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Teachers without borders:
Professional learning spanning social media, place, and time

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Abstract

Educators must consider how today's technology-mediated environments expand our conceptualization of learning contexts and the continuities and tensions between learning and participation in various settings. The Covid-19 pandemic disrupted educational systems worldwide, necessitating emergency remote teaching and coinciding with increased social media use. Such shifts require reconceptualization of learning boundaries in a digital age. This article explores British and American teachers' professional learning spanning social media, place and time. We collected #UKEdchat tweets and #Edchat tweets over 28 months, January 1, 2019–April 30, 2021, and identified tweeters who were middle or secondary school teachers in the U.K. and U.S. to interview. From analysis of these data, we report on the tensions, synergies and experiences of boundary-crossing teachers with implications for research and practice.

Keywords: teachers; professional learning; boundaries of learning; emergency remote teaching; Covid-19; social media

Introduction

Educators and researchers must consider how today's technology-mediated environments expand conceptualizations of learning contexts and the continuities and tensions between learning and participation in various settings. The Covid-19 pandemic disrupted educational systems worldwide. Teachers and students rapidly transitioned to *emergency remote teaching*, markedly different from planned online teaching (Hodges et al. 2020). This shift coincided with existing trends towards increased self-directed learning and social media use. Today, approximately half the world's population is using social media (Statista Research Department 2022) with usage

accelerating during Covid-19 (Koeze and Popper 2020). Such shifts in the educational landscape require our reconceptualization of the boundaries of learning in a digital age.

We agree with Colley and colleagues (2003) that learning encompasses formal (e.g. externally directed) and informal (e.g. spontaneous) attributes to varying degrees, rejecting claims that formal and informal learning have clear boundaries or lie on a continuum (Authors 2016). Professional learning is a complex process that develops teachers' attitudes, knowledge, and practices across various domains (Trust et al. 2016). Within this broader framing, we conceive of teachers' *professional learning networks* (PLNs) as interactive systems of people, spaces, tools and resources (Trust et al. 2016; Trust et al. 2017) that span social media and other contexts (i.e., online/offline; before/during/after pandemic; Authors 2016; Authors 2021). To reconsider the boundaries of learning, we explore teachers' engagement with social media for professional learning before and during the Covid-19 pandemic. We view such uses of social media as often (but not always) having *more informal* than formal learning attributes and contrast this with professional development such as face-to-face workshops, which we view as having *more formal* than informal learning attributes. This study analyzes tweets and interview data from U.K. and U.S. teachers participating in the Twitter communities #UKEdchat and #Edchat, two of the longest-running hashtagged conversations on Twitter pertaining to educational topics. This study answers two research questions:

- (1) How do the #Edchat and #UKEdchat Twitter hashtags provide opportunities for teachers to develop their PLNs?
- (2) How do U.K. and U.S. teachers experience more formal and more informal professional learning spanning social media and other contexts?

Theoretical framework

Grounding our work in sociocultural theoretical frameworks, firstly, we draw on our (re)conceptualisation of formal, informal and social media learning attributes (Authors 2016). Secondly, we draw on boundaries and boundary crossing between social worlds (Akkerman and Bakker 2011) which create opportunities for learning.

We conceptualize learning as a blend of co-existing formal and informal attributes which may differ in importance (Authors, 2016). We also specifically consider social media learning attributes. For example, we view Twitter communities as having both informal and formal learning attributes in different blends. A teacher may use Twitter to seek specific advice spontaneously (primarily informal learning attributes), or a teacher may use Twitter to continue learning after a face-to-face school-led workshop (primarily formal learning attributes). Learning attributes are organized into four areas (Colley et al., 2003). Firstly, *purpose* which includes who initiates the learning activity and the desired audience. Secondly, the *process of learning* which considers the roles of self and others, alongside the artifacts used to support learning. Thirdly, *location and context* includes space/place and the social structures that frame the learning that takes place (e.g. the timeframe). Finally, *content* which identifies the nature of the knowledge being acquired.

We also draw on theories of boundaries and boundary-crossing in relation to the use of social media for professional learning. A boundary is ‘a socio-cultural difference leading to discontinuity in action or interaction’ between sites or communities that are related in some way (Akkerman and Bakker 2011, 113). Movement across such boundaries opens up new opportunities for learning through engaging in multiple social worlds and encountering different and potentially conflicting multiple perspectives (Akkerman and Van Eijck 2013). Learning through boundary crossing is conceptualized broadly and includes gaining new knowledge,

changes to practice and developing identities (Akkerman and Bakker, 2011). Here we focus on multiple instances of professional learning for teachers, with different balances of in/formal learning attributes. These different social worlds often operate within different and fluctuating boundaries and can be composed of overlapping communities from different professions (e.g. edtech developers, teachers, professionals such as artists). Interactions between these communities can facilitate learning about new practices (identification), learning how to work across boundaries through tools and procedures (coordination), understanding practice through different perspectives (reflection), and adopting or co-developing new practices (transformation) (Akkerman and Bakker 2011; Akkerman and Bruining 2016). Boundary objects are artifacts or arrangements/procedures (e.g. documents, meetings) that provide a purposeful and meaningful bridge between communities (Star 2010; Akkerman and Bakker 2011).

Literature review

Teachers' professional learning

How teachers learn and develop, especially in times of crises, is complex and multidimensional (Authors 2021); teachers must constantly adjust to new students, new curricula and reforms requiring navigation of potentially conflicting messages about what and how to teach (Horn et al. 2008) from numerous sources (Trust and Prestridge 2021). Crises accelerate change, whether schooling is disrupted by terrorism (Greenhalgh and Koehler 2017) or a pandemic (Authors 2021).

To understand teachers' professional learning, we can examine their *professional learning networks* (PLNs) (Trust et al. 2017). PLNs foreground the individual; they are dynamic systems that change based on the person's goals, needs, and interests. They can evolve with or without formal learning objectives and are 'multifaceted systems that often incorporate multiple

communities, networks of practice, and sites that support both on- and off-line learning’ (Trust et al. 2016, 17).

PLNs can encompass, but are not limited to teacher professional development (PD) with more formal learning attributes, which, scholars have argued, is often disconnected from teachers’ specific learning needs, rendering it ineffective (Opfer and Pedder 2011); they have advocated for professional learning opportunities that are social, personalized, and available for long-term support (Desimone 2009). With technological advancements, teachers have increasingly turned to networking with colleagues, especially through social media, to meet professional learning needs (Authors et al. 2020; Macià and García 2016). Macià and García (2016) found educators leveraged online networks for professional learning purposes such as seeking teaching-related resources; asking and answering questions; reflecting; and garnering emotional support. The types of people in educators’ PLNs can vary (e.g. from same-subject teachers to others within or outside education; Trust et al. 2016). Furthermore, social media growth has increased opportunities for teachers to cultivate PLNs that ‘span across traditional spatial, temporal, and institutional boundaries’ (Trust et al. 2017, 2).

Recent literature reviews have indicated that global social networks (i.e., Facebook and Twitter) have been integrated into educational settings (Authors, 2020), and Twitter is one of the most adopted for teachers’ professional learning (Authors 2020; Authors 2017). Twitter research has noted that *hashtags* (text preceded by the ‘#’ symbol; e.g., #Edchat) offer a means of organizing distinct conversations (Author 2019; Author et al. 2020). #Edchat and #UKedchat provide appropriate spaces for this study because they are sustained conversations with a high volume of participation (Author 2020; Carpenter et al. 2020). #Edchat, for instance, has more than 100,000 tweets monthly, nearly all centered on education (Author 2019). In addition,

#Edchat has been one of the most widely subscribed teacher networks on Twitter (Carpenter and Krutka 2014; Author 2019) and a documented source of benefits to teachers' professional learning (Carpenter and Krutka 2014).

Teachers' professional learning during Covid-19

Global public health emergencies have been shown to disrupt normal teaching conditions (Crompton et al. 2021), and in turn, teachers' professional support networks (Rehm et al. 2021). Such crises require teachers to think and act quickly to respond to students' needs (Authors 2021). During such times conventional sources of teacher learning (e.g., more formal face-to-face training) may be unavailable, and teachers' notions and practices for professional learning necessarily shift (Authors 2021). In Spring 2020, a pandemic disrupted school for over 80% of students (UNESCO 2020). Most governments moved to remote education, requiring teachers' use of digital technologies (UNESCO 2020), causing major disruption to existing practices such as face-to-face teaching (Authors 2021; Crompton et al. 2021). Uncertainties arose around emergency remote teaching (Hodges et al. 2020), raising questions for educators on the frontlines of change. For instance, Authors (2020) found that emergency remote teaching in the United States and the United Kingdom forced pedagogical challenges, created tensions in divisions of labor (e.g., parents as teachers), disrupted system rules, and generated equity issues, all of which teachers had to navigate while working from home. As U.S. teachers (94%) moved to teaching online (Kurtz 2020), new instructional practices included little synchronous interaction with students, reduced emphasis on assessment, and changed teacher workloads (Authors 2020). Although educational institutions attempted to support educators, there was insufficient time to prepare all teachers (Trust et al. 2020) with many turning online for support. Between February and March 2020, for instance, traffic to an educator support website increased

six-fold and inquiries about remote teaching and learning became commonplace (Cavanaugh and DeWeese 2020).

Methods

Combining data mining and qualitative research methods, we identified school teachers from the U.K. and U.S. through their participation in education-related conversations on the social media platform, Twitter. Specifically, we considered participation in #UKEdchat and #Edchat hashtagged communities *before* (January 2019–February 2020) and *during* (March 2020–April 2021) the shift to online teaching as a result of the Covid-19 pandemic (Authors 2021a, 2021b).

Data collection

We used the R programming language to collect tweets through the Twitter API and the Academic Research Product Track. Specifically, we used the *academictwitteR* R package (Barrie and Ho 2021), which provided access to the historical archive of tweets containing the text “#edchat” or “#ukedchat.” We then used the *tidytags* R package (Author 2022) to collect more complete metadata for these tweets, such as the location and profile description of the accounts that composed the tweets. In total, we collected 353,196 #UKEdchat tweets and 2,491,244 #Edchat tweets spanning a 28-month time period, January 1, 2019–April 30, 2021.

To identify specific U.K. and U.S. teachers to interview, we filtered the dataset to only include question tweets—that is, original tweets (i.e., not retweets) containing the “?” symbol. There were 25,423 #UKEdchat questions tweets and 121,690 #Edchat question tweets across the before and during time periods (Table 2). From these question tweets, we identified *high frequency* question tweeters who posed at least 10 questions to #UKEdchat or #Edchat either before or during Covid-19 (U.K.: 64 before, 39 during; U.S.: 357 before, 234 during). We manually reviewed these tweeters’ profiles and tweets to exclude those not apparently teachers

(e.g., administrators, magazines) or whose questions were rhetorical not help-seeking. We then identified a smaller sample of middle or secondary school teachers in the U.K. and U.S. to interview. We contacted 16 teachers in the U.K. via their school email or Twitter direct message; 4 teachers were interviewed. We contacted 38 U.S. teachers also via email and Twitter; 8 teachers were interviewed. To match the U.K. number, we selected the 4 U.S. interviewees most similar in gender, experience, and discipline to the U.K. teachers, ensuring a balance of perspectives across the two contexts. All interviewees were experienced teachers and Twitter users who had transitioned from face-to-face to online teaching during Covid-19-spring. However, their backgrounds varied by country, school type, and age range taught (Table 1; names are pseudonyms).

Table 1. Teacher Participants in Interviews

	Lila	Alejandro	Dorinda	Jerome	Amber	James	Simon	Stephanie
Country	U.S.	U.S.	U.S.	U.S.	U.K.	U.K.	U.K.	U.K.
Teaching Experience	19 years	23 years	30 years	16 years	15 years	19 years	35 years	2.5 years
School Type	Public	Private	Public	Private	Public	Public	Public	Public
Subject Taught (Spring 2020)	English Language Arts	Math	Social Studies	Business & Computing/ Technology Coordinator	English	Science	English	Art/Design
Institution Type	Middle (aged 12-13)	Secondary (aged 14-17)	Middle (aged 11-14)	Middle & Secondary (aged 12-18)	Further Education College (year aged 16-18)	Secondary (aged 11-18)	Secondary (aged 11-16)	Secondary (aged 11-16)

We used Zoom video-conferencing to conduct individual, semi-structured one-hour interviews.

We asked teachers about their history and purposes in using Twitter and #Edchat or #UKedchat

for professional learning, how this supported their professional learning before and during the shift to online learning because of Covid-19, and with what impact on their teaching practices. Specifically, we asked about their transition to emergency remote teaching, supports their schools provided, the nature of their #Edchat or #UKedchat question tweets during this period, and what impact #Edchat or #UKedchat participation had, if any, on their online teaching. We also showed interviewees a sample of 3-4 of their #Edchat or #UKedchat tweets from before and during the pandemic. Teachers described their purpose behind the tweet, what they asked about, the responses they received (and from whom), and how the responses related to their learning and/or teaching practices.

Data analysis

To understand more about #Edchat and #UKedchat as opportunities to develop teachers' PLNs (i.e., people, spaces, tools and resources) and contexts for their professional learning, we conducted several quantitative analyses. First, we created a table of different types of tweets in each hashtag (Table 2), noting the number of overall tweet volume, original tweets (i.e., not retweets), and question tweets (i.e., original tweets containing a question). Second, we created times series plots to compare the volume and trend of original tweets (Figure 1) and question tweets (Figure 2), with a green vertical line to mark March 1, 2020, the midpoint of the 28-month period and near when schools shifted to emergency remote teaching due to Covid-19.

To explore how the hashtags #UKEdchat and #Edchat intersect with other opportunities for developing teachers' PLNs, we also created plots of hashtags occurring in tweets alongside #UKEdchat (Figure 3) and #Edchat (Figure 4). The dots are shaded by log odds ratio, which shows the strength of association between hashtag inclusion before versus during Covid-19.

Dark purple and blue dots represent smaller differences between the before and during periods, whereas bright green and yellow dots show greater differences.

To understand how teachers' professional learning through these Twitter hashtags crosses geographic boundaries, we plotted the locations of #UKEdchat and #Edchat tweeters who posted original tweets. We used ggmap (Kahle and Wickham 2013), an R package designed to visualize spatial data on static maps, to convert the geographic locations of Twitter accounts into latitudinal and longitudinal coordinates through Google's Geocoding API. We plotted these coordinates onto a world map showing the locations of #UKEdchat tweeters and #Edchat tweeters, distinguishing between locations that appeared before, during, and both before and during Covid-19.

To understand teachers' experiences of professional learning, the first and second authors analyzed qualitative interview data. Informed by prior research and our theoretical framing, we generated codes within three overarching categories: (a) purpose of the professional learning, including accessing and sharing new practices; (b) location and context including space/place and the social structures that frame learning (e.g. the timeframe); and (c) boundaries and the related concepts of social worlds or communities, boundary-crossing, boundary objects, and discontinuity/continuities. Furthermore, by showing sample tweets to interviewees, we attended to the tweet's purpose and content; who interacted/responded; and connections to teaching (online or offline). For example, we noted teachers' *purposes* in posing question-tweets (e.g., crowdsource, prompt dialogue, share resource); *content* of the tweet (e.g., teaching-related challenges; resources offered, received or requested); *people* who were tagged, responded or interacted with the tweet; and *perceived connection(s)* to remote teaching.

To help ensure trustworthiness, we engaged in researcher negotiation of emerging codes (Saldaña 2016; Tracy 2016). Country-level human subjects approval in our institutions required that we independently collect and analyze data from our respective countries. Thus, the first two authors independently coded one interview transcript each, using a priori as well as emergent codes highlighting words and ideas expressed by interviewees describing their #Edchat or #UKedchat tweeting. Next, we relied upon ‘intensive discussion’ and ‘coder adjudication’ to reconcile discrepancies in codes (Saldaña 2016, 37). We individually coded remaining interviews and engaged in peer review: bringing coding questions to weekly meetings, discussing emerging codes, identifying potential themes, and clarifying or making modifications to reach consensus (Tracy 2016). As we sought to understand the ‘uniquely defined’ nature of professional learning, we composed individual case narratives that helped us analyze and interpret particulars by interviewee, followed by cross-case analysis to interpret commonalities (Yin 2014).

Results

RQ1: How do the #Edchat and #UKEdchat Twitter hashtags provide opportunities for teachers to develop their PLNs?

In total, we collected 353,196 #UKEdchat tweets and 2,491,244 #Edchat tweets. In both hashtags, usage decreased from before to during the pandemic, across each tweet type (Table 2). Although these decreases were substantial (Figures 1–2), approximately 30–40% per tweet type, there was still a high volume of tweeting in both hashtags during the pandemic, and contributors asked questions at a similar rate (i.e., percentage of tweets containing questions remained nearly the same), with an uptick in questions within #Edchat tweets. Thus, tweets were potential sources of tools and resources that teachers could use to develop their PLNs. Decreases in both

hashtags meant fewer potential opportunities for PLN development than in the past, but still a substantial number (e.g., hundreds of daily #UKEdchat and #Edchat tweets even at the end of the observation period).

Table 2. Types of Tweets Before and During Covid-19 by Hashtag

		Before Covid-19	During Covid-19	
		Jan. 2019–Feb. 2020	Mar. 2020–Apr. 2021	Change
#UKEdchat	All Tweets	205,630	147,566	-28.24%
	Original Tweets	111,199	70,233	-36.84%
	Question Tweets	15,749 (14.16%)	9,674 (13.77%)	-38.57%
#Edchat	All Tweets	1,552,099	939,145	-39.49%
	Original Tweets	645,250	386,893	-40.04%
	Question Tweets	72,417 (11.22%)	49,273 (12.74%)	-31.96%

Figure 1. Original Tweets Before and During the Covid-19 Pandemic

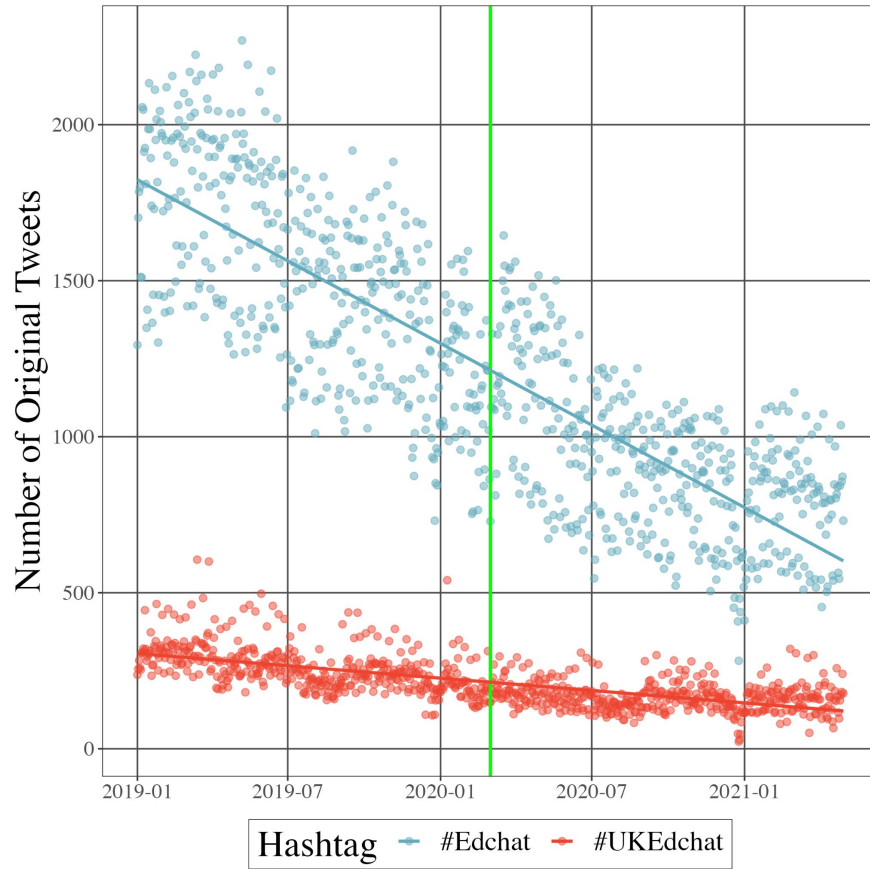
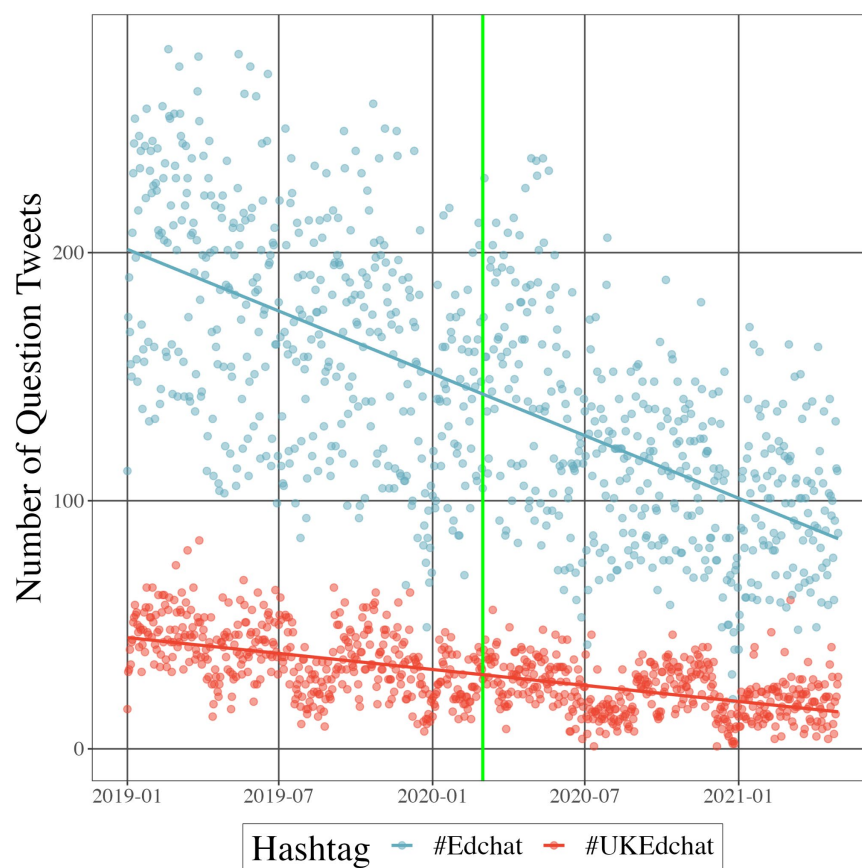


Figure 2. Question Tweets Before and During the Covid-19 Pandemic

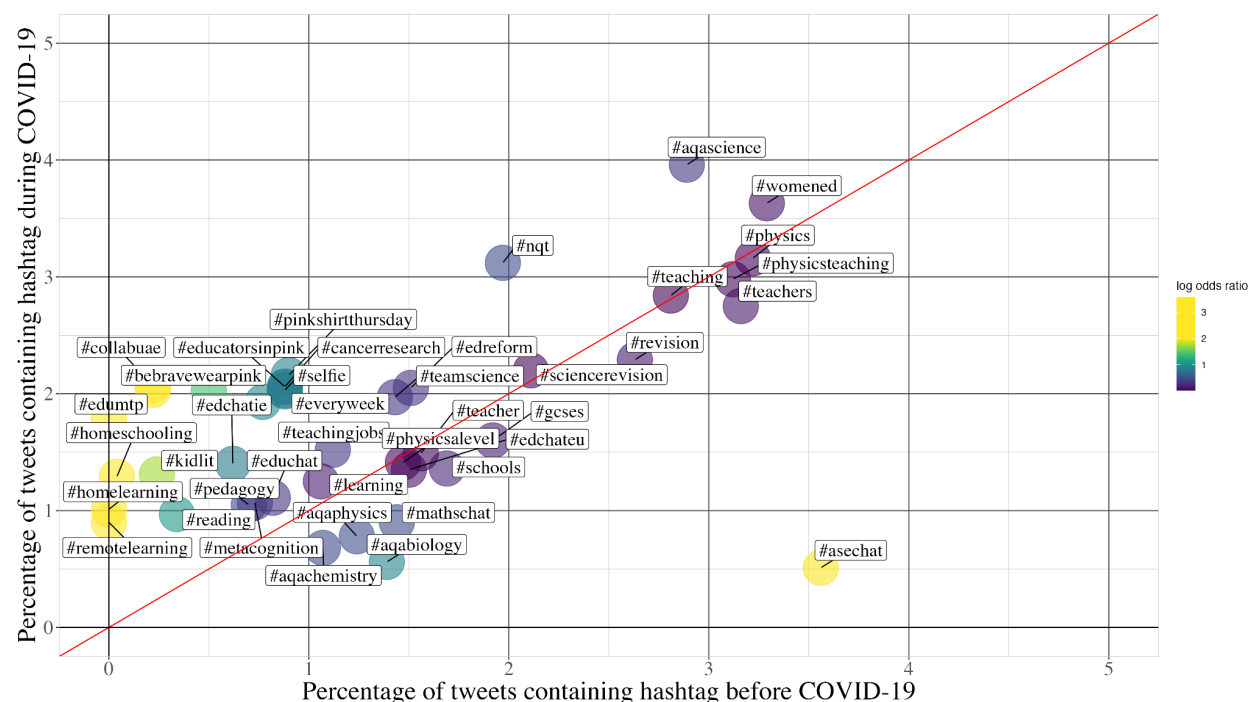


In addition to tweet volume, we examined how topics of tweets changed from before to during Covid-19. To measure topics, we examined which hashtags appeared in tweets alongside #UKEdchat or #Edchat (Figures 3–4). These coinciding hashtags represented other Twitter conversations that intersected with #UKEdchat and #Edchat—providing additional opportunities for developing and broadening teachers’ PLNs. The larger changes in presence of these other hashtags are denoted by plot coordinates and color of the dots. Note in both #UKEdchat and #Edchat, the co-occurrence of education-related hashtags like #teachers and #teaching remained consistent before and during Covid-19.

Overall, #UKEdchat and #Edchat allowed participants to cross time and place boundaries in response to pandemic disruptions, and growth in hashtagged teacher professional learning networks emerged. In #UKEdchat (Figure 3), for instance, the largest changes from before to during the pandemic were increased use of hashtags like #collabuae (i.e., a teacher PLN in the

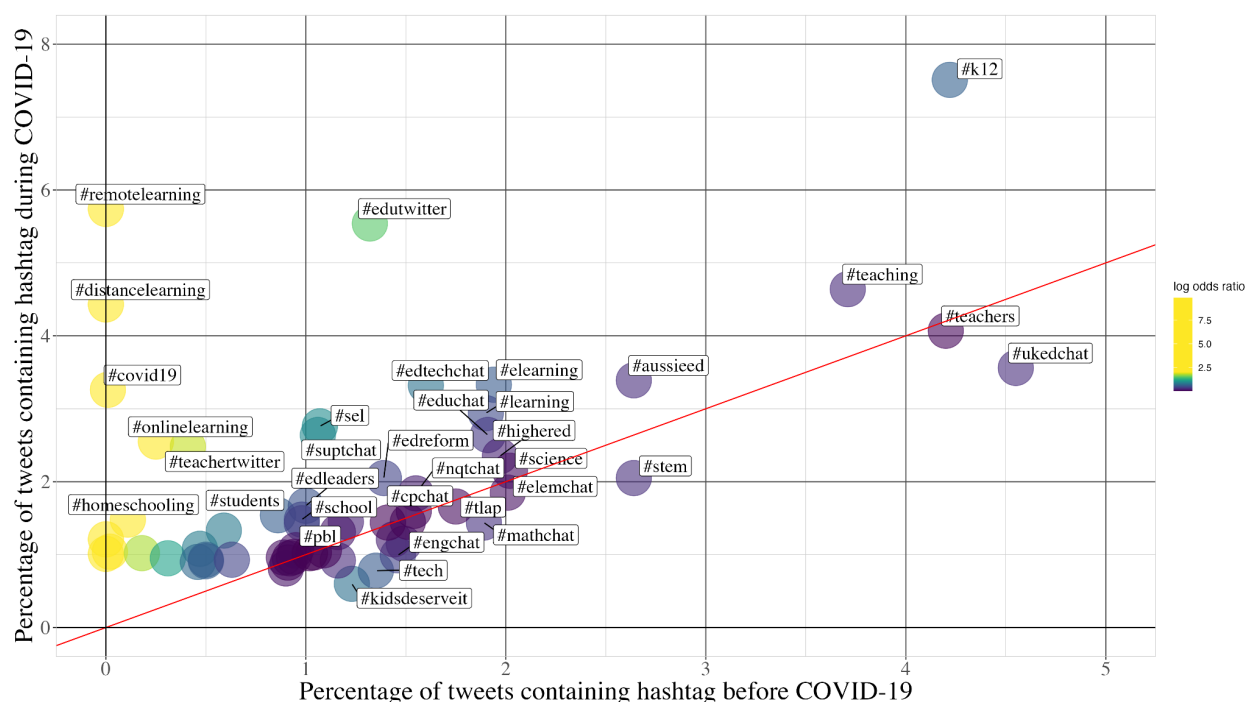
United Arab Emirates [UAE]) and #edumtp (i.e., a support group for male primary school teachers), in addition to pandemic-related hashtags such as #homeschooling, #homelearning, and #remotelearning. Thus, #UKEdchat allowed participants to cross boundaries of place (e.g., region, school) and time in response to pandemic disruptions.

Figure 3. Hashtags Occurring in #UKEdchat Tweets Before and During the Covid-19 Pandemic



Similarly, #Edchat allowed participants to cross boundaries of place and time in response to pandemic disruptions and increase support for teachers. Here ‘place’ is inferred from increased use of hashtags like #edutwitter and #teachertwitter, from before to during the pandemic, which indicate that educators were looking beyond local connections in schools and districts to connect on Twitter through these teacher-focused hashtags.

Figure 4. Hashtags Occurring in #Edchat Tweets Before and During the Covid-19 Pandemic



Furthermore, examining the location of #UKEdchat and #Edchat tweeters, as they self-disclosed in Twitter profiles, provided insight into the variety of people who potentially comprised teachers' PLNs, especially beyond their local community. Findings from geographic analysis show how participants crossed geographical boundaries to participate in Twitter conversations, a trend that became more global during Covid-19. In #UKEdchat, far more new locations appeared during the pandemic (Table 3), such as new locations in China and South America as well as denser coverage of Europe and the United States. In #Edchat, during the pandemic there was much denser coverage across North America, Europe, India, Southeast Asia, and Australia, and New Zealand.

Table 3. Number of Distinct Locations of #UKEdchat and #Edchat Tweeters Before and During Covid-19

	Before Only	Both Before and During	During Only
#UKEdchat	252	1,549	1,465
#Edchat	4,550	10,125	3,649

RQ2: How do U.K. and U.S. teachers experience more formal and more informal professional learning spanning social media and other contexts?

Teachers' purposes for professional learning

Qualitative analysis revealed that U.S. and U.K. teachers had two main purposes for professional learning spanning social media and other contexts: 1) to *access new practices* - identification (Akkerman & Bakker, 2011), and 2) to *contribute new resources or practices* which demanded coordination (Akkerman & Bakker, 2011) to reach the communities who would benefit most. Moreover, some teachers (Alejandro, James, Simon, Stephanie) sought *emotional support*, particularly when schools were closed due to Covid-19. These purposes were typically intentional (formal attribute) but also often self-determined (informal attribute) rather than externally determined by their school or district, with Twitter facilitating connecting, creating, sharing and consuming through access to a variety of communities or PLNs (Authors, 2016). First, teachers sought professional learning spanning social media and other contexts to *access new practices*, including help-seeking for specific needs or soliciting different perspectives, resources and dialogue. Lila, for instance, used Twitter to solicit resources from other teachers to expand her curriculum. She also tweeted to 'crowdsource' solutions to pedagogical issues and at authors of books her students were reading to bring the author's perspective into the classroom via Twitter or Zoom, examples of coordination or learning how to use social media to work across boundaries (Akkerman & Bakker, 2011). Dorinda, teaching in a rural area in the United States, solicited perspectives and resources from teachers, authors, or experts at professional conferences she could not attend in person; she used Twitter to 'connect with teachers' who had posted how they were using a particular technique (i.e. EduProtocols) and 'exchange[d] with

them...about how they used it.’ Alejandro sought ‘back-and-forth’ idea exchange (in synchronous chats on #Edchat) with educators in other states who may not share his subject matter (math), teaching context (high school), or role (teacher) as some interactions were with school technology coordinators from whom he sought ‘good feedback’ on his ideas, helping him engage in reflection (Akkerman & Bakker, 2011). Jerome, too, used Twitter because it ‘helped me with a problem,’ enabled him to stay informed on research related to his pedagogical orientation (project-based learning), and find teacher-curated resources ‘relevant to me and what I do.’

U.K. teachers similarly engaged in professional learning spanning Twitter and other contexts to access new practices. Amber, for instance, looked for new subject knowledge and to make teaching more interesting through new ideas, ultimately supporting transformation of her practice (Akkerman & Bakker, 2011). James requested advice (e.g., information or a fact check), ideas, resources and quick responses. Simon embraced Twitter to access resources, connect with experts (authors, academics), and get technology support. Similarly, Stephanie pursued professional learning via Twitter to broaden her understanding of specialist knowledge, connect with artists (professionals), get up-to-date information and seek ideas. Stephanie and James also learned of conferences via Twitter networks.

Second, for both U.S. and U.K. teachers, professional learning spanning social media and other contexts consisted of *contributing new resources or practices*, using the features of social media to coordinate interaction between different communities (Akkerman & Bakker, 2011). For instance, Jerome and Lila both kept a blog and as Lila put it, ‘pushed out a link’ to resources or recommended practices to ‘help’ other educators:

I published...[on my blog] the difference between “loose” and “lose”...I pushed out the link on...platforms [Twitter, Facebook, Instagram, LinkedIn, Pinterest]... if someone responded, I engaged with them...I'm trying to contribute something that will help people.

Similarly, Dorinda shared resources via Twitter especially for pre-service or new teachers joining her school. Alejandro ‘felt good about putting...my practices out there,’ and Jerome sought to ‘share some part of my practice.’ For Alejandro, Lila, and Jerome, Twitter functioned as an idea-sharing space outside constraints of their school context/culture with which they often clashed, as Alejandro put it: ‘the colleagues I'm in the same building with...they're not getting it [reform-oriented ideas]... folks on Twitter are more my colleagues than people in my own building.’

U.K. teachers’ professional learning also consisted of contributing resources or practices via Twitter. Using a unique hashtag to signal outstanding practice, James shared good ideas with a large body of followers and had an accompanying blog. Stephanie regularly shared ideas for classroom practice and posts from other art teachers, particularly work she ‘really found inspiring.’ Simon shared a link to Wakelet (a digital curation tool) that he had created collating online resources for the English text *An Inspector Calls*. He also shared Wakelets created by other English teachers. Amber mentioned sharing her knowledge and ideas for getting help in order to assist others, particularly those who ‘weren’t sure of themselves.’ She contributed regularly to Twitter chats, although noted that #UKEdchat had become ‘quieter’ since Covid-19, suggesting this was because ‘I think they've found their people...it started off as a nice big general [community]...then you start following other people and you form a different community or different network.’

Social media learning attributes for professional learning processes

Social media and its learning attributes facilitated U.S. and U.K. teachers' professional learning processes and PLN development through features that supported coordination between communities (Akkerman & Bakker, 2011). Teachers' tweeting transcended modal and temporal boundaries and enabled self-directed, peer- or other-influenced learning and unintended network effects (Authors 2016). First, social media features and conventions enabled teachers to layer communication modes rather than be constrained by asynchronous, text-based modality commonly found in online learning (e.g., pushing out hyperlinks to blog content, videos, or other media within the character limit of a tweet; participating in synchronous chats) (Authors, 2022). Moreover, when showed a sample of their tweets from before and during Covid-19, U.S. and U.K. teachers talked about using the convention of hashtags (#) to participate in education-related conversations and Twitter handles (personal accounts) to engage directly with specific individuals.

Second, social media afforded professional learning unbounded by time (informal attribute). Dorinda's comment was particularly representative: 'Twitter is a 365, 24/7 PD opportunity...if I wake up at two in the morning and have this burning question about how to do X or looking for a resource, I usually get at least one answer if not multiple.' Amber and James also talked about enjoying professional learning and using Twitter to do so during evenings and weekends. Similarly, teachers emphasized its affordances for quick, anytime responses when seeking specific help, opinions, fact-checking, keeping up-to-date, or crowdsourcing.

Third, teachers' professional learning processes were self-directed (e.g., driven by their questions, need for resources or desire to share) or peer- or other-influenced when unintended network effects revealed spontaneous content (e.g., conference opportunities for Stephanie, Amber, James, Dorinda, Jerome or live-tweeted educational events for Alejandro, Dorinda,

Jerome, James). Jerome, perhaps, best articulated the nuances of professional learning spanning multi-faceted social media:

When I think of a PLN, I think electronic...but there are in-person ones as well...It's all very webby and interconnected...hard to separate...peers, colleagues...you associate with...think of it as a big professional learning network that helps move you forward in your practice.

Boundary-crossing

Physical/virtual

Four U.S. teachers and two U.K. teachers highlighted the blurring of boundaries between physical and virtual communities, social worlds which differ by their very nature. Alejandro and Jerome cultivated relationships with like-minded colleagues in their school or district. When they moved to new schools, they maintained these supportive professional relationships online. Amber became a member of an active online community which subsequently arranged to meet face-to-face. James mentioned like-minded individuals who came together through Twitter and then met in person to share ideas. This created more opportunities for learning through increasing the number of physical and virtual sites (and boundaries) within which these teachers engaged with professional learning, facilitating identification and reflection potentially leading to transformation (Akkerman & Bakker, 2011).

James also spoke about the symbiotic relationship between social media and face-to-face conferences. He used social media to identify conference speakers, recruit participants and share thoughts during the conference. This extended learning from the physical to a virtual audience, making the boundary around face-to-face PD more flexible and porous. Lila mentioned talking to people at conferences who had followed her on Twitter for years.

James also talked about seeking help through Twitter, arranging an online synchronous meeting with Twitter colleagues, supplementing the discussion in the meeting through social media and discovering relevant more formal PD opportunities. Stephanie talked about more formal PD and less formal professional learning activities being interlocked through social media; you can learn something on the job or at a face-to-face PD session and then reach out to different Twitter communities to learn more. Lila said that following an ‘in-person’ tip, she had researched the topic on the internet, identified a book recommendation and subsequently met online with the book author. Dorinda, another U.S. teacher in a rural area, noted that Twitter enabled her to maintain connections made at conferences/meetings despite geographical distances between colleagues.

Local/global

Teachers mainly used Twitter to connect with educators beyond their local community who were not previously known to them, including those teaching the same subject or age group, but also teachers of different subjects, grade levels, in different roles who could contribute new perspectives in diverse contexts. Three U.S. teachers and all U.K. teachers talked about the benefit of reaching out to a wider network which opened up opportunities to seek ideas and develop communities around specialist networks, such as pedagogical approaches and subject knowledge hashtags (e.g., #PBL for problem-based learning, #SSchat for social studies teachers, #UKFEchat for teachers in further education colleges).

Teachers also used Twitter to access specialists (e.g., artists, authors, edtech specialists) and experts (e.g., educational ‘world leaders’ and researchers), with social media ‘[opening] doors that you wouldn’t normally have [opened]’ (James), an example of enhancing coordination through social media (Akkerman & Bakker, 2011). This enabled the teachers to develop deeper

understandings of specific practices, access technical support, and obtain expert advice. Two U.S. and three U.K. teachers specifically mentioned the benefit of direct access to such specialists, enabling them to cross the boundary to new communities and supporting transformation of their practices (Akkerman & Bakker, 2011): ‘it's important as well to go beyond the teacher [...] because you’ve got other people who are knowledgeable’ (Simon). For example, Stephanie talked about learning a new skill she needed for her classroom from industry experts:

I’ve never taught animation in my life. So I put a tweet out with the hashtag “animators” ...I managed to get...feedback from...companies..., “We’ll be willing to help you...If you want to use our PowerPoints in your lessons, then feel free to take them.”... They introduced me to... programs I've never heard of before. So that was just a really useful way of developing myself as an art teacher.

Two teachers noted that local colleagues requested that they contact their Twitter networks for advice. Amber described identifying two new ideas which subsequently became embedded in her school’s practices underpinned by more formal PD events. From Amber’s perspective, the new knowledge, gained from global networks, directly influenced local (institutional) practices, crossing the global/local boundary:

I'd stumbled across them [GCSEPod, a revision tool] on Twitter...my managers said, “Well, why don't you do a pitch?” So I did a pitch and now we have GCSEPod [at our institution]. They come and do training, there are webinars...things I stumbled across on Twitter that have prompted outsiders to come in [and provide more formal PD].

In contrast, Simon identified a technology solution he felt would benefit learners in his school during the pandemic, but could not persuade his colleagues to adopt it. Similarly, Lila and

Alejandro in the U.S., reported how difficult it was to change the status quo in their institutions which frustrated them given that many conversations on Twitter related to reforming school culture. Here, institutional politics acted as a barrier to the adoption of new practices (transformation) from the different communities that our teachers participated in. The discontinuity between practices was maintained.

Amber commented on the importance of moving beyond local to global to avoid the trap of being in a local echo chamber. However, Simon noted that some hash-tagged communities could also be echo chambers. Stephanie, Lila, and Alejandro all noted how useful it was to learn about pedagogical practices in other countries through crossing geographical boundaries.

Before/during Covid-19

The start of the pandemic and pivot to remote teaching created a new temporal boundary. The U.K. teachers' professional learning practices changed from before to during Covid-19 for various reasons. Amber found that her students had limited access to technology in lockdown so Twitter conversations at the time (around supporting remote learning through digital solutions) were less useful to her. She noted that her institution had increased the amount of more formal PD offered since the pandemic started. James had shifted into a management position; his priorities changed from classroom practices to strategic goals around supporting disadvantaged students. Simon set up a new Twitter account (in addition to his personal account) and actively sought digital solutions for remote learning, particularly those suitable for mobile phones. He directly interacted with EdTech providers via Twitter to seek specific technical support and identified useful webinars that he attended. He also tried to find out what was going on in other state schools and connected to a U.S. school. A negative aspect for Simon was his frustration at being unable to emulate some overseas practices due to strict rules in the U.K. around

safeguarding (ie. limited use of synchronous video conferencing). Stephanie, a beginning teacher, sought out more emotional support through Twitter; she also noted that many useful resources had been shared around this time.

Similarly, in the U.S., two of the four teachers' practices changed from before to during Covid-19. Whereas before the pandemic, Alejandro's professional learning concerns revolved around standards-based teaching, his concerns shifted during Covid-19 to finding ways to maintain his classroom culture remotely (e.g., supporting collaboration, maintaining integrity of assessments) and 'taking the temperature of what was happening at other schools.' He also engaged in 'rethinking' with colleagues on Twitter about the structure of education (i.e., 'the value of the classroom itself'). Unlike Alejandro, Jerome was both a classroom teacher and technology coordinator responsible for helping other teachers pivot to teaching online. He felt fortunate that his school already had a strong technology infrastructure and online learning 'routines' in place. Whereas before Covid-19, he relied heavily on in-person EdTech conferences for professional learning, during Covid-19 Twitter became a 'replacement' for 'in-person interactions I was no longer having.' He used social media to crowdsource what teachers were doing in other districts that looked successful and then adapting those ideas.

In contrast, two U.S. teachers felt their professional learning practices remained largely unchanged from before to during Covid-19. Lila maintained her pre-pandemic practices, but tried to contribute more links to resources and 'a positivity mindset' on Twitter as a counter to the negativity she saw others sharing. Her school offered more formal online PD during Covid-19, but as in the before Covid period, she found this 'undifferentiated' compared to the 'personalization' of Twitter and of little use to her. Lila did not have the inclination or the power to address the discontinuities between more formal and more informal learning activities.

Dorinda's professional learning practices also stayed largely the same during Covid-19, although her quests via Twitter for digital tools increased. She praised her district's technology infrastructure and in-person more formal PD that directly preceded the pivot to online teaching and experienced the transition to remote education as 'easy peasy.' In Dorinda's case, she was able to transform her practice through introducing new tools identified through her existing, external networks.

Public/private

Amber talked about reaching out to individuals via Twitter handles and communities via hashtags but receiving private responses and privately shared resources, reflecting different forms of coordination between communities (Akkerman & Bakker, 2011). She noted that publicly sharing resources can be subject to abuse with individuals copying and selling them via teacher resource websites. James talked about using direct messaging on Twitter to seek targeted help compared to eliciting various opinions publicly that needed sorting through:

The questioning tends to be through direct messages [...] sometimes you want lots of people to contribute because you [...] want the interaction, the dialogue [...] on Twitter.

But it will go to direct messages if you're like, "Can you help me out with X, Y or Z?"

Similarly, Lila and Dorinda talked about the boundary between public interactions through social media and the private space of their classrooms. Dorinda noted that it was important to model to her students how to make professional and educational connections via social media. Dorinda spoke about showing her students 'how they can be engaged with the rest of the world [via social media] in appropriate ways.'

Discussion

The results illustrate the wide variety of professional learning taking place across different contexts, which have formal, informal and social media learning attributes (Authors 2016) in varying degrees. The social media attributes facilitate connection, sharing and consuming (identifying) new practices. Professional learning is commonly influenced by the Twitter communities that teachers access, enabling them to reflect on their current practices, engage with a wider range of perspectives and seek emotional support. Twitter also enables access to multimodal resources to support that learning. Social media can provide spaces that move beyond physical contexts and support anytime, anywhere learning.

The impact of Covid-19: New communities and increased networks

The volume of tweets mentioning #UKEdchat and #Edchat decreased from before to during Covid-19, continuing long-term usage trends of these pre-pandemic hashtags (Author 2019). Despite this decrease, teachers were still able to develop their PLNs as participants continued asking questions at similar rates, and created new communities on pandemic-related topics, reaching a wider global audience. This highlights the fluidity in socially-mediated communities. Amber, for example, talked about engaging with more specialized educational social media communities and felt that #UKEdchat had become ‘quiet’.

#UKEdchat and #Edchat hashtags allowed teachers (and others) to cross geographical boundaries and interact with others in PLNs that spanned every continent; this geographical boundary-crossing increased during COVID-19 as did the network density and/or number of connections. This can be explained in part by the Covid-19 crisis, a global event that may have served as a unifying experience. Previous research suggests that educators appreciate social media’s freedom from temporal and geographical constraints, especially encountering perspectives more diverse than those available locally (Carpenter and Krutka 2014; Trust et al.

2016). In addition, Greenhalgh and Koehler's (2017) study of the Twitter hashtag #educattentats observed the geographic expansion of a social media network after the Paris terrorist attacks in November 2015. This was a form of 'just-in-time' professional learning responding to a crisis with a sudden onset (Greenhalgh and Koehler 2017). In contrast, Covid-19 was a crisis with a very long development, and existing hashtags like #Edchat and #UKEdchat adapted more slowly but nevertheless noticeably, in terms of topics and geography. Overall, this points to the sensitivity (to global change) and the fluidity of PLNs spanning social media like Twitter.

The Covid-19 crisis also shifted the focus for many teachers as they expanded their PLNs and formed new communities around their need to develop digital and remote pedagogies (eg. #remotlearning). Again, this highlights the ease with which teachers could reconfigure their PLNs through the affordances of social media. For example, Simon told us how he used Twitter to identify ideas for using edtech and to seek specialist technical support. Teachers also used Twitter to fill the void left by the lack of more formal face-to-face PD as social distancing requirements forced providers to also shift online.

The role of social media in boundary crossing

In the polycontextual (Engeström, Engeström and Kärkkäinen 1995) social worlds associated with teachers' professional learning, social media, hashtags and even individual tweets and resulting interactions act as boundary objects (Akkerman and Bakker 2011). These boundary objects bridge different communities, support coordination, and thus enable teachers to seek and share new ideas, practices and perspectives with/from those beyond their local networks. The use of boundary objects in this way leads to 'increasing boundary permeability' (Hyvärinen, Kangas and Krokfors, 2016, 133). Thus, social media and its various boundary objects can render the boundaries between communities more porous and sometimes invisible, enabling frictionless

movement despite differing perspectives and practices. For example, our teachers talked about interweaving in-school, organized, more formal PD activities with self-initiated questioning and searching through social media.

Social media ‘extends and reframes how communities organize and express boundaries and relationships’ (Wenger, White and Smith 2009, 11). It enables new communities to come together (and disband) easily around hashtags, such as the communities that emerged as Covid-19 struck offering support and guidance on remote learning. These overarching communities bring together different stakeholders (classroom teachers from different subject specialisms, school leaders, external experts such as edtech providers). This again underlines how social media enables fluidity and boundary permeability.

Discontinuities

As teachers interact across multiple social worlds they can make connections through ‘sense-making, translating, and integrating or actively introducing elements from one world to another’ (Bronkhorst and Akkerman 2016, 20). When successful, learning can be continued across contexts with various actors, settings and experiences sustaining the learner’s ongoing participation and development of practice. Where unsuccessful, teachers may face differences in perspectives and practices that are in conflict and cannot be reconciled, maintaining the discontinuity and limiting the opportunities for learning (Bronkhorst and Akkerman 2016). Such was the case for five teachers in our study (Alejandro, Lila, Jerome, Amber, Simon) when the reform-oriented perspectives, questioning practices, or topic of conversation that characterized participation in professional learning on social media conflicted with their own school contexts. The result in four cases (Alejandro, Lila, Jerome, Simon) was that teachers brought change within their classrooms but felt alienated from the larger institutional culture. Discontinuities, which form boundaries

between social worlds, require learners to ‘shift...position and perspective or leave them troubled’ and therefore, can have negative consequences for learning trajectories (e.g., disengagement, quitting or dropping out) (Bronkhorst and Akkerman, 2016, 20). Indeed, in these four cases, teachers’ experiencing difficulties in reconciling discontinuities planned to or exited their workplaces (e.g., Lila was developing as a full-time educational consultant and Simon had recently taken early retirement). On the other hand, when teachers and institutions respond positively to discontinuities, they can be a powerful source of transformational growth and system change as was the case for one teacher (Amber) who ‘pitched’ ideas gleaned from social media which then became embedded in institutional practices. This provides a good example of boundary crossing from the individual to the institutional (Akkerman and Bruining 2016), albeit initiated by Amber’s interactions with a global, online community. These findings underscore that digital technologies such as the internet and social media are implicit in structuring teachers’ work, workplaces, and occupational cultures. Teachers’ professional learning is increasingly distributed and fragmented where technology-based work bleeds into the various spaces teachers inhabit and social media is ‘playing a key role in working one’s way up *or* out of school’ (Selwyn, Nemorin and Johnson 2017, 394).

Conclusions

This paper takes a critical approach to professional learning spanning social media and other contexts and considers the tensions, synergies and experiences of boundary-crossing teachers. Our analysis is informed by the application of our framework of formal/informal/social media learning attributes (Authors 2016) enabling the complexities of this ever-evolving use of social media to be revealed. This paper contributes to the fields of learning ecology, identity, agency

and teachers' professional learning practices through the analysis of boundary-crossing facilitated by social media.

Like 'doctors without borders' who respond to health emergencies wherever needed, the Covid-19 pandemic highlighted that education is always an emergency: serious, situational, immediately important, and educators too are without borders, translating, integrating and actively responding with care. Such a calling requires lifelong, lifewide approaches to professional learning. Teachers' professional learning has long been facilitated more *formally* through structured workshops typically in-person and locally based (e.g., in a school), mentoring programs and collaborative planning (Ronfeldt and McQueen 2017). More recently, social media have provided opportunities for more *informal* professional learning that is self-initiated (Macià and García 2016), flexible (Authors 2021), just-in-time (Greenhalgh and Koehler 2017) and with wider access to expertise (Trust et al. 2016).

Whereas there has been a substantial body of work on young peoples' learning lives (e.g. Gilje and Silseth 2019; Jornet and Erstad 2018; Silseth and Erstad 2022), less is known about the learning lives of teachers (Authors 2020). Research in this area is needed and important as teachers' identities and practices outside of the classroom are relevant to their students' educational experiences (Cremin and Oliver 2017; McCarthy et al. 2014). In the area of literacy education, for instance, teachers who pursued their personal interest in authoring were better able to enrich composition curricula through sharing their experience, examples, and expertise (McCarthy et al. 2014). Similarly, little is known about how teachers sustain or (re)establish continuities across their learning lives or how being unable to reconcile discontinuities, which can lead to teachers' detachment and exit from the workplace, can be managed or prevented.

Research in these areas will be critical for rethinking the boundaries of teacher professional learning in this digital age.

Statements on open data, ethics and conflict of interest

Code for computational analyses is available on GitHub (URL removed) and data through Open Science Framework (URL removed). This study was approved by the Human Research Protection Program at each of the three authors' universities.

Declaration of interest statement

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References

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Akkerman, S. F., and A. Bakker. 2011. "Boundary Crossing and Boundary Objects." *Review of Educational Research* 81 (2): 132–169.

Akkerman, S. F., and T. Bruining. 2016. "Multilevel Boundary Crossing in a Professional Development School Partnership." *Journal of the Learning Sciences* 25 (2): 240–284.

Akkerman, S. F., and M. Van Eijck. 2013. "Re-theorising the Student Dialogically Across and Between Boundaries of Multiple Communities." *British Educational Research Journal* 39 (1): 60–72.

Barrie, C., and J. C. Ho. 2021. "academictwitterR: An R Package to Access the Twitter Academic Research Product Track v2 API Endpoint." *Journal of Open Source Software* 6 (62): 3272.

- Bronkhorst, L. H., and S. F. Akkerman. 2016. "At the Boundary of School: Continuity and Discontinuity in Learning Across Contexts." *Educational Research Review* 19: 18–35.
- Carpenter, J. P., and D. G. Krutka. 2014. "How and Why Educators Use Twitter: A Survey of the Field." *Journal of Research on Technology in Education* 46: 414–434.
- Carpenter, J., T. Tani, S. Morrison, and J. Keane. 2020. "Exploring the Landscape of Educator Professional Activity on Twitter: An Analysis of 16 Education-Related Twitter Hashtags." *Professional Development in Education*, 2020, 1–22.
- Cavanaugh, C., and A. DeWeese. 2020. "Understanding the Professional Learning and Support Needs of Educators During the Initial Weeks of Pandemic School Closures through Search Terms and Content use." *Journal of Technology and Teacher Education* 28 (2): 233.
- Colley, H., P. Hodgkinson, and J. Malcolm. 2003. *Informality and Formality in Learning: A Report for the Learning and Skills Research Centre*. London: LSRC.
- Cremin, T., and L. Oliver .2017. "Teachers as Writers: A Systematic Review." *Research Papers in Education* 32 (3): 269–295.
- Crompton, H., D. Burke, K. Jordan, and S.W. G Wilson. 2021. "Learning with Technology During Emergencies: A Systematic Review of K-12 Education." *British Journal of Educational Technology* 52 (4): 1554–1575.
- Desimone, L. 2009. "Improving Impact Studies of Teachers' Professional Development: Toward Better Conceptualizations and Measures." *Educational Researcher* 38 (3): 181–199.
- Engeström, Y., R. Engeström, and M. Kärkkäinen. 1995. "Polycontextuality and Boundary crossing in Expert Cognition: Learning and Problem Solving in Complex Work Activities." *Learning and Instruction* 5: 319–336.

- Gilje, Ø., and K. Silseth. 2019. “Unpacking FIFA Play as Text and Action in Literacy Practices in and Out of School.” *Learning, Media and Technology* 44 (2): 180–192.
- Greenhalgh, S. P., and M. J. Koehler. 2017. “28 Days Later: Twitter Hashtags as ‘Just in Time’ Teacher Professional Development.” *TechTrends* 61: 273–281.
- Hodges, C., S. Moore, B. Lockee, T. Trust, and A. Bond. 2020. “The Difference Between Emergency Remote Teaching and Online Learning.” *EDUCAUSE Review*, March 27.
- Horn, I. S., S. B. Nolen, C. Ward and S. S. Campbell. 2008. “Developing Practices in Multiple Worlds: The Role of Identity in Learning to Teach.” *Teacher Education Quarterly* 35 (3): 61–72.
- Hyvärinen, R., M. Kangas and L. Krokfors. 2016. “Primary Schools Crossing Boundaries: A Study on Extended Learning Environments in Two Finnish Village School Contexts.” In *Learning across Contexts in the Knowledge Society*, edited by O. Erstad, K. Kumpulainen, Å. Mäkitalo, K. C. Schrøder, P. Pruulmann-Vengerfeldt, T. Jóhannsdóttir, 131–144. Rotterdam, The Netherlands: Sense Publishers.
- Jornet, A., and O. Erstad. 2018. “From Learning Contexts to Learning Lives: Studying Learning (Dis)continuities from the Expertise of the Learners.” *Digital Education Review* 33: 1–25.
- Kahle, D., and H. Wickham. 2013. “ggmap: Spatial Visualization with ggplot2.” *The R Journal* 5 (1): 144–161.
- Koeze, E., and N. Popper. 2020. “The Virus Changed the Way We Internet.” *The New York Times*, April 7.
- Kurtz, H. 2020, April 10. National Survey Tracks Impact of Coronavirus on Schools: 10 key findings. *Education Week*.

- Macià, M., and I. García. 2016. "Informal Online Communities and Networks as a Source of Teacher Professional Development: A Review." *Teaching and Teacher Education* 55: 291–307.
- McCarthy, S. J., R. Woodard, and G. Kang. 2014. "Elementary Teachers Negotiating Discourses in Writing Instruction." *Written Communication* 31(1): 58–90.
- Opfer, V. D., and D. Pedder. 2011. "Conceptualizing Teacher Professional Learning." *Review of Educational Research* 81 (3): 376–407.
- Rehm, M., S. Moukarzel, A. J. Daly, and M. del Fresno. 2021. "Exploring online social networks of school leaders in times of COVID-19." *British Journal of Educational Technology* 52 (4): 1414–1433.
- Ronfeldt, M., and K. McQueen. 2017. "Does New Teacher Induction Really Improve Retention?" *Journal of Teacher Education* 68 (4): 394–410.
- Selwyn, N., S. Nemorin, and J. Johnson. 2017. "High-tech, Hard Work: An Investigation of Teachers' Work in the Digital Age." *Learning, Media, and Technology* 42 (4): 390–405.
- Silseth, K., and O. Erstad. 2022. "Exploring Opportunities, Complexities, and Tensions when Invoking Students' Everyday Experiences as Resources in Educational Activities." *Teaching and Teacher Education* 112: 103633.
- Star, S. L. 2010. "This is Not a Boundary Object: Reflections on the Origin of a Concept." *Science, Technology & Human Values* 35 (5): 601–617.
- Statista Research Department. 2022. "Number of Social Network Site users Worldwide from 2017 to 2025." Statista, January 28. <https://www.statista.com/statistics/278414/number-of-worldwide-social-network-users/>

- Tracy, S. J. 2010. "Qualitative Quality: Eight 'big tent' Criteria for Excellent Qualitative Research." *Qualitative Inquiry* 16: 837–851.
- Trust, T., D. G. Krutka, and J. P. Carpenter. 2016. "'Together We Are Better': Professional Learning Networks for Teachers." *Computers & Education* 102: 15–34.
- Trust, T., J. P. Carpenter, and D. G. Krutka. 2017. "Moving Beyond Silos: Professional Learning Networks in Higher Education." *Internet & Higher Education* 35: 1–11.
- Trust, T., J. P. Carpenter, D. G. Krutka, and R. Kimmons. 2020. "#RemoteTeaching and #RemoteLearning: Educator Tweeting During the COVID-19 Pandemic." *Journal of Technology and Teacher Education* 28 (2): 151–159.
- Trust, T., and S. Prestridge. 2021. "The Interplay of Five Elements of Influence on Educators' PLN Actions." *Teaching and Teacher Education* 97: 103195.
- UNESCO Institute for Statistics. 2020a. *Global monitoring of school closures caused by COVID-19* [Data set]. <https://en.unesco.org/covid19/educationresponse>
- Wenger, E., N. White, and J. D. Smith 2009. *Digital Habitats: Stewarding Technology for Communities*. Portland, OR: CPsquare.
- Yin, R. K. 2014. *Case Study Research: Design and Methods* (5th ed.). Washington DC, U.S.: SAGE.