersection between universities and the wider world, yet research focused on their activities outside the university rarely conceptualises these as KE opportunities, the underlying message being that student learning and KE are not mutually compatible. It is notable that the only appearance of students in the KEF is in relation to graduate start-ups. Students do not feature in KEF metrics in any significant way, although some institutions include reference to student KE in their submissions.

There is very little research which explicitly explores students' roles in KE activities. One area in which student contributions have had a somewhat higher profile is in the guise of 'public engagement'. Defined by the National Co-ordinating Centre for Public Engagement (NCCPE) as 'the myriad of ways in which the activity and benefits of higher education and research can be shared with the public' (NCCPE 2019), student activity is more often recognised. Queirós et al. (2022, 6) describe

'teaching-related activities and supervision of students' (including internships and placements), as part of the 'academic engagement' activities of HE. Both internships (Goodenough et al. 2020) and placements (Divan et al. 2022) have been identified in the literature as having positive student outcomes, though these are not generally promoted as KE opportunities. Deeley (2010) writes about service learning as unique as 'its aim is to benefit students and the recipients of their service in the community' (p. 43) and although not described as a form of KE, this is probably about as close to articulating a role for students in KE as is seen in the literature. Johnson (2022) outlines the potential role of teaching in KE, noting a dual interest in this area – from a government-led skills perspective as well as from a more activist-led concern for challenging privileged forms of knowledge. However, he also notes that although there are potential employability gains of combining public engagement and student learning, reliance on an external partner can be 'risky' in an era of student satisfaction scores and league tables. It is these potential opportunities and barriers which we explore further in this research.

A final issue to consider relating to KE is the meaning of 'knowledge' in this context. Relatively little attention has been paid in the HE literature to different forms of knowledge and their relationship to KE activities. The term 'knowledge' has a contested history which we don't attempt to cover in detail here, but which is discussed in more depth by Pritchard (2018). Nonetheless, several existing typologies of knowledge appear significant within the context of KE. A common approach is to distinguish between explicit and implicit knowledge (or codified and tacit knowledge) (Eraut 2014; Polanyi 1958), with some research focused on the use of KE protocols to make tacit knowledge explicit (Herschel, Nemati, and Steiger 2001). However, it is arguably more useful to divide forms of knowledge still further into what Burnard (1996) describes as:

- (1) Propositional knowledge – usually understood as expert knowledge, explicit, formalised knowledge that can be articulated in words or symbols. It consists of declarative knowledge, knowledge about a topic (or content knowledge);
- (2) Personal (or tacit) knowledge – a non-linguistic, context-specific way of knowing rooted in personal experience and intuition which may be unconscious and is often hard to express;
- (3) Procedural knowledge – knowing how to do something. It involves skills and techniques, often acquired through practice and experience and most effectively conveyed through demonstration.

These three types of knowledge may be held in different proportions by participants in a KE setting. The typology is sometimes considered as a hierarchy, with propositional knowledge having highest status (Pritchard 2018). Other literature suggests that procedural knowledge may be more important than propositional knowledge in influencing behaviour, though much research does not differentiate between them, and that which does often produces mixed findings (Kaiser and Fuhrer 2003). Consideration of the ways in which students may develop and share different types of knowledge through their university journey is an under-explored area in the literature.

This paper reports findings from the first stage of a project funded by Research England and the Office for Students, which aims to explore and expand student KE activity in HE. The project involved research with a range of stakeholders and the development of a model of student-led knowledge exchange (SLKE) which is intended to help support further expansion of such activity in a range of different contexts. The pedagogic model which forms one of the outcomes of the research is presented here as a potential blueprint for other institutions to devise student-led knowledge exchange opportunities across a wide range of contexts.

Methodology

This paper focuses on a project aiming to explore student-led knowledge exchange (SLKE) in undergraduate teaching and learning. The initial phase of the work consisted of a stakeholder

analysis exploring the role of undergraduates in KE in the context of a set of innovative student-led health and wellbeing clinics, in which students took a leading role in engaging with external service users (sometimes described in quotes as patients, though some of the work is preventative). We utilised the following research questions:

- (a) What were the drivers and barriers for SLKE from the perspective of students, academics, and partners?
- (b) In what ways and to what extent does participation in the clinics contribute to student learning and knowledge exchange?

This research utilised an instrumental case study approach (Stake 1995), in which the focus was on the processes of learning and KE – explored within a single institution. Owing to the complexity and multi-faceted nature of the subject matter, as well as the desire for in-depth data on the experiences of various stakeholders, a qualitative, interpretive approach was selected as most appropriate. Data collection for this phase of the research took the form of 26 semi-structured interviews conducted between September 2020 and August 2021 after ethical approval was obtained. A purposive sample of stakeholders with specific roles in relation to the clinics was used. These were key informants who had detailed experience with clinics and had been involved in different positions to get a diverse range of views and maximise the opportunity to learn from the sample. Interviewees included:

- Clinic facilitators who manage and deliver clinics (7)
- Programme architects who initiated the clinics (4)
- Students who had successfully previously participated in the clinics (9). (Students were contacted by a member of staff that was not involved in their clinic to reduce the possibility they might feel pressurised to participate.)
- Representatives from external organisations who are project partners (6)

All interviews were undertaken using Microsoft Teams. Interview schedules were flexible and differed slightly for each group of respondents but together they explored the rationale for introducing the clinics; the perceived benefits to students of participating; and the conditions which facilitate or act as barriers to participation and successful KE. Interview schedules were piloted to ensure interpretation was as intended and that the probes met the needs of the research. All data were recorded and transcribed with the assistance of Otter.ai software though accuracy was checked, and editing and anonymisation undertaken before analysis.

Data were saved in a password-protected file and analysed in two phases. The first involved a ‘sorting’ approach to coding, relating the data in each group to key codes drawn inductively from the data corpus in relation to the project aims. The second stage of analysis involved an iterative process, reviewing the data in each code and drawing out cross-cutting themes which were broader in nature. These were articulated as a set of propositions about the drivers and barriers for student learning through KE, and the types of student learning outcomes achieved. The propositions were used, together with the wider data set and theoretical insights, to develop a model reflecting the conditions which promote SLKE in HE.

Findings: towards a pedagogy of knowledge exchange

This section outlines preconditions and processes which need to be in place to achieve the desired outcome of SLKE in HE. In it we identify and discuss key elements of the model (presented in Figure 1), together with evidence from the data and related literature which underpin each aspect. The model is divided into four phases: Preconditions, Prior Knowledge, Pedagogic Context and Planning, and Product. Each is discussed in turn below.

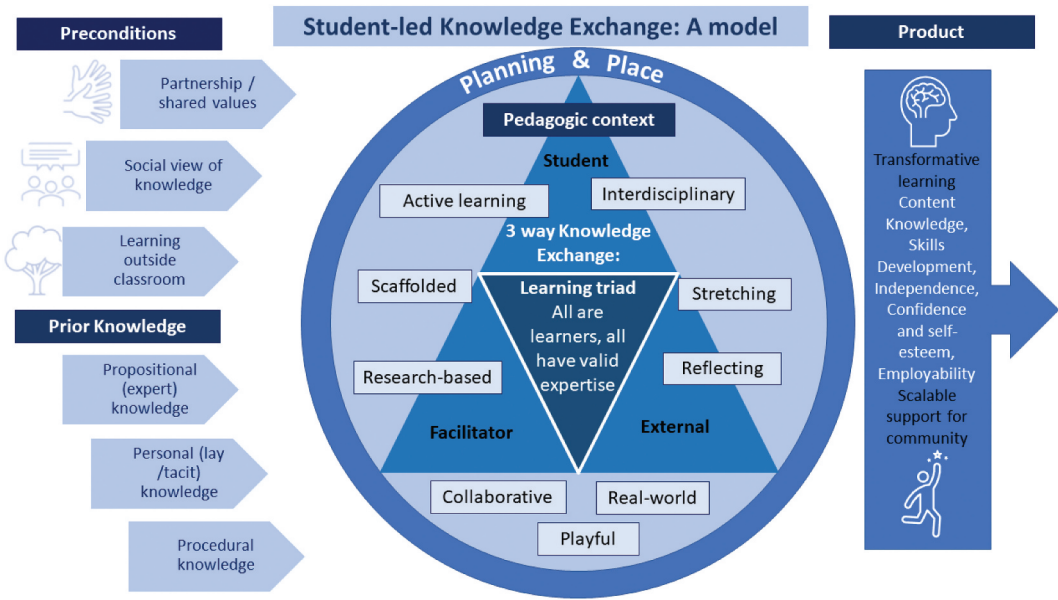


Figure 1. Student-led knowledge exchange: a model.

Preconditions

The findings from the stakeholder analysis emphasised key conditions which need to be in place for successful SLKE to occur. These ‘preconditions’ are outlined in the model as a starting point for any consideration of university-external partnership which intends to pursue this approach. The pre-conditions are identified as:

- Partnership/Shared Values
- Social View of Knowledge
- Learning Outside the Classroom

Taking each in term, the importance of shared values was a recurring theme which arose in interviews with partners and staff as an important reason for engaging in collaborative work:

Obviously, for [this institution], it’s such a huge part of what they do. It’s a huge part of their mission and how they provide their degree courses ... there’s a lot more passion for it. (Partner EE)

Before embarking on a SLKE arrangement with another organisation, universities should consider what their core mission and values are and to develop relationships with organisations that mirror those.

Another important condition which underpins the development of SLKE opportunities is the need for a social view of knowledge. The ‘social construction of knowledge’ paradigm is usually contrasted to ‘scientific knowledge construction’ (see McAdam and McCreedy 2000), an ‘absolutist’ view of knowledge, associated with the ‘assimilation of factual inputs’ (p.158). An alternative paradigm considers knowledge as socially constructed rather than consisting of universal truths, a learning community similar to Lave and Wenger’s (1991) Communities of Practice, and one which considers different types of knowledge as equally valid (see section 2 below):

I learned from listening to my student [who’d had breast cancer] speaking to one of the group members. So it was about how I’m coming across and whether I was being a little bit too cautious ... you can’t get that from a book. (Arch K)

As organisations which depend heavily on expert knowledge for their power, universities need to be open to new ways of thinking to embrace this model.

A final consideration prior to adopting the SLKE model, is understanding that important learning can and should take place outside the classroom, either literally or through inviting external participants into university spaces. In early pilots, staff found that having clinics on-site (usually in the gym or sports centre rather than traditional teaching rooms) was more conducive to an informal and non-medical atmosphere than in other venues – and had additional benefits of opening up the campus to local communities. The physical setting forms an important part of the hidden curriculum as informal clinic environments open up dialogue between staff, students and patients:

It doesn't feel like a conventional learning or study area ... it feels less like a classroom where it's someone talking at you and you just listening. It feels there's possibility for dialogue and discussion. (Staff F)

Engagement with the outside world through an external partner is a key underpinning focus for the model. It is this that situates the pedagogy as KE rather than simply as experiential learning, and it is an important contributor to the outcomes achieved via this approach. An institution with significant links to the local community will therefore be better placed to facilitate SLKE.

Prior knowledge

As mentioned above, there has been limited attention within the KE literature to forms of knowledge. Yet the type of knowledge which is being exchanged, shared or transferred is a key element in the KE process. In the context of SLKE, Burnard's (1996) tripartite division of knowledge into Propositional, Personal and Procedural Knowledge offers an important distinction, as it helps bring into focus the different types of knowledge which different participants in the learning triad may bring. The three types of knowledge identified in the model are all considered important in the SLKE context and they may be possessed as prior knowledge to varying degrees by different participants. In a real-life context, 'knowing about' (propositional or expert knowledge) and 'knowing how to' (procedural knowledge) both have a part to play – but offer different benefits. Personal knowledge (also called lay or tacit knowledge) was also felt to be of significant value in enabling the external (in our case a patient with intimate knowledge of the condition) to share their perspective.

Tacit knowledge could be gained by students, for example, by developing an ability to make connections with patients and thereby promote behaviour change:

I think the knowledge I'm focusing on is more of a tacit knowledge ... The knowledge exchange that I think is more subtle is the value of being able to have a conversation with someone, being able to get someone to feel like you support them. (Staff A)

Although unusual, there were sometimes barriers to engagement due to students' knowledge gaps. However, one student went on to point out opportunities for peer learning, which were also evident between patients who often learnt from each other how to manage their condition:

Some of the patients who've been coming to those clinics had been coming for a long time ... So they understood the problem a lot better than some of the new patients (Student S)

Although it might be assumed that propositional and procedural knowledge would come primarily from staff, and personal knowledge from patients, this was by no means always the case. Both students and patients could provide propositional and procedural knowledge and it was not unusual for students to have experience which meant that they could also contribute personal knowledge. Occasionally, a student's propositional knowledge from a different context was explicitly drawn on:

One of the supervisors called me in to help him with the patient because he said, they're having an issue with their foot ... And they said, Could I get your opinion on it, because you've done a three-year course in podiatry. So that's so your area of expertise. (Student S)

Whilst the valuing of non-expert knowledge is particularly pertinent in the health context where this model originated, we would argue that there are many other contexts in which KE could recognise the role of organisations or individuals as providers of knowledge rather than simply as receivers.

Pedagogic context and planning

Central to the pedagogic context is the learning triad. This constitutes the student, facilitator (usually a member of university staff) and an external (in our context, the patient). The types of KE vary but all three are seen as having valid expertise to contribute, and the presence of students encourages all to take the role of learner and be open to new ideas. The learning triad is the central focus of multi-directional KE:

There's knowledge exchange from what the students learn in the clinic, or the staff ... But also, there's the patients' knowledge exchange with each other and back to the student as well. (Arch C)

The pedagogic principles of supportive discovery learning and group interaction which underpin the clinics are central to interaction between staff and patients as well as students. Peer learning occurred between all participants, with the students forming a key part of the team, often acting as a catalyst for patients' engagement:

It's almost as though by them [the patient] knowing there's a student there, they want to support the student. So they tend to engage more readily. (Arch K)

Students were seen as key to the clinic experience. Something different happened when students were trying to help patients – they searched for different understandings, they listened more, and everyone learnt together through interaction.

Surrounding the learning triad are various pedagogic elements identified as contributing to learning in this context by staff and students. [Table 1](#) illustrates these elements and their links to the data via propositional statements developed through the analysis. Quotes exemplifying each proposition are provided to illustrate the issues which were raised in relation to each.

Added as an outer circle around pedagogic context is a planning phase. This reflects various considerations which should be taken into account to extract maximum benefit from a pedagogy of KE. They will differ depending upon context but, as an exemplar, the conditions which emerged from our evaluation are discussed briefly below with questions to help consider how to make an activity most successful:

- Recruitment inclusivity – Who gets involved in the activity and how? Which students do not engage and why?
- Student motivations – Are students there to tick a box? To build up hours as an accreditation requirement? Or do they have a genuine interest?
- Staff expertise – What staff expertise do you have and what is needed? Is staff knowledge propositional, procedural and/or personal? Which is needed in this context?
- Resource availability – What is required to make this activity work? SLKE in authentic contexts can be resource intensive. Is there external support available?
- Space and place – Where does the activity take place? What is the impact on learning and other outcomes? How accessible is it? What is the role of the hidden curriculum?
- Timing in academic cycle – How quickly can you respond to a request from partners for student contributions? What is the alignment between external organisations and the academic time-scale? What times of year are students available?
- Rules and expectations – What ground rules should be in place to ensure appropriate engagement? How can non-attendance be managed? Is there understanding of professional behaviour?

Table 1. Pedagogic context.

Element in model (Figure 1)	Propositional Statement	Exemplar quote
Active learning	Students gained a confidence boost from realising they had valid expertise, and from being able to take an active role in helping patients and seeing them improve	<i>When [students] go off into different opportunities afterwards, they can actually talk about real experiences that they've had, it's not something that they've studied. The confidence that brings ... you see really see students grow. (Staff G)</i>
Interdisciplinary	The interdisciplinary, applied nature of the clinics supports higher levels of learning such as application and synthesis of information	<i>There's nothing hypothetical about the care we provide for these patients. And the students get to be able to deliver that. And we know from ... working as an interdisciplinary team, that these students have the skills to be able to work alongside us. (Staff E)</i>
Scaffolded	Student learning is scaffolded by prior preparation and detailed resources as well as by supportive staff	<i>The fact that they had a hard copy of the stuff that we had done in the session, as well to take home with them helped reinforce their learning. (Staff D)</i>
Stretching	The combination of stretching activities in a very supportive atmosphere builds confidence and offers a deep learning experience for students	<i>It's in at the deep end, but with loads of support ... all I want them to do is sit next to someone and talk. And I know how amazing that is as an experience for a student. So I know that level of stretch and flex is there. (Arch B)</i>
Research-based	Student learning is enhanced through undertaking research with patients and doing dissertations based on clinic work	<i>There was always a bit of research done by us and the students. It was always linked into a project, whether it was a student on placement, or doing a dissertation. (Arch C)</i>
Reflecting	Students learnt from shadowing clinic staff, watching lecturers and clinic facilitators interact and build relationships with patients, and reflecting on their experiences	<i>We [staff and student] had a chat at the end. So we chatted about how the people had got on that day, what we thought and how we felt about a session, how it had gone. It was the reflection straight afterwards, which was good. (Student P)</i>
Collaborative	Patients, students, staff and medical professionals work collaboratively together through the clinics – with the students forming a key part of the team and enhancing patient engagement	<i>We all worked as a group collaboratively anyway. So yeah, with the nurses, myself, placement students and the patients, we all work collaboratively. And the clinic supported that, definitely. (Staff CC)</i>
Real world	Students learn from exposure to real-world situations (with patients of various ages and with different conditions) and apply theory to practice, helping them understand the context of their learning	<i>Well, the students benefited, because they were dealing with real world situations, real people ... they could apply the theory that they'd learnt, and then the reality and look at similarities and differences there to really enhance their learning. (Arch C)</i>
Playful	Students found the clinic environment an enjoyable and safe space, and felt well supported by staff to learn from mistakes rather than worrying about failure.	<i>I found the exposure of being in that clinic environment where you're dealing with different patients from ages to abilities to mobility, supporting such a wide range of clients . it was just really enjoyable, and you felt comfortable. (Student U)</i>

- Risk assessment – What risks might there be to students from inappropriate behaviour by external participants? Is there a risk of students attempting an activity they are under-qualified for?
- Evaluation – How will you evaluate the activity? What are the key outcomes that you want to achieve? Who will evaluate? How can you access views from all participants?

Product

This element describes the outcomes achieved using the SLKE model. At a high level, the crucial outcomes are transformative learning (Mezirow, 1997), independence and behaviour change. Transformative learning occurs through students' immersion in a real-life complex situation, often emotionally charged but with support to facilitate learning:

You're seeing people that [are] really in their worst point of their pain, they've kind of given up on everything. And so I think seeing those patients is really, really vital for our learning. (Student P)

Students who may not have been high performers in other contexts often gained significant benefit from engagement in KE activity – they were not selected on academic ability; clinic opportunities were available to any student:

Some of the students I've worked with weren't the top students ... They had the greatest step change from being involved with the clinics; it often saved them from dropping out of the university or not getting a good degree ... I think there's that opportunity to transform students that perhaps were struggling, the real-world learning helped them. (Arch C)

Breaking down the outcomes into disparate areas, benefits for students included content knowledge; skills development; employability; confidence and self-esteem:

It also means they grow in terms of their academic knowledge and their education, but it means they grow as people and as professionals. (Staff E)

I think my communication skills ... you're seeing an array of different people and personalities and the way you speak to them will change depending on that ... I think it's probably the biggest thing I got from the clinics. (Student T)

You could see this student, he was quite a nervous lad. But he asked the leading question to my colleagues and he got a response back. And then all of a sudden you could see his confidence grow. (Partner RR)

The wider outcomes of the scheme included opportunities to provide scalable support for the community, seen as highly valuable in the context of post-pandemic demands on healthcare, as well as workforce development:

As a result of the students coming out of university, they will have a much better ability to be able to deliver effectively from day one, rather than having to spend another year in practice learning those skills. (Partner Z)

The SLKE model

Building on the elements outlined above, the final SLKE model is presented in [Figure 1](#) below. The model goes beyond the original propositions, utilising a synthesis of theory and data to build a framework for new developments which can be contextualised to a range of different settings.

Discussion

Academics are increasingly expected to engage in knowledge exchange alongside their core roles of research and teaching. Encouraging a wider conceptualisation of KE which includes undergraduate students developing and sharing different forms of knowledge radically expands the opportunities for HE institutions to have real-world impact on external partners or the public involved in activities with the institution. This study offers the first empirically based model of student-led KE and the SLKE model helps to position students within the KE ecosystem, illustrating both how they can contribute to, and benefit from, KE opportunities. A key finding has been around the centrality of students in promoting learning: The presence of students in this context creates a more balanced non-hierarchical learning context which benefits both them and external partners. It allows us to reconsider KE with a broader view of what knowledge is, and with a more democratic understanding of what we mean by 'exchange'. This is important in the context of calls for making KE more participatory, putting researchers on a more equal footing with research users (Fazey et al. 2014) Fazey et al. also call for a stronger focus on explicitly designing KE to enhance engagement, and the SLKE model outlines a number of ways in which this might be achieved. There are potential policy implications arising from our study around the ways and extent to which SLKE impacts can be accounted for in exercises such as KEF. Consideration of students in institutional KE strategies would

be a first step here and future studies which explore the extent to which the model could offer an additional dimension to KEF metrics or narrative would be welcomed.

The literature on HE pedagogy, as well as on KE, would be enhanced by efforts to sharpen the focus on what is meant by knowledge. Knowledge remains a contested subject in HE: What counts as valid knowledge in each discipline, and who makes those decisions are key concerns of curriculum developers. KE has always involved expert academics as the arbiters of knowledge boundaries and this may explain the absence of consideration of students in the literature. But what our research shows is that there can be benefits for all parties of including students in the KE process. As well as challenging knowledge hierarchies, the SLKE model also supports proponents of active learning who argue that engagement with higher level learning can run alongside foundational knowledge acquisition. This has been an ongoing debate in the educational literature, originating arguably in Bloom's taxonomy (Bloom 1956) which was explicitly developed as a hierarchy of learning. The categories after knowledge were presented as 'skills and abilities', with the understanding that knowledge was the necessary precondition for putting these skills and abilities into practice (Armstrong 2010). To achieve the higher levels (analysis, synthesis etc), according to Armstrong, a student must first memorise and understand facts. Similarly, Willingham (2009, 19) insisted that 'factual knowledge must precede skill', the argument being that foundational knowledge is an essential prerequisite to critical thinking and using knowledge in practice. However, recent research by Agarwal (2019) demonstrated that factual quizzes did not improve higher order test performance, suggesting that transferability of such memorisation exercises may be low.

Other criticisms of Bloom's taxonomy have come from various directions: Lemov (2017) argued that it undervalues knowledge which is considered a lower level in the hierarchy. This is important, he argued, because it means that low-income students with perhaps less exposure to foundational knowledge suffer from a knowledge gap – they don't have the cultural capital to develop those higher level learning outcomes. Mehta (2022) offers a competing opinion, suggesting that Bloom's taxonomy instead undervalues higher level skills by insisting that students learn 'the basics' first. Mehta sees the base level of the taxonomy as indicating its importance and argues that an over-riding focus on students learning the basics might mean that they never get the opportunity to apply their knowledge. He maintains that students learn across a range of levels by doing and applying – and through that process encounter and develop basic knowledge and understanding within the context in which they are required. He recommends '*learning* that is purposeful, authentic, and connected to the broader human domains of which those learners are part' (p. 3). Mehta (2022), would argue that it is crucial to engage students in using and creating knowledge, and to promote authentic learning experiences where skills are developed through practice – rather than focusing on traditional classroom instruction. This is much closer to the ideas encapsulated in the SLKE model shared here.

Through the SLKE model, this paper articulates a pedagogy of KE with a view to inviting further conceptual and practical consideration of the role of undergraduate students in KE. To date, the connections between KE and pedagogy have received limited consideration in the literature. Where links have been made, they have generally been focused on postgraduate taught or research students, and on just one or two elements of the SLKE model. For example, Peck (2021) discusses the pedagogy of collaborative doctoral education, drawing out the importance of a reflective approach in KE for PhD students. Duchelle et al. (2009) also studied graduate students, but this paper is very much focused on information sharing and skills-building (the 'what' rather than the 'how' of KE), and the KE mostly involves one-way transmission of ideas with the students in this case taking on the role of expert more typically reserved for academic staff. However, they also note the need for a culture of collaboration in the learning environment, echoing our findings. A paper by Tishelman et al. (2008) considers undergraduate nursing students as mediators of KE, though the students are involved solely in producing literature reviews to inform practice rather than having direct contact with external partners. In terms of pedagogy, the key point identified in this study was the importance of supervision from, and discussion with, senior researchers (echoing the 'scaffolding' and 'collaborative' elements of our model). Given that many degree programmes include

a work-based learning module, an approach that supports the pedagogy of KE has clear implications for supporting the increasingly important employability agenda in universities (see also Johnson 2022). Building SLKE opportunities into the curriculum allows students to develop these skills without requiring a significant time commitment beyond their programme (identified as an equity concern by Divan et al. 2022).

Looking at the wider HE literature, it is evident that most pedagogic elements of the SLKE model (e.g. interdisciplinary, collaborative and research-based context; the use of real world, stretching, active learning approaches in a playful and low stakes setting; strong scaffolding and support for students and participants and encouragement of reflection on action) reflect attributes that have been identified in the educational literature as enhancing teaching and learning in general (see for example Fry, Ketteridge, and Marshall 2015), indicating the strength of SLKE as a learning context. There is also a substantial literature base looking specifically at the related area of service learning, with largely positive outcomes and which may lead to transformation for many students (Asghar and Rowe 2018; Deeley 2010) although Hébert and Hauf (2015) note the difficulty of assessing efficacy of such learning approaches, and suggest that the intended positive learning outcomes may not always be realised. Goodenough et al. (2020) focus on internships (another context in which student-led knowledge exchange could be relevant), and evidence enhancement in adaptability, optimism, purposeful direction, ingenuity and support-seeking scores on a psychometric test for those students who took an internship. They also note student-reported employability enhancements as a result of the internship, unsurprising in such a career focused context. Our model offers a possible route for programme teams to gain the benefits of internship or service learning opportunities for a wider group of students.

Johnson (2022) explicitly links the engagement element of KE with research-informed teaching (RiT) and the SLKE model cross-cuts Healey's (2005) conceptualisation of the research-teaching nexus, offering opportunities for students to engage actively in using research findings in an authentic context. However, the model also illustrates the role of students as teachers or knowledge sharers which is currently under-explored in the RiT literature. Although lack of space precludes discussion here, there is scope for further conceptual consideration of the different understandings of 'research' in the RiT literature and how these inter-relate with the different understandings of 'knowledge' which abound in the KE literature.

A limitation of this research is that it was undertaken in a specific discipline context (health and well-being) and in a single UK institution (a new university with a strong teaching and vocational orientation), and we would call for further research to be undertaken, testing the model's applicability in different contexts. Indeed, we have already started to trial use of the model in different contexts, since later parts of our project involved 'scaling up' KE activities in different contexts and in partnership with other institutions, where the model has proved to be extremely useful as a heuristic device. It is important to bear in mind similarities and differences between institutions which may impact on the functioning of the model. While their overall missions of education, research and KE are in common, each institution has its own history and values which influence potential avenues for development of SLKE. Although research-intensive institutions might seem to offer more fruitful territory for KE (see Johnson 2022), there is some evidence both from this research and the extant literature that newer institutions may be more closely linked with regional employers as part of their educational role. Schofield et al. (2013) noted that college-based HE institutions had 'more of a focus on courses providing students with opportunities to bridge the local skills gap', and new universities were 'in tune with issues of employer engagement' (p. 202–3). This is echoed by Queirós et al. (2022) who suggest that different institutional missions influenced the type of KE pursued – with more vocationally-oriented institutions being more likely to focus on teaching-related KE. Fazey et al. (2014) note that conceptualisation of KE varies between different disciplines, so further research looking at different discipline contexts would be very valuable. The paucity of studies which consider KE in an undergraduate context, however, and the very limited consideration of the pedagogy of KE, gives this research value as a springboard for further work.

Conclusion

Despite the increasing interest in KE across HE, the possible contribution of students has been under-explored. In this paper, we have outlined a potential approach to student-led KE, along with a model demonstrating its underpinning basis. A key element of the SLKE model concerns the different forms of KE which occur between individuals in a learning triad consisting of a student, a facilitator and an external participant, all of whom are seen as having valid expertise. The model outlines the benefits of student co-production of knowledge, enhancing motivation and engagement; it illustrates the importance of students encountering real-life contexts and experiences; and it evidences the skills required by staff to support multi-directional knowledge brokering. All of these elements offer crucial insights for development of a more expansive conception of KE in HE and offer the potential to enhance student learning and agency. By using active learning in a real-world context, students engage with knowledge in its widest sense, simultaneously understanding and applying knowledge in context and moving between the different 'levels' of Bloom's taxonomy.

Unlike much knowledge exchange, SLKE involves an exchange in the truest sense of the word: as well as enhancing their own learning, simply having students present makes the other parties more open to learning and adds value to the activity. The students' position is a liminal one: They are neither entirely giver or receiver of knowledge but contribute to and catalyse multi-directional KE through interaction with patients and university staff in a learning context. The multi-directionality of KE resists the implicit or explicit hierarchies evident in much of the literature on this topic. Using the SLKE model can help faculty design authentic learning opportunities for students. The model can be adapted for use in diverse contexts and we would argue that using SLKE could be considered much more widely in educational contexts where transformative learning and development of confidence and employability are aspirations. The model offers a potential blueprint for other institutions, an opportunity for universities to contribute to their local community whilst providing students with an authentic learning experience. In short, it provides an initial attempt to envisage a pedagogy of knowledge exchange.

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ORCID

D.R.E. Cotton  <http://orcid.org/0000-0001-7675-8211>

S. Cooper  <http://orcid.org/0000-0002-5540-0672>

M. Fornasiero  <http://orcid.org/0000-0002-4197-195X>

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