COVID as a catalyst: Uncovering misaligned power dynamics and the importance of new Professional Learning Networks for Higher Education science laboratory teaching

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Abstract

The COVID-19 (SARS-CoV-2) pandemic brought in-person teaching to an abrupt halt in early 2020, leaving educators with the problem of how to continue to deliver Higher Education laboratory courses remotely. Three new Professional Learning Networks (PLNs) formed to address this critical need in Biosciences and Chemistry in the UK and Australia. The findings show that the PLNs provided an essential space for knowledge development, collaboration and innovation, with COVID-19 creating a common focus for the networks.

Findings also highlighted a lack of empowerment for highly experienced teaching-focused staff to lead change within their departments. The authors recommend significant consideration be given to this issue as well as ensuring suitable resourcing for teaching-focussed staff to engage with opportunities for professional growth.

Keywords: Professional Learning Network, Higher Education, laboratory teaching, evaluation

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1. Introduction

Hands-on practical experience forms a core part of the science curriculum (Hofstein & Lunetta, 1982; 2004) and governing and oversight bodies require that students develop hands-on practical skills during their studies (QAA, 2019a, 2019b; RSB, 2019; RSC, 2019; Pyke et al., 2014; Schultz et al. 2020). The

COVID-19 (SARS-CoV-2) pandemic brought in-person teaching to an abrupt halt during the early months of 2020 leaving educators with the problem of how to continue to deliver laboratory courses remotely. This prompted Biosciences and Chemistry Higher Education (HE) laboratory-focused teaching staff to come together to share and discuss ideas in three new 'drylabs' Professional Learning Networks (PLNs) that formed in the UK and Australia in March/April 2020. This paper seeks to investigate the impact and implementation of these PLNs.

1.1. Teaching-focused staff in Higher Education

The highly specialised nature of work in HE means that the day-to-day operations of staff occur in "silos", which can limit social interactions, opportunities for collaboration and professional growth (Trust, 2017). HE staff that are teaching-focused can also be further isolated in a research-intensive institution (Skelton, 2012, Gretton & Raine, 2017) due, in part, to the low number of peers within a department (Hubbard et al. 2015). Teaching staff come from a variety of backgrounds (Nyamapfene, 2014) and include non-academic "third space" professionals (Whitchurch, 2008). A supportive community of peers outside of the home institution is therefore hugely important (Scott, 2015).

1.2. Professional Learning Networks

The majority of research into PLNs in education has focused on the school system, with only a few studies considering PLNs in Higher Education (Trust, 2017). Brown and Poortman (2018) define Professional Learning Networks (PLNs) as "any group engaging in collaborative learning with others outside their everyday community of practice, in order to improve teaching and learning in their school and/or school system more widely".

The benefits of participating in PLNs have been shown to be wide-ranging, including: providing access to support and collaboration opportunities (Trust, 2012); opportunities for discussion of practical solutions; reduced isolation; provision of a greater opportunity for professional growth; sharing of resources and experiences due to a heightened sense of collegiality (Macia & Garcia, 2016); filtering and curation of new ideas; reflection on teaching practice; increasing the innovation potential of participating organisations; improving the practice of teachers and as a result, student outcomes (Brown, 2020). PLNs have also been shown to have longer-term benefits including development of teachers' social capital and professional identity as well as providing emotional support leading to enhanced engagement and a sense of belonging (Lantz-Andersson et al., 2018; Davis, 2015). Research investigating PLNs for Higher Education staff has shown that the flexibility of PLNs offers a new learning experience for staff and has advantages over one-size-fits-all workshops or annual conferences, especially around the ability to engage with learning anytime and anywhere with geographically-dispersed colleagues (Trust, 2017).

1.3. Spaces for PLNs

PLNs require a space for educators to connect and learn, this space can be physical (for in-person interaction e.g. conferences) or virtual (e.g. Twitter, Facebook) (Trust, 2017).

Historically, in-person (face-to-face) school PLNs have required geographical proximity to facilitate physical meetings, and a shared history, community, aspirations and needs (Brown, 2020). In HE, expertise can be widely geographically located which has constrained PLNs due to geographic and temporal complexities (Trust, 2017).

The use of technology (internet and social media) can remove some of the traditional constraints on PLNs, including geographic barriers (Trust, 2017) and can supplement face-to-face PLNs to create a broader, enriched learning landscape for knowledge exchange and negotiation of meaning with peers (Jenkins, Purushotma, Weigel, Clinton, & Robinson, 2009). Online PLNs have traditionally taken two forms: "Information Aggregation" and "Social Media Connections" (Trust, 2012). Information

Aggregation PLNs are a compilation of websites, news sources and other forms of information, which enable participants to scan quickly through materials to keep up to date with new information (Trust, 2012). Social Media Connection PLNs use social networking sites (e.g. Facebook, Twitter) and real time interaction tools (e.g. Skype) to connect with other individuals around the world.

A third online space for PLNs has developed with the increased access to video conferencing platforms such as Zoom and Microsoft Teams accelerated by the COVID-19 pandemic move to remote working (Waizenegger et al. 2020; Bouziri et al. 2020). There has been little research published about the advantages and challenges of the use of this new space for PLNs.

1.4. Successful implementation of PLNs

Research has shown that the success of PLNs within the school and Further Education context can be dependent upon multiple factors, including the behaviours of the individuals within the PLNs, structure and support from participants' home organisations, contextual and environmental factors (Brown, 2020; Hubers & Poortman, 2018; Harris & Jones, 2010). Brown (2020) provides a detailed summary of key factors for the success of PLNs, these are summarised in Table 1.

Success factor	Detail
Collaborative and collegial educator-to-educator exchange	Collaboration must enable educators to harness the social capital available within the network and must involve the inducement of mutual obligation, foster interdependence, expose the practice of educators to the scrutiny of others and encourage initiative in terms of developing approaches to teaching and learning. Educators will be more motivated to collaborate with one another when the success of their efforts depends up on it.
Trust	Trust relates to beliefs regarding the competence, benevolence and integrity of others. In high-trust situations, individuals feel supported and 'safe' to engage in risk taking and the innovative behaviour associated with efforts at sharing, developing or trialling new practices. Trust takes time to develop, but can materialise more quickly when the network is between educational institutions with similar quality features and similar context factors.
Fear of competition	Successful PLNs need to be able to put aside fear of competition, for example around attracting students. This is more easily overcome where there is already a historical collaboration in place (i.e. pre-existing relationships have already been established).
Common focus	For PLNs to succeed, they must have a common focus and work on clearly defined topics. The common focus must be realistic and achievable within the resources available to the network. The common focus leads to a shared sense of purpose amongst the members in relation to the specific goals of the PLN.
Long-term commitment	There is a need for long-term commitment to enable the results of PLNs to come to fruition. Evidence suggests that a minimum of three years is required to lead to a meaningful improvement in students' outcomes. Interim, short-term "wins" can be essential alongside longer-term commitment for participants to feels they are experiencing mutual benefit from participating.
Senior Leadership Team	Senior leaders play several roles in ensuring the success of PLNs: • ensuring meaningful participation by the educators; • enabling participation to make a difference within the educators' 'home' institution. There are several areas in which senior leaders need to be invested in the participation of their educators in the PLN. They must: • be signed up to the common purpose of the network and the focus for its activity; • understand that change take time to come to fruition; • recognise that resources may need to be committed and maintained over the long-term; • acknowledge that the outcomes of the PLN are for improving outcomes of all students in all institutions in the network (and not just their own); • recognise that distributed leadership must be encouraged i.e. the PLN participants (who may not be formal leaders within their institution) must be supported to engage in the network and then to be able to lead change within their institution.
Formalisation	Participation should be formalised to ensure that the activities of the PLN align with the improvement priorities and vision for the institution. Therefore, participation in the PLN remains a priority and is not side-lined as other priorities emerge. If participation is not formalised there is a risk that participation becomes simply a 'bolt-on' to existing work. Formalisation of PLN

	engagement typically involves incorporating the PLN activity into existing policies and procedures (e.g. as part of organisational improvement plans, or as development review targets).
Prioritisation	Enabling prioritisation requires adequate resources to be provided. This requires senior leaders to ensure time for educators to attend as well as time for distributed leadership to empower the educator in making change as a result of their participation in the PLN. The participants must also ensure that they treat the activity associated with the network as a priority. Senior leaders can help participants by empowering staff to engage with the process and to provide autonomy for staff to innovate in addition to providing support for the development of practices when required.
PLN leadership	Effective leadership of the PLN is essential to ensure that the network functions.

Table 1. Factors required for PLNs for educators to be successful (Brown, 2020).

1.5. Higher Education teaching-focused PLNs

Calls have been made for an increase in national networks to provide education-focused meetings (Gretton & Raine, 2017) to help prevent HE teaching-focused staff from "*becoming an island, [with few] opportunities for renewed inspiration and sharing of good practice*" (Hubbard et al, 2015). The Chemistry Collaborations, Workshops and Communities of Scholars programme has spawned more than one online network (Leontyev, et al. 2020) which have been shown to have been effective during the COVID-19 pandemic (Nataro, 2020). Virtual networks like AdvanceHE Connect have also recently arisen but operate in a more traditional manner of material sharing and offering written discussion boards as the primary means of communication (AdvanceHE, 2021). In the UK, an existing face-to-face network was moved onto Zoom (Authors. 2020) which initiated the drylabs networks that are the focus of this paper.

2. Description of the DryLabs20, #DryLabsRealScience and #DryLabsDownUnder networks

Three drylabs networks were formed in 2020 with the aims of sharing knowledge, ideas, experience, and resources for teaching a practical subject both remotely and using a digital learning platform. The specific aims of the networks are given in Table 2 along with a summary of their arrangements. Meeting formats and content varied between networks and are summarised Table 3.

	DryLabs20	#DryLabsDownUnder	#DryLabsRealScience
Network leaders (organisers)	2 staff Single institution	Single person	3 staff Multi-institutional
Presenters	Network hosts, volunteers from attendees, invited contributors.	Volunteers.	Volunteers from attendees.
Target audience	Educators in practical chemistry teaching.	First time creators of online learning environment in chemistry.	Bioscience teaching lecturers & academics.
Attendees	80 (av), 35 (min), 120 (max)	50 (av), 38 (min), 84(max)	60 (av), 25 (min), 150 (max)
Original aims	To establish how other institutions in the UK were going to adapt their practical chemistry courses to an online-only environment. To discover and share any 'dry' practical materials.	Forum for discussion and sharing ideas. Sharing resources. Creation of online resources page accessible by community.	To share best practice, experiences, and ideas when supporting remote learning in the life sciences.

Content suggestions	Suggestions by email, from meetings, and other requests.	Proposed by talk volunteers.	Suggestions from attendees, by email, requested by organisers.
Meeting platform	Zoom	Zoom	Zoom
Other network content	Shared drive for resources, webhosting platform.	ChemNet website.	Resources hosted on LectuREmotely. YouTube videos.
Other activities	Resource sharing.	YouTube recordings.	Video resources. How to guides.
Frequency of meetings	Fortnightly, moving to monthly.	Every 3 or 4 weeks.	Fortnightly moving to monthly.
Advertising	Email & Twitter.	ChemNet (academic staff teaching chemistry at Australian universities), Twitter.	Email & Twitter.
Meeting format	2 or 3 x 20 mins talk with 1-hour open discussion later in break-out groups.	4 or 2 20 min talks with 10 mins discussion.	4 or 3 20 min talks with Q&A.

Table 2. A summary of key features of the three drylabs networks.

	DryLabs20	#DryLabsDownUnder	#DryLabsRealScience
Presentations on teaching (logistics)	Regular	Occasional	None
Presentation on teaching (content)	Occasional	Regular	Regular
Presentations on policy	Occasional	None	Regular
Q&A after presentation	Regular	Regular	Occasional
Discussion on presentation theme	Occasional	Regular	Regular
Break-out rooms (theme-based discussion)	Regular	None	None
Break-out rooms (group work)	None	None	None
In-meeting collaborative work	None	None	None

Table 3. Summary of frequency of session content at the three drylabs networks.

3. Research questions

The study undertook to answer five research questions.

To what extent did attending the drylabs networks:

1. impact on participants' knowledge of specific areas related to laboratory teaching?
2. impact on participants' confidence to change their own practice in specific areas related to laboratory teaching?
3. impact on participants' confidence to discuss/implement changes in practice within their department in specific areas related to laboratory teaching?

4. impact on participants' confidence to and practice relating wider elements of their role in Higher Education teaching?
5. lead to the development of new contacts for participants?

In addition, the study investigated factors affecting implementation of the networks including participant engagement, experience, benefits, and barriers.

4. Methodology

The study was conducted using three online surveys (using JISC online surveys) for members of the drylabs networks. Participants that had attended at least one meeting were invited by the network organiser to complete the survey for that network. Publicity for completing the surveys was via announcements at the network meetings and via email to the network mailing lists. Respondents to the survey were self-selecting voluntary participants, there was no incentive for participating in the study. Self-report surveys have the potential for bias (including social response bias and acquiescence response bias) and misinterpretation of questions, however, the ability to survey at scale within a short period of time was considered to outweigh these limitations (Demetriou, 2015). The wording of questions and information about the purpose of the survey were carefully designed with the aim of minimising bias. The survey was piloted with academic colleagues with similar experience to those attending the networks before being refined and opened for responses between 16th July to 14 September 2020 (DryLabs20), 30th July to 14 September 2020 (#DryLabsDownUnder) and 16th July to 14th September 2020 (#DryLabsRealScience).

The survey contained a mix of closed and open questions collecting: background information about current role, experience and perceived ability to suggest and implement change; reasons for attending the network; perceived impact from attending the network; engagement with the network; support and barriers for participation; experience of other networks; and detailed questions about their personal characteristics. Quantitative data were downloaded from the survey software and analysed using descriptive statistics using the Jamovi statistical package and Microsoft Excel. Qualitative data from open text responses were analysed thematically (Braun & Clarke, 2006).

4.1. Participants

Respondents to the three surveys included 76 individuals from 44 unique institutions in the UK, Ireland, Australia, New Zealand and the USA (Table 4). The majority of respondents (>94%) from each network were based in an institution within the country in which the network was hosted.

	DryLabs20	#DryLabsDownUnder	#DryLabsRealScience	All networks
Network leaders' estimate of average number of attendees	80	50	60	190
No. of survey respondents	34	19	23	76
No. of unique institutions represented	16	14	16	44
No. not identifying institution	9	2	1	12

Table 4. Summary of respondents to the survey.

Respondents to the survey were generally experienced teachers or experienced in their role supporting teaching, with >70% of the DryLabs20 and #DryLabsDownUnder respondents having been teaching for more than five years and >65% for #DryLabsRealScience (Table 5). Over half of the #DryLabsDownUnder respondents had been teaching for over 10 years. There were respondents with more than 30 years of experience in all three networks. Over 70% of respondents from the DryLabs20

and #DryLabsDownUnder networks had been at their current institutions for over five years (Figure 1). The figure was lower for the #DryLabsRealScience network where half of respondents had been in their current institution less than five years. Across all three networks, the majority (88% DryLabs20, 72% #DryLabsDownUnder, 91% #DryLabsRealScience) of respondents were on permanent/non-fixed term contracts.

	DryLabs20		#DryLabsDownUnder		#DryLabsRealScience	
	N	%	N	%	N	%
0 - 2 years	3	9	1	5	2	9
2 - 5 years	6	18	3	16	6	26
5 - 10 years	13	38	5	26	6	26
10+ years	12	35	10	53	9	39

Table 5. Number of years for which teaching/supporting teaching had been part of respondents' roles.

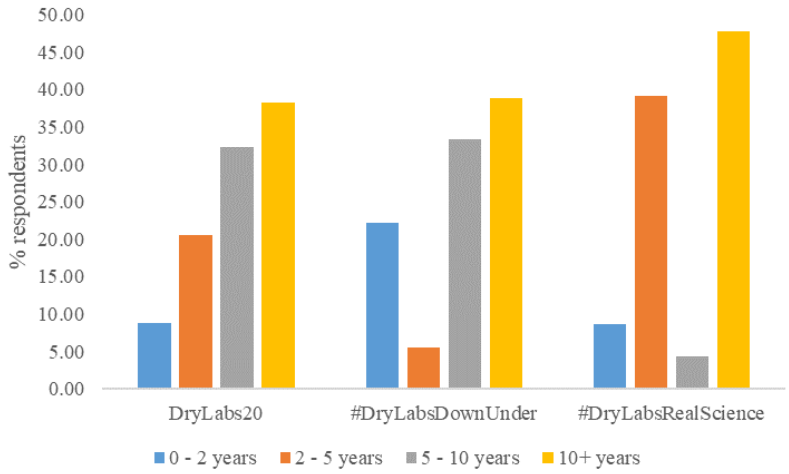

Figure 1. Number of years for which respondents had been at their current institution (DryLabs20 n=34, #DryLabsDownUnder n=18, #DryLabsRealScience n=23).

5. Impact of participation

Respondents to the survey from the DryLabs20 network had attended an average of 4.82 meetings, #DryLabsDownUnder respondents 2.47 meetings and #DryLabsRealScience respondents 3.00 meetings (Table 6).

	N	Mean	Median	Min	Max
DryLabs20	34	4.82	5	2	7
#DryLabsDownUnder	19	2.47	3	1	3
#DryLabsRealScience	23	3.00	3	1	6

Table 6. Average number of meetings attended by respondents.

5.1. Reasons for participating

Respondents were asked to rate the importance of various factors as to why they **initially** chose to participate in the networks. Within the top three reasons rated "very important" by respondents from all three networks was "to learn from the ideas and experiences of colleagues at other institutions". Other reasons in the top three factors included "the need to develop knowledge of different teaching methods (due to the impact of COVID-19)", "to be part of a community of experts in practice", "the range of topics being discussed" and "no registration or travel costs incurred by attending".

For all three networks, "the practitioner focus of the meetings" was considered to be in the top three "very unimportant" reasons for initially choosing to attend. Other reasons in the top three "very unimportant" factors included being "required to attend as part of your role (e.g. directed to attend on behalf of your department)", "flexibility to multitask whilst attending", the "reputation of the team organising [the network]", "encouragement to attend by colleagues" and "existing connections with the team organising [the network]".

When asked to rate the importance of various factors as to why they **continued to** participate in the networks, respondents from all three networks indicated that "to learn from the ideas and experiences of colleagues at other institutions" remained in their top three "very important" reasons. Other reasons in the top three factors included "to be part of a community of experts in practice", "the need to develop knowledge of different teaching methods (due to the impact of COVID-19)", "how welcome you felt" and "the practitioner focus of the meeting". Of particular interest is that this final factor changed from being in the top three "very unimportant" factors why respondents initially attended the #DryLabsRealScience network to being in the top three "very important" reasons why they continued to attend.

"Encouragement to attend by colleagues" and being "required to attend as part of your role (e.g. directed to attend on behalf of your department" continued to be rated by all three networks as being in their top three "very unimportant" reasons for continuing to attend the networks along with the "flexibility to multitask whilst attending", and "reputation of the team organising [the network]". "Sharing your ideas and experiences with colleagues from other institutions" joined the top three "very unimportant" factors for one or more of the networks.

A wide range of themes emerged of particular elements of their roles/responsibilities that respondents hoped attending drylabs might assist with before they attended the first meeting (Table 7).

Knowledge exchange/Sharing ideas
Getting suggestions for resources, software and technologies to support the changes to teaching from COVID-19 restrictions
Discussion about online lab teaching
How to run face-to-face in-person teaching labs with social distancing requirements
General discussion of the implications of COVID-19 on teaching labs
How to teach labs with no access to labs
Ideas and examples of alternative practical work
Discussion around undergraduate dissertation/final year project work
Professional development/upskilling
Assisting with planning for upcoming delivery of practical work
Blended teaching
Teaching methods and teaching strategies
Optimising the learning experience for students in changed teaching arrangements
How to engage students and ensure student wellbeing when teaching online
To develop new ideas in general
To support summer school teaching
Community/social aspects
Reassurance about their plans and approaches
To support their roles in general as lab coordinators/directors/leaders
To find out what others across the sector were doing
Developing ideas for inter-university ventures
To access shared resources
To be part of a community
To provide advice to others

Table 7. Themes from open-text responses for elements of respondents' roles which they hoped would be assisted by attending the drylabs networks.

5.2. Changes to practice due to participating in the drylabs networks

Respondents reported via an open-text question that attending the network had already led to an increase in their knowledge of specific areas and that the network had helped with the development of teaching plans. Responses also showed the networks were facilitating the exchange of ideas.

Respondents appreciated the usefulness of the fora as platforms for information sharing by the professional bodies (the Royal Society of Chemistry, RSC, and Royal Society of Biology, RSB).

> *"It has been really useful to know what the RSC think of remote labs when feeding back to my department."*
>
> DryLabs20 network

> *"The first meeting with the RSB also in attendance was excellent - it gave reassurance of what was expected and then also started to discuss … project alternatives - fab! I then went back to my institution to disseminate the ideas for dry lab/ alternative projects."*
>
> #DryLabsRealScience network

Additionally, participants considered that the networks had assisted with their understanding of the wider-picture of practice, which they were then able to use as a lever for change within their home department.

> *"Other institutions doing things helps with causing change here."*
>
> DryLabs20 network

> *"Gaining a broader knowledge of what is being done in other institutions. This aids my own discussions and proposals within my institution."*
>
> #DryLabsDownUnder network

> *"Being able to convince colleagues that plans are in line with other institutions is very helpful."*
>
> #DryLabsRealScience network

Several respondents commented that attending the network had not yet changed their practice, with reasons given being that they already had high confidence and good knowledge or that they had not yet been attending long enough to be able to know if it would change their practice.

5.3. Benefits to departments

A number of themes emerged from open text responses about the key benefits respondents considered their departments would get from their participation in the drylabs networks. More than half of respondents considered their department would benefit from the knowledge they would gain through their sharing and exchange of ideas including how this would assist with planning for lab delivery. Several respondents also felt that the visibility, reputation and esteem of their departments would increase through their participation and that beneficial collaborations would develop. Improved consistency, quality and standards for undergraduate labs was also felt to be an important benefit along with providing an improved student experience.

5.4. Impact on individuals' knowledge

Responses show that all three networks assisted in increasing participants' knowledge of specific areas related to laboratory teaching at some level. More than half of respondents from the DryLabs20 and #DryLabsRealScience networks considered that they had had a large increase in knowledge in relation

to “online/virtual/remote lab teaching options”. DryLabs20 respondents also considered that they had had a large increase in knowledge in relation to “considerations relating to social distancing in labs” and “who is working in a similar area to you and what their interests/areas of expertise are”. #DryLabsRealScience reported a large increase in knowledge in relation to “technology to enhance/support lab teaching” with the other two networks reporting a small increase in knowledge in this area. In addition, across all three networks, more than half of respondents considered attending the network had led to a small increase in knowledge in relation to “Assessment” and “Student wellbeing considerations”.

5.5. Development of new contacts

Over half of respondents (62%) from the DryLabs20 network reported that they had made new contacts through the network. Of these, 43% had contacted these peers outside of the network. Within the #DryLabsDownUnder and #DryLabsRealScience networks, a lower percentage of respondents reported having made new contacts (42% and 28% respectively). However, of these a larger percentage had then made subsequent contact with these individuals (50% and 73% respectively).

5.6. Experience of participating

The majority of participants to all three networks reported feeling welcome (Table 8) and feeling very comfortable taking part in discussions (Table 9). Three (out of 34) respondents from the Drylabs20 network reported feeling somewhat or very uncomfortable taking part in discussions, these corresponded to the respondents that reported feeling neither welcome or unwelcome or very unwelcome.

		Very welcome	Somewhat welcome	Neither welcome nor unwelcome	Very unwelcome
	N	%	%	%	%
DryLabs20	34	68	24	6	3
#DryLabsDownUnder	19	68	26	5	0
#DryLabsRealScience	23	83	17	0	0

Table 8. How welcome participants felt when participating in the networks.

	Very comfortable		Somewhat comfortable		Somewhat uncomfortable		Very uncomfortable		Not applicable	
	N	%	N	%	N	%	N	%	N	%
DryLabs20	21	62	10	29	2	6	1	3	0	0
#DryLabsDownUnder	13	68	6	32	0	0	0	0	0	0
#DryLabsRealScience	13	57	8	35	0	0	0	0	2	9

Table 9. How comfortable participants felt taking part in discussions.

5.7. Engagement

From the DryLabs20 network, 29% of respondents had given a presentation. This figure was 42% for the #DryLabsDownUnder network and 14% for #DryLabsRealScience. The percentage that had shared thoughts, ideas or experiences at meetings was much higher with 91% for DryLabs20, 84% for #DryLabsDownUnder and 65% for #DryLabsRealScience. Of the 35% of respondents that indicated that they had not shared thoughts and experiences at the #DryLabsRealScience network, all reported that they felt very welcome.

5.8. Barriers to participation

Respondents were asked if they had encountered any barriers or challenges which affected their ability to participate fully in the drylabs networks. Key themes which emerged were clashes with other work commitments (e.g. online teaching, exam boards, administration, general high workload), time commitment due to the length of the meetings, internet connection problems, and working from home with children or other caring responsibilities. Reduced concentration and attention span were also problematic in the online environment.

The online nature of the networks meant that some respondents found that ad-hoc discussions were more difficult and that there was a lower depth of interaction in the networking outside of the discussion around presentations. The DryLabs20 network introduced breakout room sessions as a means of facilitating deeper discussion. A small number of respondents reported difficulties introducing themselves or joining in within what felt like an already established community.

5.9. Suggested changes or improvements to the networks

There was a general consensus from respondents that the network was beneficial and that there was a desire for it to continue. However, reducing the frequency of meetings once teaching recommenced was suggested by several respondents.

6. Change in engagement created by COVID-19

A rich set of responses were received to an open-text question on whether respondents had engaged with the drylabs networks differently compared to any previous networks they had been part of, due to the exceptional circumstances created by COVID-19.

In general, the response to the online face-to-face format of the networks was positive and respondents felt that they had been able to participate and access the networks in a way that would not have been possible previously. Key themes that emerged are summarised in Table 10. Not all changes were considered to be positive and a mixed response was received relating to workload and varying flexibility within roles.

Facilitating factor	Detail
Necessity	• The current exceptional circumstances had *"added a great NEED to the situation on top of the normal CPD".* • COVID-19 had created an immediacy and necessity with respondents prioritising attendance over other activities. • COVID-19 "*catalysed*" involvement.
Collegiality and collaboration	• Particularly from the #DryLabsRealScience respondents, the collegiality and sense of positive sharing within the network had made a difference for their participation: *"We are all learning together in a challenging situation where no-one has all the answers. The collegiality and positivity of the meetings has been great".* • The shared resources and ability to access the presentations after the sessions had been a particular benefit for respondents from the #DryLabsRealScience network.
Time	• Overall smaller time commitment to attend the online meetings had enabled respondents to attend the drylabs networks compared to participation in networks in the past. Central to this was the lack of travel time. Respondents stated they would previously have been unlikely to engage with a network especially if travel had been needed or a whole day had to be committed to attend. • Working from home had led to more flexibility to be able to attend meetings. • Changed teaching patterns due to COVID-19 assisted in freeing time when they could attend. • Flexibility around childcare from not having to travel was also noted in the comments.
Cost	• Free cost of participation. • Lack of travel costs associated with online meetings.

	• Some respondents commented that they may have been able to find funding to attend a single meeting, but funds to cover attendance at the frequency of the drylabs networks would not have been possible if there was a cost to participating or if travel had been required. • Multiple respondents commented that it is a challenge for them to access funds for this type of activity.
Growing networks	• Frequency of meetings leading to a greater ability to meet more people compared to a single one-off face-to-face meeting, especially when attendance at in person meetings was often problematic. • The ability to connect beyond their normal network, especially due to the online nature of the event enabling attendance from international colleagues, this would not have been possible for an in-person event.
Accessibility	• One respondent indicated that they found it much easier to interact online through breakout rooms and the chat function, as they found in person social events difficult. • Inclusion of discussion within the networks was commented by one respondent to have been important to them ensuring that they put time aside to attend, as this was an important part of the learning for them.
Flexibility	• Flexibility due to the online nature of the meetings. • Ability to multitask during less relevant sessions • Ability to jump between breakout rooms enabled the respondents to get the most from their participation.
Wellbeing	• For some attendees, the meetings provided a routine, and attending the meetings on a fortnightly basis was commented by one DryLabs20 respondent to be *"really important for maintaining my own happiness".*

Table 10. Summary of themes relating to how respondents considered that the exceptional circumstances created by COVID-19 had led to them interacting differently with the drylabs networks compared to previous networks.

Respondents were asked to comment on whether the online nature of the drylabs meetings changed their interaction with colleagues. In general, respondents found that the online nature of the meetings had had a positive impact for them. Key themes included:

- The names of participants being present on screen at all times. This assisted for those with memory problems and also for finding out about colleagues' research interests by being able to look them up online more easily.
- Facilitating interaction with colleagues from around the world. Breakout rooms and the chat function in Zoom were commented to particularly facilitate conversations, both with new and existing colleagues.
- More discussion about talks and including a broader group (e.g. international colleagues) that may have occurred at an in-person meeting. Chat boxes were also commented to make it easier to break down barriers and to interact with others.
- Communication was reported to be more inclusive and that the chat function made conversations more democratic. One respondent commented how the online format made it easier to talk to everyone in a room. A female respondent commented that the online format levelled the playing field *"I felt that I could have a voice here (often this is not the case since male colleagues are quite effective in derailing contributions). I felt that this network levelled the playing field very well."*
- Respondents indicated that the online meetings made conversation easier and that they felt more at ease *"Helped with my anxiety in meeting people from other institutions"*. One respondent commented that it was *"easier to be somewhat anonymous/passive so lowers the barrier to join in"*.
- The barrier to perceived seniority was also commented to be lessened by the online format *"The Zoom format makes me more comfortable expressing my opinions than if I were in a face-to-face breakout session with scary-good people"*. *"It was good to see names [of participants],*

but I would rarely know which institution they were from or how senior they were, so perhaps helped with not being intimidated."

However, not all responses were positive, challenges that had been encountered included:

- The online format being easier to access but *"not necessarily easier to speak"* with another respondent indicated that they had an increased reluctance to speak due to talking over one another.
- Technical limitations of how many people could be seen on the screen at once.
- That the online format had made networking in an informal way more difficult.

A number of respondents commented that the online format had not changed how they interacted with colleagues and several noted that online video conferencing had become a familiar activity since the beginning of the pandemic.

7. Development of individuals

7.1. Support for attending the drylabs networks

The majority of participants in all three networks had recommended the network to colleagues (88% DryLabs20, 79% #DryLabsDownUnder, 96% #DryLabsRealScience). Over half of respondents from the DryLabs20 network felt supported to be part of the network by their line manager (Figure 2). Participants from the #DryLabsRealScience network also felt supported by their colleagues to attend. In general, all three networks saw an increase from respondents in the level of support they felt they had to continue to attend the networks (Figure 3).

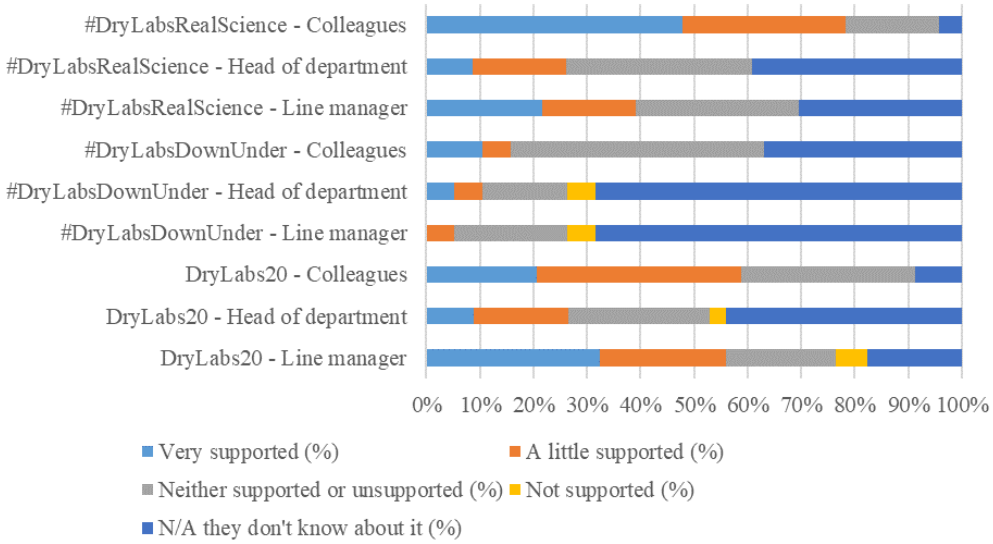

Figure 2. How supported/encouraged respondents felt to be part of the drylabs networks by different stakeholders (DryLabs20 n=34, #DryLabsDownUnder n=19, #DryLabsRealScience n=23).

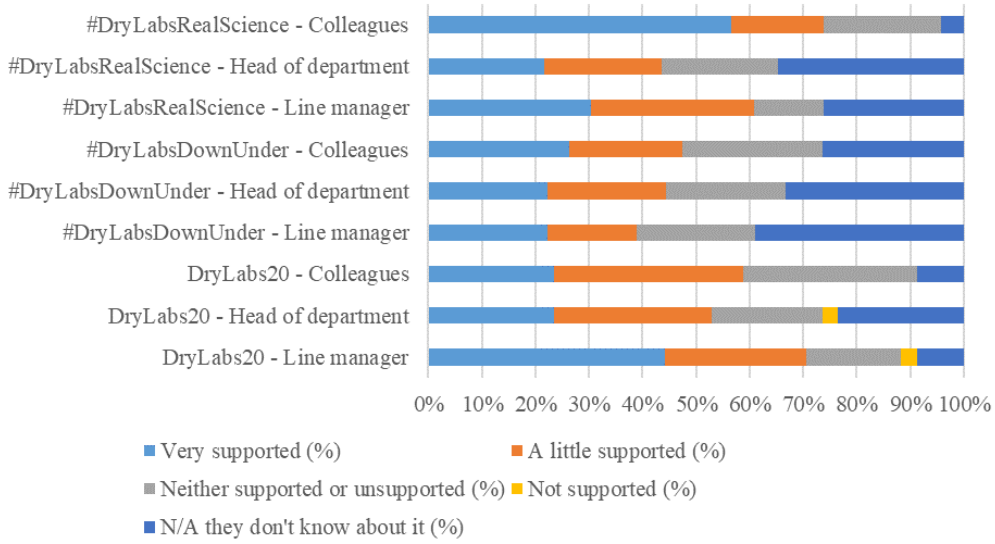

Figure 3. How supported/encouraged respondents felt to *continue* to be part of the drylabs networks by different stakeholders (DryLabs20 n=34, #DryLabsDownUnder n=18/19, #DryLabsRealScience n=23).

7.2. General impact on respondents' confidence

Respondents to the survey commented that being part of the network had increased their confidence in their own practice or that of their department.

> *"...confirmed that my approach to supporting pedagogy in the lab environment was well grounded and well founded so provided me with much more confidence."*
>
> DryLabs20 network

> *"...confidence in the quality and equivalency of my current practice."*
>
> #DryLabsRealScience network

> *"Confirming that our choice of how to present lab work to our students was a sound one."*
>
> #DryLabsDownUnder network

Responses also suggested that participants considered themselves and each other to be representatives of their departments, sharing and taking knowledge back to their home department.

7.3. Impact on participants' confidence to change their own practice in specific areas related to laboratory teaching from attending the drylabs networks

More than half of DryLabs20 respondents reported a large increase in confidence to change their own practice in relation to laboratory teaching in relation to "considerations relating to social distancing in labs" and #DryLabsRealScience reported a large increase in relation to "online/virtual/remote lab teaching options". There were no areas in which more than half of #DryLabsDownUnder respondents considered they had had a large increase in confidence.

Respondents from all three networks indicated a small increase in confidence to change their own practice in relation to "networking". Two out of three networks reported a small increase in confidence in relation to "student wellbeing considerations", "technology to enhance/support lab teaching", "student lab skills" and "course development".

7.4. Impact on participants' confidence and practice relating wider elements of their role in HE teaching from attending the drylabs networks

More than half of respondents from all three networks reported a small positive impact on their confidence and practice in relation to "the way they design their lab courses", "development of their collaborations" and "their teaching practice in the lab".

7.5. Impact on participants' confidence to discuss/implement changes in practice within their department in specific areas related to laboratory teaching from attending the drylabs networks

All networks reported increased confidence to discuss/implement changes in practice within their department in relation to "online/virtual/remote lab teaching options". Two of the three networks showed increased confidence in "course development" and "assessment". Only #DryLabsRealScience showed increased confidence in discussing or implementing change in considerations relating to social distancing in labs.

Table 11 shows that there were fewer areas in which respondents considered that drylabs had increased their confidence (either a small or large amount) in relation to discussing or influencing changes in laboratory teaching at a departmental level compared to impact on individual practice.

Number of areas showing an increase in confidence in relation to …	DryLabs20	#DryLabsDownUnder	#DryLabsRealScience
Changing own practice (out of 12 areas)	6	5	7
Discussing/implementing changes in practice within their department (out of 10 areas)	3	2	4

Table 11. Number of areas in which respondents considered that attending the drylabs network had increased their confidence to discuss or implement change to their own practice or within the department.

7.5. Ability to implement change

Respondents were asked to report how able they felt in relation to suggesting or implementing changes to teaching practice/course design within their department (Table 12). The vast majority had some ability to suggest and implement changes at departmental level. However, whereas for #DryLabsDownUnder and #DryLabsRealScience the ability to suggest and implement changes was very similar, noticeably fewer DryLabs20 respondents felt very able to implement changes (18%) compared to suggesting them (44%).

Considering the findings based on the experience level of the respondents (Table 13) shows that for those respondents for whom teaching/supporting teaching had been part of their role for more than 10 years, only 50% of DryLabs20 respondents, 30% of #DryLabsDownUnder respondents and 56% of #DryLabsRealScience respondents felt very able to suggest changes to teaching practice/course design within their department. One comment received in response to an open question on barriers to participation highlighted this sentiment

> *"Most of us participating have heavy admin loads and much, if not all, the responsibility to respond to and to create a robust new delivery of labs (and teaching) rests on our shoulders. However, many of us do not wield the power to make decisions so we are buffeted by the vagaries and changeable rules and dictates. Most of us are permanently exhausted and see no change in the future. There is a lot of responsibility and it isn't clear that this will be recognised or rewarded in the future."*
>
> *DryLabs20 network respondent, in role 10+ years*

	DryLabs20		#DryLabsDownUnder		#DryLabsRealScience	
	N	%	N	%	N	%
Suggest changes to teaching practice/course design within your department?						
Very able	15	44	5	26	12	52
Somewhat able	18	53	12	63	10	43
Not able	1	3	2	11	1	4
Implement changes to teaching practice/course design within your department?						
Very able	6	18	7	37	11	48
Somewhat able	26	76	10	53	10	43
Not able	2	6	2	11	2	9

Table 12. Respondents answers to the question "To what extent do you feel able to…"

	DryLabs20		#DryLabsDownUnder		#DryLabsRealScience	
	N	%	N	%	N	%
Somewhat able to suggest changes within department	5	42	6	60	4	44
Very able to suggest changes within department	6	50	3	30	5	56

Table 13. Perceived ability to make changes within their department for respondents' that had teaching/supporting teaching as part of their role for 10+ years.

8. Discussion

Respondents were overwhelmingly positive about the role the networks had played in assisting them in a time of great need. Multiple factors had come together in March 2020 to enable the successful creation and facilitation of engagement with the networks. The circumstances created by COVID-19 removed barriers that had previously existed for Biosciences and Chemistry laboratory-focused teaching staff in HE in the UK and Australia to engage with PLNs.

8.1. Did the networks meet their aims?

Overall, the drylabs networks met the aims for which they had originally been created. The meetings were well attended, with more than half of all respondents attending at least half of the meetings and the networks had facilitated participants developing new contacts. Responses show that all three networks assisted in increasing the knowledge of participants, with the areas and levels to which this occurred varying across the networks. Additionally, respondents reported that attending the networks had led to an increase in their confidence to change their own practice in several areas in relation to laboratory teaching. In relation to increasing confidence or practice relating to wider elements of their role in HE teaching, respondents indicated that attending the networks had led to a small positive impact in some areas.

The majority of respondents reported that they felt they had some ability to suggest changes to teaching practice/course design within their department. However, there was a noticeable difference between networks in relation to respondents feeling able to implement change. Whereas for the #DryLabsDownUnder and #DryLabsRealScience networks, respondents reported that they considered their ability to suggest and implement change to be very similar, noticeably fewer DryLabs20 respondents felt very able to implement changes compared to suggesting them. Of greater note is the finding that for respondents for whom teaching/supporting teaching had been part of their role for more than 10 years, only 50% of DryLabs20 respondents, 30% of #DryLabsDownUnder respondents and 56% of #DryLabsRealScience respondents felt very able to suggest changes to teaching practice/course

design within their department. This concern is compounded by the finding that there were few areas in which respondents considered that attending the networks had increased their confidence in relation to discussing or implementing change within their department. The findings highlight that experienced staff are not feeling empowered to make changes within their department, despite many years in their roles.

8.2. Supportive community

Participants to all three networks reported feeling welcome and being very comfortable taking part in discussions. The majority reported that they had shared thoughts, ideas or experiences at meetings. Scott (2015) and Brown (2020) both highlight the importance of a welcoming and 'safe' environment to create a trusting environment in which participants feel able to share ideas, take risks and share innovative ideas.

Across the three networks, the main reasons for continuing to attend included learning from the ideas and experiences of colleagues at other institutions, to be part of a community of experts in practice, how welcome they felt, the practitioner focus of the meetings and the need to develop knowledge of different teaching methods (due to the impact of COVID-19). Of particular interest, is the practitioner focus of the meetings that changed from being in the top three "very unimportant" factors for initially attending the network, to being in the top three "very important" factors for continuing to attend the #DryLabsRealScience network. This may highlight those participants had not realised the importance of being part of a community of practice before attending drylabs, possibly due to not having the opportunity to be part of one previously. However, once this had been experienced, this became something that they were keen to continue.

8.3. Online with face-to-face engagement as a space for PLNs

In general, the response to the format of the networks was positive and respondents felt that they had been able to participate and access the networks in a way that would not have been possible previously with physically in-person events.

The networks appeared to have facilitated discussion and contribution from a wider range of voices than would have been the case with an in-person network meeting (e.g. due to attendance by international colleagues). Breakout rooms on the video conferencing platform were considered to have been particularly beneficial for facilitating conversations. The use of the chat function was also commented upon to have facilitated more active discussion and to have broken down barriers to perceived seniority and for those who may have been less keen to ask a question or comment verbally.

One aspect which could be interesting to explore in future research is whether the online face-to-face format leads to participants engaging at a more superficial level compared to in-person PLNs. This could be hypothesised from the findings that respondents considered that it was less easy to engage in in-depth conversations, that it was easier to split attention across multiple tasks and to jump between breakout room topics, along with some participants reporting reduced concentration.

Participants considered the reduced time commitment for attending the online meetings, compared to in-person meetings, to be particularly beneficial. Respondents noted that they previously would have been unlikely to engage with a network especially if travel had been needed, or a whole day had to be committed to attend. Flexibility around childcare from not having to travel was also noted in the comments.

Another benefit that the online nature of the meetings had brought was that there were no travel costs or registration fee to attend. Access to funding by teaching-focused HE staff was highlighted to be particularly difficult, and would not have been available for in-person attendance at the frequency at which the online sessions ran.

The online face-to-face nature of the drylabs networks appears to have inadvertently highlighted and simultaneously addressed several previously unacknowledged challenges. Firstly, that participation at PLNs was logistically challenging for teaching-focused staff in HE, due to a lack of time and funding to attend. Secondly, that expertise in HE laboratory-focused teaching is geographically widespread, and the online nature of the network has removed this barrier for attendance. Thirdly, that some participants felt uncomfortable or felt they could not make their voice heard at in-person PLNs, but the online nature of the drylabs network had provided a new, safe space in which they felt they could contribute. Finally, that the drylabs networks provided a practitioner-focused, free, national "public" network in HE Chemistry and Biosciences laboratory teaching, which had previously not been available.

8.4. Benefits of the networks for individuals

Respondents reported several areas in which attending the networks had already provided benefits and led to changes in practice, including helping with the development of teaching plans and facilitating the exchange of ideas. The networks had assisted participants with their understanding of the wider-picture of practice, which several reported that they had been able to use as a lever for change within the home department. The findings demonstrate many of the benefits of PLNs that have been observed in previous studies (Macia & Garcia, 2016; Trust, 2012; Lantz-Andersson et al., 2018; Davis, 2015; Trust, 2017).

The sharing of knowledge, experiences and plans to improve consistency, quality and standards for undergraduate laboratory teaching was also felt to be an important benefit along with providing an improved student experience. These findings align with many of the factors for successful implementation of PLNs (Brown, 2020).

8.5. Facilitating PLN implementation

Further factors that align with research evidence around successful implementation of PLNs were also stated by respondents (Harris & Jones, 2010; Hubers & Poortman, 2018; Brown, 2020).

Collaboration

The collegiality and sense of positive sharing within the networks was commented on as having been particularly beneficial by respondents. Being able to connect beyond their normal network and the frequency of meetings enabling participants to meet more people than a one-off conference was considered to have made the network different to other activities.

Leadership

Buy in to the purpose of the network – As well as the individual benefits gained from participating in the network, respondents were also positive about the benefits they considered their department would get from their attendance, including knowledge gain through sharing and exchange of ideas to assist with planning for lab delivery. In addition, several respondents highlighted the benefits to the visibility, reputation and esteem of their departments through their participation in the network.

Support to engage in the network – Just over half of respondents from the drylabs network felt supported by their line manager and colleagues to be part of the networks. In general, all three networks saw an increase in the level of support respondents felt they had for continuing to attend the networks. However, the responses to the survey also indicate that respondents did not consider it important that they were encouraged to attend the network by colleagues or that they were required to attend as part of their role. Research shows that it is important for leadership to provide support for effective participation in PLNs (Brown & Flood, 2019; Brown, 2020). The literature suggests that this support should be evidenced through both the provision of resources (including time to discuss and implement change back in the home institution in addition to the initial time to attend the PLN meetings), as well as ensuring that the member of staff is empowered to lead change through distributed leadership. Additionally, research evidence shows that if participation in PLNs is not formalised with leadership,

then there is a risk that participation in the PLN becomes a 'bolt-on' on top of existing work, rather than it being resourced to provide time within the role. Therefore, although staff may not currently consider that they need encouragement from leadership to attend network meetings, buy-in for participation from leadership should be considered to be important to ensure staff are supported to be empowered to lead change and to have access to sufficient resources to effectively implement the changes. Considered alongside the finding that significant proportion of experienced respondents that felt that they were not able to suggest change within their departments, these findings may be an indication that the expertise of laboratory-focused teaching staff is potentially being over-looked and under-valued within departments.

Prioritisation

Several respondents indicated that key reasons why they had chosen to participate in the DryLabs20 network at this particular point in time was the immediacy and necessity that been created by COVID-19. One respondent commented how they had prioritised attending over other activities and another felt that the COVID-19 conditions had "*catalysed*" their involvement. There was a feeling that the current exceptional circumstances had "*added a great NEED to the situation on top of the normal CPD*". The increase in priority for such an activity follows the literature which suggests that self-initiation to attend has been of increasing importance for successful PLNs and that successful engagement will only occur if the individual is able to prioritise both attending and acting on their learning from the network (Biddolph & Curwood, 2016; Tour, 2017; Trust, Krutka, & Carpenter, 2016; Brown, 2020).

Respondents indicated that clashes with other work commitments (e.g. online teaching, exam boards, administration, general high workload), time commitment due to the length of the meetings, internet connection problems, working from home with children or other caring responsibilities had all led to challenges for participation. Therefore, although it had been possible to prioritise participation in the network when there was alignment between the focus of the goals of the network and the main competing priorities of the other elements of staff's roles (i.e. redeveloping laboratory courses for socially distanced, remote or online delivery), it will be important to see whether engagement with the networks continues to remain as a priority over time. This is again an area where research shows that leadership plays an important role in supporting staff to see the benefit of prioritising participation in PLNs, providing sufficient resource to participate fully and to ensure that in the long-term staff are empowered to lead change (Brown, 2020).

Leadership of the network

A final important element to consider is the role of leadership of the networks. All three networks reported that leadership had been carried out as an addition to their existing roles. Moving forward, this may be a role which the network leaders may wish to formalise with leadership within their own organisations to ensure sufficient recognition, resourcing and support for the valuable role they have been undertaking (Brown, 2020).

8.6. COVID-19 at a catalyst

COVID-19 has played an important and unexpected role in facilitating the success of the three drylabs networks. Respondents to the survey highlighted that it had previously been challenging to find the time or funding to engage with this type of professional development, in addition to there not having previously been a practitioner-focused PLN of this type in this area. COVID-19 created a common focus for the networks and prioritised engagement that aligned with individual and organisational needs. The necessity to move networking activities online also created a more accessible (and importantly cost-free) means for a broader range of staff to participate. The nature of remote working, changes to teaching loads and alignment with institutional needs, also meant that previous barriers to participation around asking/gaining access to funding from leadership or arranging buy-out from teaching in order

to attend were removed. For many respondents, this enabled the possibility of self-initiation of engagement in the networks (Tour, 2017).

8.7. Recommendations

Moving forward, the authors recommend that leaders in HE should give significant consideration to the empowerment of teaching-focused staff to lead change within their specialist areas along with consideration as to how they can be suitably resourced to engage with opportunities for professional growth through PLNs. Teaching-focused staff are frequently isolated in their specialisms within their own department, and therefore the opportunity to engage with meaningful discussion, collaboration and innovation with other teaching-focused staff outside their own institution is essential for the development of high-quality and innovative teaching practices.

Respondents reported that they were keen for the networks to continue. In the longer-term, the nature of the focus for the networks is likely to need to adapt to best suit the changing priorities of the individuals and their departments. Participants and leaders should understand that it takes time for the benefits of a PLN to come to fruition (Brown, 2020). COVID-19 presented an unusual situation where there were significant, rapid, short-term wins due to the need to address the immediate challenges presented by COVID-19. However, it is likely that moving forward, change and innovation will occur more slowly. This, however, does not make participation any less valuable and should be encouraged and supported wherever possible.

8.8. Limitations of the current study and opportunities for further research

The current study was conducted between July and September 2020, which was still in the highly exceptional period of emergency remote teaching for many HE institutions. The study was limited in the method of data collection and number of responses from participants, and this should be taken into consideration when interpreting the findings. However, although the sample of respondents may not capture the full range of experiences of all participants, the responses provide a valuable insight into the views of a wide range of laboratory-focused HE teaching staff from a broad range of institutions.

Future research would benefit from collecting data from a larger sample of participants using a longitudinal design to investigate changes in engagement over time. Consideration of the impact of participation on teaching practices within home departments alongside understanding support from leadership would also be beneficial to investigate. As noted above, further exploration of the barriers and challenges for continued participation in the networks should be undertaken.

9. Conclusion

In March 2020, COVID-19 presented a highly challenging situation for educators, raising the question of how to continue to deliver laboratory courses remotely. Three new Professional Learning Networks (PLNs) formed to support laboratory-focused HE teaching staff in Biosciences and Chemistry in the UK and Australia in response to this challenge. This study has shown that these networks provided a vital source of knowledge, discussion and collaboration to support the innovations in teaching that were required during this challenging time. This paper contributes important findings relating to the need for PLNs for building scientific communities in HE and identifies misaligned power dynamics for implementing change in laboratory-focused teaching in HE.

Prior to the COVID-19 pandemic, it had been challenging for respondents to find the time or funding to engage with this PLNs, COVID-19 created a common focus for the networks and led to prioritised engagement that aligned with individual and organisational needs. The necessity to move networking activities online created a more accessible (and importantly cost-free) means for a broader range of staff to participate. The nature of remote working, changes to teaching loads and alignment with institutional

needs, also meant that previous barriers to participation around asking/gaining access to funding from leadership or needing/arranging buy-out from teaching to attend was removed.

Findings from the study have highlighted a lack of empowerment for some highly experienced teaching-focused staff to lead change within their departments. A key recommendation from this study is that leaders in HE should give significant consideration to the empowerment of teaching-focused staff to lead change within their specialist areas along with consideration as to how they can be suitably resourced to engage with opportunities for professional growth such as PLNs.

Limitations of the current study included the number of responses received and self-report nature of the study at a single point in time. However, the findings provide a valuable indication of the views of laboratory-focused teaching staff from 44 HE institutions in the UK, Ireland, USA and Australia and highlight findings that warrant further investigation. Future research should investigate in more depth the origins of the perceived lack of empowerment of teaching-focused staff, in addition to further exploration of the barriers and challenges for continued participation in PLNs.

There was a clear desire from respondents that the networks continue and careful consideration should be given as to how this is supported. Whether the networks have longer-term success and can be maintained will depend upon whether former barriers to participation reappear, or whether priority is given to opportunities for professional development (through activities such as PLNs) by both participants and senior leaders.

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