

Inquiring tweets want to know: #Edchat supports for #RemoteTeaching during COVID-19

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Abstract

Social media use has spiked around the world during the COVID-19 global pandemic as people reach out for news, information, social connections, and support in their daily lives. Past work on professional learning networks (PLNs) has shown that teachers also use social media to find supports for their teaching and ongoing professional development. This paper offers quantitative analysis of over a half million Twitter #Edchat tweets as well as qualitative content analysis of teachers' question tweets ($n = 1054$) and teacher interviews ($n = 4$). These data and analyses provide evidence of the kinds of supports that teachers in the United States and Canada sought on social media during the rapid transition to emergency remote teaching in Spring 2020 and how these supports informed teaching practices. These results provide insights into PLN theory and teachers' social media use during times of disruption and crisis.

KEYWORDS

emergency, pandemic, professional learning network, remote online teaching, social media, teachers, Twitter

Practitioner notes

What is already known about this topic

- Prior to the spring 2020 pandemic, teachers turned to social media to find supports for teaching and just-in-time professional development (PD).
- #Edchat, one of the oldest and most used educational hashtags on Twitter, supports education-related conversations, frequently self-promotional rather than collaborative.
- The COVID-19 pandemic disrupted educational systems globally and created new demands on teacher PD during transitions to emergency remote teaching and learning.

What this paper adds

- Teachers' professional learning networks (PLN) on social media can be flexible around contextual circumstances and users' needs.
- #Edchat discourse can move beyond self-promotion to inquiry with benefits for professional learning.
- Education-related response networks on social media are useful to teachers in emergency situations (and beyond them) where just-in-time professional learning needs and questions surpass local PD capacity.

Implications for practice and/or policy

- Teachers should increase capacities inquiring discourses on Twitter.
- Education stakeholders should increase support for teachers' agency and advocate for broader conceptions and approaches to PD that incorporate PLNs spanning social media.

INTRODUCTION

The worldwide COVID-19 pandemic in 2020 resulted in economic and social disruption of unprecedented scale. While social distancing (i.e., physical distancing in public spaces) has become the new normal, social media offer respite from being alone. Statistics show spikes in social media usage worldwide during the pandemic as 2 billion people accessed platforms to stay connected and informed (Koeze & Popper, 2020). In addition to easing loneliness, social media may offer supports for educators in emergency situations. Before the pandemic, teachers turned to social media to find teaching supports and just-in-time professional development (PD; Bruguera et al., 2019; Greenhalgh & Koehler, 2017). However, less is known about teachers' social media use during the pandemic, when just-in-time PD is essential but complicated by the increased volume of social media posts and teachers' urgent needs.

This study examines the role that social media played, if any, in teachers' educational response to COVID-19. We explored the supports that teachers sought on social media during the transition to emergency remote teaching in spring 2020 and how teachers' social media supports influenced their thinking about their online teaching. This study increases understanding of social media as a flexible tool for just-in-time PD.

We investigate teachers' social media use in the context of the educational Twitter hashtag #Edchat. Twitter is one of the most adopted social media platforms for teachers'

professional learning and the second most-studied in education (Greenhow & Askari, 2017; Greenhow & Galvin, 2020; Greenhow, Galvin et al. 2020). Twitter research has often noted the inclusion of hashtags (i.e., text preceded by the '#' symbol) as a means of organising distinct conversations (e.g. Greenhalgh et al., 2020; Staudt Willet, 2019). #Edchat organisers have described the opportunity the hashtag provides for teachers:

Any educator can discuss and learn about current teaching trends, to integrate technology, to transform their education, and to connect with inspiring instructors around the world. We...discuss education policy, education reform, and...allow world-class leaders to take part in our talks ('What is #Edchat'?, 2019)

#Edchat is an appropriate site for this study of teachers' social media use during COVID-19 because it is a long-term conversation about educational topics. #Edchat has sustained a high volume of participation with more than 100,000 tweets monthly, nearly all centered on education (Staudt Willet, 2019).

THEORETICAL FRAMEWORK

We frame this investigation of Twitter #Edchat with the *professional learning network* (PLN) concept. While conceptions vary, PLNs can be conceived of as interactive systems of people, spaces tools and resources (Trust et al., 2016, 2017). Grounded in situated learning theories that view learning as occurring within social contexts and distributed among participants (Lave & Wenger, 1991; Putnam & Borko, 2000), PLNs foreground the individual. Trust et al., (2016) conceived of PLNs as uniquely defined, dynamic systems that shift and grow based on the individual's needs, interests and goals. They can exist with or without formal learning objectives and are 'differentiated from online communities, networks of practice or social media sites...PLNs are broader, multifaceted systems, that often incorporate multiple communities, networks of practice, and sites that support both on- and off-line learning' (p. 17). A PLN framing prompts questions related to an individual's *agency* rather than describing the group characteristics, as do community of practice (Wenger, 1998) or community of inquiry (Garrison et al., 2000) frameworks for professional learning.

Krutka et al., (2017) posit that because PLNs support personalised learning, the range and types of people in educators' PLNs can vary (e.g., from same-subject teachers to others with diverse experiences). PLNs also traverse spaces where educators connect and learn, from face-to-face (e.g., conferences) to virtual spaces like Twitter. Indeed, social media growth has prompted more opportunities for teachers to cultivate PLNs that 'span across traditional spatial, temporal, and institutional boundaries' (Trust et al., 2017, p. 2). Through PLNs, teachers seek tools and resources (e.g., ideas, curricular materials, teaching and learning perspectives, encouragement, technological tools) which can help them grow (Trust et al., 2016, 2017).

A PLN framing is well-suited for this study because it draws attention to how teachers initiate interactions needed to respond to challenges; the ad hoc but semi-structured nature of PLNs seems an appropriate approach to professional learning amidst the uncertainty of disrupted education during COVID-19. Although schools provided PD, it is likely many teachers needed to work ahead of official workshop pacing by quickly connecting and collecting resources beyond their district via social media through their PLN.

REVIEW OF RELEVANT LITERATURE

Teachers' professional learning and social media

Although quality PD has been shown to improve K-12 teaching practices and student learning (Kennedy, 2016), traditional PD frequently includes workshops and seminars disconnected from teachers' specific needs that are ultimately ineffective (Opfer & Pedder, 2011). Meaningful teacher training and resources are personalised, social and available for long-term support (e.g., Desimone, 2009). Teachers increasingly turn to networking with colleagues, especially through social media, to meet their professional learning needs (e.g. Galvin & Greenhow, 2020; Greenhow, Galvin, et al., 2020; Krutka & Carpenter, 2016; Trust, 2012).

Greenhow, Galvin et al. (2020), reviewing over a decade of research on K-12 teachers' use of social media in education, found that most studies focussed on teachers' use of social media for professional learning, rather than classroom instruction or communicating with stakeholders. Similarly, Macià and García's (2016) literature review of teachers' online PD found educators use online networks for various professional learning purposes: asking and answering questions; sharing and finding teaching-related resources; reflecting; dialoguing and garnering emotional support.

As PLNs span local and global contexts (Trust, 2012), teachers value social media as part of their PLNs because it can be accessed to find individualised, timely and novel help without geographic limitations (Greenhow, Galvin et al., 2020; Macià & García, 2016). Teachers appreciate being able to access expertise and perspectives more diverse than those locally (Davis, 2015; Trust et al., 2016). Through social media, teachers curate new tools and strategies recommended by other teachers (e.g., Greenhow, Galvin et al., 2020). They retrieve educational resources (e.g., Carpenter & Krutka, 2014) that can be applied in the classroom immediately (Carpenter & Harvey, 2020). In one study, the majority (87%) of survey respondents reported visiting a social networking platform (i.e., Edmodo Math Subject Community) to find new ideas and resources (Trust, 2017).

Such searches on social media often take the form of active inquiry (Trust, 2017). Through content analysis of messages in an educational listserv, Hew and Hara (2007) found that *making requests* (i.e., asking for information, ideas or participation) was the second most common activity (after sharing knowledge), occurring in 25.7% of messages. Trust (2015) reported that more than half (54%) of initial Edmodo posts were a *request for action* (i.e., asking for help, feedback, ideas, resources or information). One Edmodo participant described how they posted questions with an expectation of getting an immediate response (Trust, 2017).

Despite these benefits, there are challenges to professional learning with social media. Developing PLNs that span social media can blur personal and professional boundaries (Fox & Bird, 2017) and create additional pressure for teachers to be available to students and colleagues outside work hours (Selwyn et al., 2017). Social media offer access to resources but few mechanisms to determine their quality, resulting in teachers retrieving materials counter to best practices (Carpenter & Harvey, 2019, 2020; Sawyer et al., 2019). Many resources are commercially driven or self-promotional in ways that some teachers do not prefer (e.g., Carpenter & Harvey, 2019). Additionally, although teacher interactions on social media may increase the availability of knowledge, it is unclear whether these interactions provide evidence of professional learning (van Bommel et al., 2020), and some interactions can be harmful with negative feedback, disparaging comments, harassment and the spread of misinformation (Fischer et al., 2019).

Teachers' professional learning via #Edchat

The ability to filter and organise information by using hashtags is an important and valued feature of Twitter (Davis, 2015; Greenhow & Gleason, 2012). Past research has shown the Twitter educational hashtag #Edchat is a source of many benefits for teachers' professional learning in addition to being one of the most widely subscribed teacher networks on Twitter (Staudt Willet, 2019). Carpenter and Krutka's (2014) seminal survey of how and why educators use Twitter found that #Edchat was teachers' most-used hashtag.

Similar to findings reported for social media generally, educators describe valuing #Edchat as an opportunity to connect with other teachers beyond their school (Britt & Paulus, 2016; Carpenter & Krutka, 2014; Davis, 2015). A principal interviewed by Britt and Paulus (2016) participated in #Edchat weekly because it was a chance to 'engage other passionate educators in a conversation about education' (p. 55). Participants in Carpenter and Krutka's (2014) study highlighted Twitter as an opportunity to learn through connections with other teachers, characterising these connections as 'positive, creative colleagues and leaders' (p. 422). Furthermore, Twitter #Edchat can span divisions between teachers, providing 'opportunities for seasoned and less experienced to learn from one another' (Davis, 2015, p. 1555).

Twitter also enables inquiry and quick responses. Carpenter and Krutka's (2014) survey reported that teachers appreciated Twitter's interactivity, being able to 'question and react to people and ideas' (p. 426). However, this mode of participation seems under-utilised in #Edchat. In one study, #Edchat participants amplified others by retweeting, sharing resources and self-promoting, but rarely pursued mutual benefit through networking, collaborating, sincere discussion, civil disagreement or offering emotional support (Staudt Willet, 2019).

Xing and Gao (2018) studied 643,347 #Edchat tweets composed during Tuesday one-hour synchronous sessions spanning six years, using machine learning techniques to categorise each tweet by discourse type. They found 27.8% of #Edchat tweets exhibited *cognitive discourse* (i.e., stating personal ideas or opinions, sharing experiences and initiating new conversations by asking a question) and 27.3% exhibited an *interactive discourse*—expressing agreement or responding to an earlier tweet (Xing & Gao, 2018). Because of the scale of computational analysis, discourse types were too broad to illuminate the nuances of inquiry across cognitive and interactive categories.

In smaller scale, hand-coded content analysis of #Edchat tweets, Forte et al., (2012) found that 20% of #Edchat tweets requested response (e.g., asking a question) and approximately 5% of #Edchat tweets responded to a request. Years later, Staudt Willet (2019) reported an even lower response rate: only 1.31% of #Edchat tweets were replies to others. These studies emphasise Twitter #Edchat as more *bulletin board* than *conversational space* (Staudt Willet & Carpenter, 2021). In sum, although prior research suggests that asking questions is an important activity on social media, it has been under-represented in studies of Twitter broadly, and #Edchat specifically.

Pandemic emergency remote teaching

Uncertainties around pandemic-induced *emergency remote teaching* (Hodges et al., 2020) raised questions for educators on the frontlines of change. Greenhow, Lewin, et al., (2020) examined educational responses to COVID-19 in the United States and United Kingdom. They found that the move to emergency remote teaching forced pedagogical challenges, created tensions in the division of labour (e.g., parents as teachers), disrupted system rules and generated digital equity issues, all of which teachers had to navigate while also working

from home. In contrast to pre-COVID classrooms, as nearly all U.S. teachers (94%) moved to teaching online (Kurtz, 2020), new instructional practices included little synchronous interaction between teachers and students, reduced emphasis on assessment, created new attendance expectations, and changed teacher workload (Greenhow, Lewin, et al., 2020).

Although educational institutions attempted to support educators, there was not enough time to professionally prepare all teachers (Trust et al., 2020); thus, many educators turned online for support. Between February and March 2020, traffic to an educator support website (support.office.com/education) increased six-fold; the most common searches shifted from broad professional learning inquiries (e.g., reading tools) to inquiries specific to remote teaching and learning (e.g., assignments in digital learning environments; Cavanaugh & DeWeese, 2020). On social media, over half of the tweets using #remoteteaching and #remoteteaching during COVID-19-spring shared resources, ideas or insights addressing cognitive needs related to teachers' transitions to emergency remote teaching (Trust et al., 2020). Approximately 43% of tweets addressed teachers' social and affective needs by sharing motivation and encouragement.

PURPOSE AND RESEARCH QUESTIONS

This study advances the knowledge base on the role social media played in teachers' educational response to the COVID-19 pandemic. Many teachers and students worldwide transitioned to some form of emergency online teaching and learning in Spring 2020. Although several studies have explored teachers' use of social media generally, and the Twitter hashtag #Edchat specifically, few studies have examined how and why teachers might turn to social media for support during an emergency. Here, we seek to better understand teachers' use of social media for professional learning in response to the global COVID-19 pandemic by studying #Edchat, one of the oldest, most popular education spaces on Twitter (Staudt Willet, 2019). We accomplish this by answering three research questions:

- **RQ1.** How, if at all, did participation in #Edchat change during COVID-19?
- **RQ2.** What questions did teachers ask in #Edchat during COVID-19?
- **RQ3.** How did teachers perceive their social media use impacting their teaching during COVID-19?

METHOD

Data collection

Using Twitter Archiving Google Sheets (Hawksey, 2014), we collected 257,703 tweets containing the keyword '#edchat' from 1 March–31 May 2020 (referred to hereafter as 'COVID-19-spring') as the effects of the COVID-19 pandemic were beginning to become widespread. To compare how #Edchat participation may have changed, we revisited previously collected tweets containing '#edchat' from a year earlier, 1 March 1–31 May 2019 ($n=332,067$). We used the statistical computing language and environment R (R Core Team, 2020) for data cleaning and analysis, starting by using the R package tidytags (Staudt Willet & Rosenberg, 2020) to collect additional metadata about each tweet and remove tweets that had been deleted or made private.

By conducting a search for the '?' symbol, we identified 15,584 *question tweets* (i.e., original tweets, not retweets, that contained a question) from 4,100 tweeters in the 2019 #Edchat tweets, and 12,901 question tweets from 3,949 tweeters in 2020. Because we wanted to

TABLE 1 Teacher participants in interviews

	Alex	Nicholas	Stephen	Vivian
Country	U.S.	Canada	U.S.	Canada
Teaching Experience	22 years	10 years	11 years	20 years
School Type	Private	Public	Public	Public
Subject Taught (Spring 2020)	Math	All subjects	Math	All subjects
Grade Level	High school	5th–6th	7th	Kindergarten
Twitter Experience	4 years	7 years	8 years	11 years
Twitter Followers (January 2021)	2,337	1,632	1,382	12,677
Average daily tweets during COVID–19	11.4	7.3	4.2	30.5
Percentage of tweets asking a question	15.1%	10.7%	10.9%	12.4%

interview teachers who had tweeted in #Edchat, we needed to take a purposeful sample of the 3,949 tweeters to reduce the number of accounts to classify as teachers or not. Although Twitter users who ask many questions likely differ from typical users, previous research showed that prolific #Edchat contributors were not spammers—that is, the most frequent #Edchat tweeters posted relevant educational content (Carpenter et al., 2020).

We identified *high frequency* question tweeters by filtering #Edchat question tweets from contributors who posted at least 10 question tweets during the 2020 time period, resulting in 6,087 question tweets from 223 tweeters (a purposeful sample from the 3,949 overall question tweeters). We looked at these tweeters' profiles and recent tweets to identify 33 teachers (excluding #Edchat moderators). These teachers posted 1,054 #Edchat question tweets in #Edchat during COVID-19-spring. From the 33, we identified 11 K-12 teachers in the United States or Canada who used question tweets to interact with other tweeters and invited them to be interviewed. We received five positive responses and report interview data from four (Table 1). All interview participants were experienced teachers and Twitter users, but their backgrounds varied by country, school type, and grade level. All teachers transitioned from face-to-face to online teaching during COVID-19-spring.

We used Zoom video-conferencing to conduct and record individual, semi-structured one-hour interviews. We asked teachers about their social media use (i.e., Twitter and #Edchat) during the initial months of the COVID-19 pandemic (1 March 31 May 2020). Specifically, we asked about their transition to emergency remote teaching, supports their schools provided, their purposes and nature of #Edchat question tweets during this period, and what impact #Edchat participation had, if any, on their online teaching. During each interview session, we also showed teachers a sample of 5–10 of their tweeted questions from COVID-19-spring and asked them to talk through each tweet. Teachers described why they created each question tweet, what they asked about, the responses they received (and from whom), and how the responses related to their teaching practice.

Data analysis

To answer the first research question, we calculated the daily count of all #Edchat tweets from the same period (1 March 31 to May) in 2019 and 2020, grouped by the type of tweet (i.e., original tweets, question tweets, retweets). We also calculated the *log odds ratios* of hashtags occurring in tweets alongside #Edchat. An odds ratio quantifies the strength of association between hashtag inclusion in 2019 and 2020 tweets; the logarithm tempers sensitivity to relative positions that often occurs in odds ratios.

To answer the second research question, we filtered the 2019 and 2020 tweet data to only contain *question tweets* (i.e., tweets containing a '?' and not retweets). We then identified the five most common topics in each year using *latent Dirichlet allocation* (LDA) topic modelling, a statistical method of grouping words together using frequency and likeness. We also conducted discourse analysis of the 1,054 #Edchat tweets from 33 high-frequency tweeting teachers through open coding (Saldaña, 2016) these tweets by hand with an emergent coding scheme.

To answer the third research question, the first and third authors engaged in qualitative analysis of interview data. Informed by prior research and PLN framing, we generated codes within four overarching categories: purpose of tweeted question; content of tweeted question; who interacted/responded; and connection to online teaching. For instance, drawing on PLN framing and prior literature, we noted teachers' *purposes* in posing question-tweets (e.g., prompt discussion, self-promote, share resource); the *content* or subject of the tweet (e.g., teaching-related challenges; resources or tools offered, received or requested); *people* who were tagged, responded or interacted with the tweet; and the *perceived connection(s)* to remote teaching, if any. To help ensure trustworthiness, we engaged in researcher triangulation to ensure that the analysis was not confined to one perspective (Saldana, 2016; Tracy, 2010; Yardley, 2015). Two coders reviewed and coded one interview transcript using a priori codes as well as emergent codes highlighting words and ideas expressed by teachers describing their #Edchat tweeting (e.g., recognition, validation). We relied upon 'intensive discussion' and 'coder adjudication' to reconcile discrepancies as we talked through the transcript (Saldaña, 2016, p. 37). We individually coded remaining interviews and engaged in peer review: reviewing each other's coded transcripts, discussing emerging codes, identifying potential themes and clarifying or making modifications to reach consensus (Tracy, 2010; Yardley, 2015). As we sought to understand the 'uniquely defined' nature of professional learning we composed individual case narratives which helped us analyse and interpret particulars by teacher followed by cross-case analysis and write-up to interpret commonalities (Yin, 2014).

RESULTS

RQ1. How, if at all, did participation in Twitter #Edchat change during COVID-19?

In Figure 1, we observe that daily Twitter #Edchat activity is similar from 2019 to 2020, with weekly spikes on Tuesdays due to #Edchat synchronous chats. The number of question tweets is nearly identical during COVID-19-spring as the previous year. One notable difference is that there were generally fewer retweets in 2020 than in the previous year, other than a retweeting uptick in mid-March 2020 when most U.S. schools made a sudden shift to emergency remote teaching and learning. After a few weeks of heightened retweeting, this activity again decreased below the 2019 level.

Although overall tweet activity levels were similar, the content of #Edchat tweets appeared to be different in 2020 when compared to the year before (Figure 2). Looking at all #Edchat tweets in March to May 2019 and 2020, the hashtags #edtech, #education, #k12, #teaches and #teaching were used frequently and consistently in #Edchat tweets across the two periods (log odds ratio ≤ 0.4). However, hashtags such as #librarians, #stem, #kidsdeserveit (related to the book *Kids Deserve It!*) and #sketchnote (related to the visual note-taking technique) dropped in 2020. The drop in usage of these hashtags may have been due to increased use of pandemic-related hashtags. For instance, #remoteteaching,

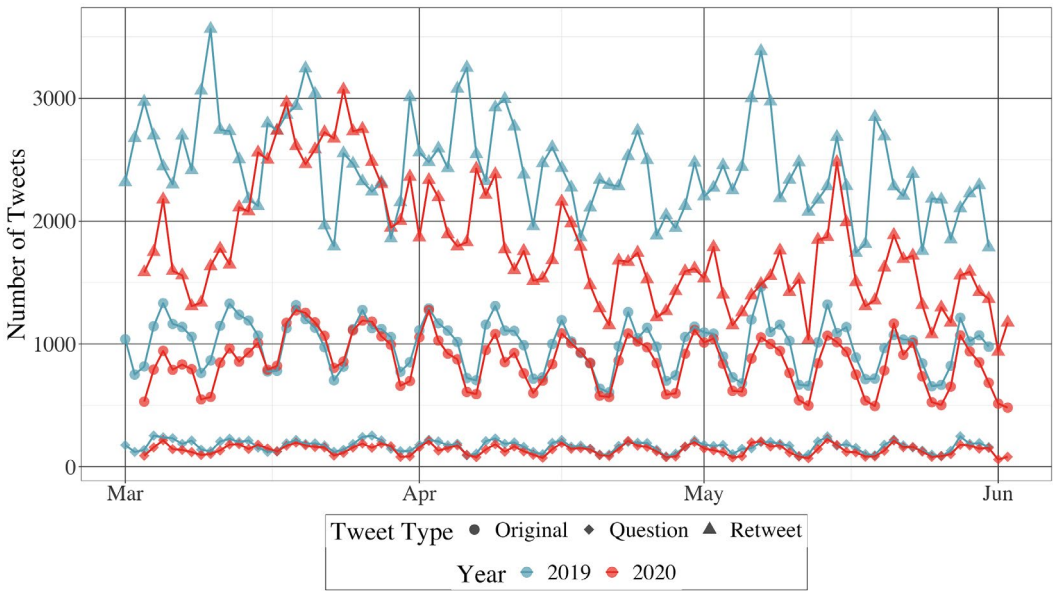


FIGURE 1 Daily #Edchat Tweets in 2019 versus 2020. The 2020 dates have been shifted by +2 to align weekdays between 2019 and 2020. This better highlights the weekly spike in #Edchat tweets due to synchronous chats every Tuesday

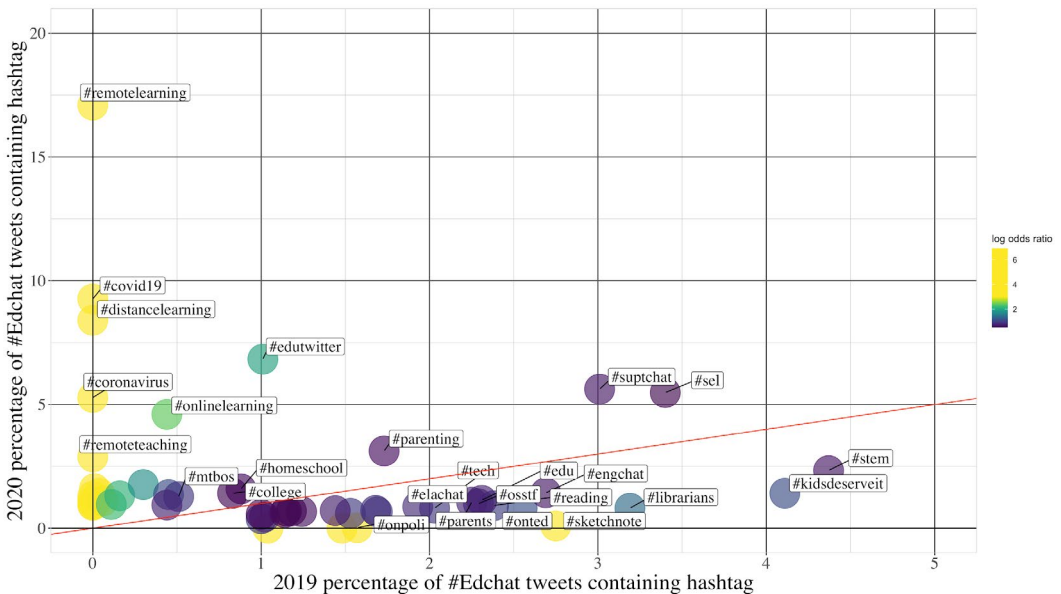


FIGURE 2 Hashtags in #Edchat Tweets in 2019 versus 2020. The red diagonal line represents an equal likelihood that a hashtag appeared in both years. Only hashtags with a log odds ratio ≥ 0.5 are shown

#remoteteaching, #distancelearning, #COVID19 and #coronavirus were used alongside #Edchat for the first time, and #edutwitter, #onlinelearning, #homeschool and #parenting were used more often during COVID-19-spring than in the previous year.

RQ2. What questions did teachers ask in Twitter #Edchat during COVID-19?

Conversation topics in #Edchat question tweets differ in some ways from 2019 to 2020, but also show similarities (Figure 3). Across all 10 topic models (five each year), terms like ed-tech, learn(-ing), teach(-ing or -er) and school are common, as indicated by the bright bands of yellow or green across the rows associated with these terms. In 2019, pre-COVID-19, Twitter #Edchat was already a place where users tweeted questions to look for help, presumably related to new K-12 resources (2019 Topics 1, 3). These often seemed to be related to classroom teaching (2019 Topics 4, 5) and sometimes specific subjects like reading (2019 Topic 2). Some of the 2020 topic models demonstrated similar themes, although perhaps with a greater sense of urgency (2020 Topics 1, 2). Additionally, asking for help was more prevalent in 2020, with increased appeals to fellow educators through ‘edutwitter’, apparently seeking free classroom resources (2020 Topic 5). Finally, the pandemic dominated two 2020 topic models, with Topic 3 including students, online, remotelearning, onlinelearning, now, help and home; and Topic 4 centered on math, but in conjunction with distancelearning, online, COVID19 and coronavirus.

Discourse analysis of 1,054 #Edchat question tweets composed by 33 teachers during COVID-19-spring showed a variety of ways questions were used (Table 2). About half (46%) were questions used to *promote* the tweeter’s own website, books or ed tech products for

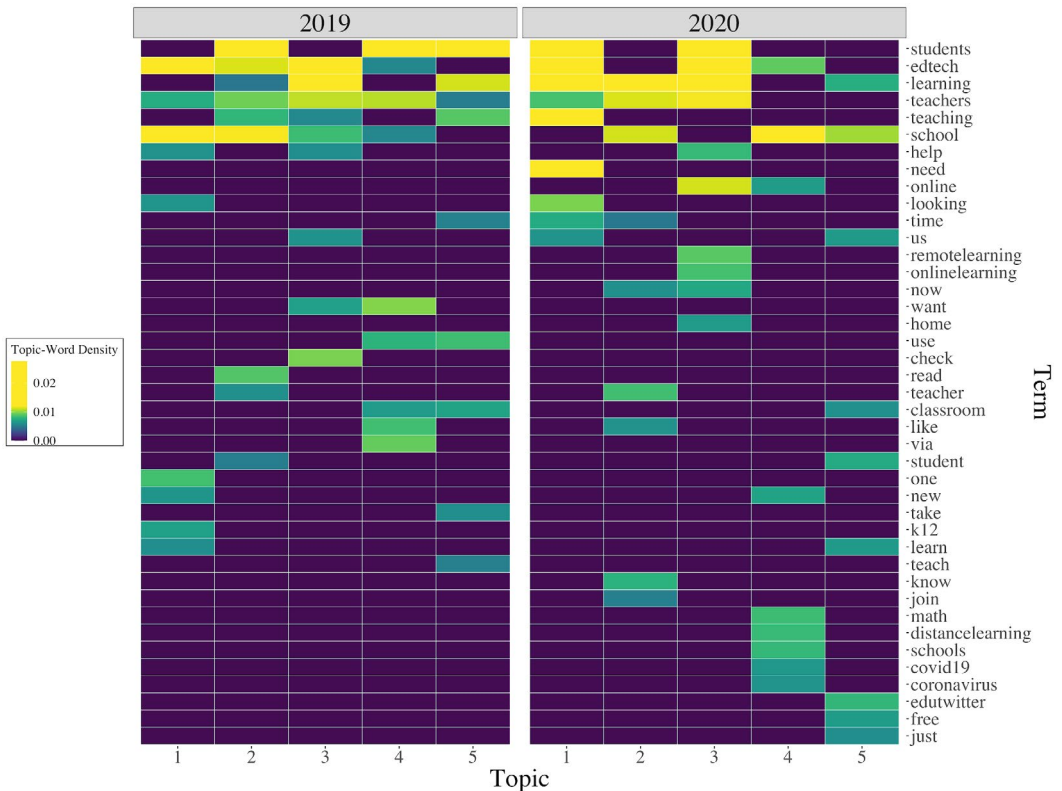


FIGURE 3 Topics in #Edchat Tweets in 2019 versus 2020. Columns depict five topics from 2019 and five from 2020. ‘2019–2021’ can be read as ‘2019 Topic 1’. Brighter colours show higher density of terms in a topic, with the dark purple colour meaning that a term was absent from a topic. Rows have been computationally reordered using principle components analysis so that adjacent rows are more similar than non-adjacent rows

TABLE 2 Codes and results from discourse analysis of teacher tweets

Code	Count	Definition	Examples
Promote self	488 (46.3%)	Question written as part of self-promotional strategy, typically drawing readers to the tweeter's own website. In some cases, the question promotes an ed tech tool with which the tweeter is formally associated (e.g., as a brand ambassador)	'Interested in doing a book study? My new book is out this week! Also, check out my other titles on my website: [link].' 'Looking for the latest in ed tech news and ideas? Look no further! Our ed tech news recap has you covered. Here's the latest: [link].'
Start discussion	330 (31.3%)	Question seeking response, that is, the prompt at the beginning of a potential dialogue	'What is everyone using to do check-ins (and check-outs) with their students?' 'What guidelines do you give students for using Zoom? Anyone have something they'd be willing to share?' 'Many teachers are moving to emergency remote teaching soon. How are you doing? How are you engaging with this new reality? Let's talk and support each other here.' 'What do you want to talk about during this week's #Edchat? Crowdsignal link: https://t.co/HPPJYCrjg9 '
Share resource	211 (20.0%)	Question written to direct readers to an ed tech tool or article (with which the tweeter has no formal association)	'What Will School Be Like in the Fall after a Distance Learning Spring? https://t.co/uGSrYOxnYQ ' 'Are You Prepared For The Future Of Social Learning? https://t.co/e/KOuZaG13 '
Respond in dialogue	46 (4.4%)	Question written in reply to or quote tweeting someone (i.e., retweet with comment)	'Interesting that you say that. My school sent a survey to teachers about our familiarity with online learning. They sent it to parents and students also. Has anyone else gotten something like that?' 'I think that teaching and learning this fall may look really different even we return to school buildings. Less physical everything: collaboration, activity, resources. Also, will extracurricular activities be able to run?'
Comment rhetorically	40 (3.8%)	Question used as a statement to make a point or advance an argument	'The mayor is talking about our city going into lockdown. My classes have already moved to emergency remote teaching, but they want me to go into school to do my planning for online teaching. You really want me to leave my kids at home with someone to do this? Seriously, just let us work from home.'

which the tweeter was an ‘ambassador’. Similar to the ‘share resource’ code, questions in these tweets were used as part of an invitation to follow a hyperlink to observe content elsewhere rather than interact on Twitter. The next most common type of questions, appearing in about a third (31%) of the discourse, were those intended to *start a discussion*. These discussions spanned many topics, including the general well-being of teachers during pandemic disruptions, ideas for teaching with technology, tech support for a specific tool and polling for ideas for future synchronous Twitter chats. Tweets that shared resources (20%) contained questions that were part of an Internet article title. Occasionally, someone wrote a question tweet that spanned categories, such as both promoting self and starting a discussion: ‘I just wrote a blog post: [link]. Thoughts? Anything to add’? For the most part, though, question tweets fit into one of the categories described in Table 2. Finally, a handful of questions were used to comment rhetorically, without expecting an answer.

RQ3. How did teachers perceive their social media use impacting their teaching during COVID-19?

All four teachers who tweeted questions to #Edchat during COVID-19-spring expressed challenges they faced in transitioning to emergency remote teaching and how supports sought and received through #Edchat impacted their teaching online. Each teacher’s case is summarised below, followed by cross-case themes.

Alex

An experienced high school math teacher at a private U.S. boarding school, Alex had been using Twitter professionally for four years, regularly participating in #Edchat Tuesday chats. During COVID-19-spring, he tweeted questions to #Edchat to ‘sharpen his discourse’ (i.e., thinking about teaching math online), find ‘workarounds’ to teaching problems, seek validation and get affirmation for change. For instance, he tweeted: ‘Are online relationships as meaningful and “real” as the ones we create in the classroom? I don’t think so because of how I grew up. But if kids grow up with online learning, what would THEY think? Would they fill their needs differently? #edchat.’ His questions revealed pedagogical challenges; he struggled to translate critical aspects of his face-to-face pedagogy (e.g., small group work and daily, low-stakes assessments) to an online environment. Respondents to his questions included other teachers, mostly outside his school, and ‘heavy-hitters’, or teachers with large followings with whom he interacted or solicited to spread his questions to a wide audience. He valued hearing from other teachers on Twitter who differed in how and who they taught. Reflecting on his participation, Alex highlighted #Edchat’s usefulness in shifting his mindset (e.g., disrupting his thinking that ‘real teaching’ could not be done online). Participating in #Edchat during COVID-19-spring helped his confidence teaching in a new context and reaffirmed his core beliefs in regular assessment despite having to re-tool (e.g., ‘trust your kids’; at-home assessments can be valid).

Nicholas

Teaching at a Canadian public elementary school, Nicholas had used Twitter and #Edchat for several years to connect with other educators, share his teaching ideas, and gain recognition for strategies he developed. During COVID-19-spring, Nicholas tweeted questions seeking advice and resources from teachers who had begun emergency remote teaching

before he did. He asked questions about specific tools and resources (e.g., digital citizenship materials), classroom management (e.g., tracking student log-ins) and to prompt supportive community conversations (e.g., 'I am keeping up my routines and taking time for myself to help my students! How are you engaging with the reality around you?'). Nicholas appreciated connecting on Twitter with 'awesome teachers' and education professionals both locally and abroad, as well as other stakeholders (e.g., librarians, parents). Although he did garner specific teaching practices on #Edchat during COVID-19-spring (e.g., ideas for designing his own daily check-in activities with students), Nicholas emphasised how #Edchat shifted his perspective from one of fear and anxiety (e.g., avoiding virtual synchronous teaching because of privacy concerns) to prioritising students' needs (e.g., holding regular virtual synchronous meetings with students and their families).

Stephen

Stephen, a 7th-grade math teacher in a public U.S. school, had been using Twitter and #Edchat for approximately eight years to connect with other middle school teachers, share lesson ideas, and glean lesson inspiration. He valued #Edchat as both a global and interdisciplinary platform: 'I think it's really cool to take an English activity or a social studies activity and try to find a way to adapt it back to teaching math content... I'm able to get ideas from people in Australia and connect with people from Florida.' During COVID-19-spring, Stephen asked questions on #Edchat to find remote teaching resources and get help using specific tools (e.g., YouTube). These uses shaped his teaching practice because he was constantly needing new ideas to find what worked for his students; Stephen described it as returning to his 'first year teaching' and a reminder that 'we're going to do this together.' He was also more 'intentional' in sharing his own teaching ideas in hopes of helping others. Stephen asked questions to hook other educators' interests in his own shared resources (e.g., 'Want to learn some cool things about Exponential Growth?'). He also used #Edchat for interaction with his students (e.g., estimation challenges in math). Although he mostly connected with other middle school teachers, he found that students and families engaged with the content he tweeted for class.

Vivian

A kindergarten teacher in Ontario, Canada, Vivian had tapped Twitter and #Edchat for 11 years to find resources specific to teaching kindergarten or to connect to students' interests. She also used Twitter to spark discussion and engagement with other educators around her own teaching-related blog posts, prompting other education professionals to: 'share.. their thoughts [on her blog post]...or extend the conversation.' She blogged on topics related to emergency teaching online, including regular reflections on how her '#distancelearning' was going and ideas for other kindergarten teachers. During COVID-19-spring, her questions related to the challenges of 're-considering' kindergarten pedagogy, such as moving play online, fostering small group conversations, supporting parents in home-learning and relationship-building with children. Her tweeted questions included: 'Fostering Relationships In Front Of A Camera: What Do You Do?' and 'How can educators & parents work together to use questions with kids at home to support learning?' She received responses from educators, administrators and parents in her school community, as well as teachers and academics beyond it. Vivian explained that #Edchat impacted her teaching during COVID-19-spring by providing a window into how kindergarten educators were successfully facilitating children's play online and small group conversations, which supported her to 'try something' similar in her own classroom.

For all four teachers, #Edchat was a space they accessed before and during the pandemic for teaching-related supports. Next, we present common themes across teachers related to the purpose and content of their question tweets, who responded, and teachers' perceptions of the influence these interactions had on their emergency online teaching.

Inquiring tweets want to know: Challenges to remote teaching

During COVID-19-spring, the four teachers posed questions to #Edchat mainly to prompt discussion, share resources or promote teaching-related content they developed, sometimes blending these purposes. First, teachers used questions in various ways to engage their audiences, encourage interaction between users and solicit feedback. Whether asking about a specific need (e.g., Nicholas: 'Teachers who do online read alouds, are you asking permission first from authors?') or opening a conversation about a broad topic (e.g., Alex: 'What I do know: the physical and emotional negatives...[of] too much screen time (heavily researched) don't go away just because we're in a pandemic and need...distant learning. How are we planning classes to reduce unnecessary screen time?'), the teachers used questions to elicit response about issues surrounding emergency remote teaching. Both Vivian and Stephen also used questions prominently as part of self-promotion and resource-sharing. Vivian's frequent tweets to share her blog posts always included at least one question asking for readers' thoughts or ideas (e.g., 'What have you tried? What might you suggest? Looking for some collective voices here'). More than simply advertising her blog, Vivian blended self-promotion with an attempt to engage her audience through shared content. Stephen similarly used questions to invite readers to participate in trying the resources he shared (e.g., 'Want to learn some cool things about Exponential Growth? I'm going to use this thread to tweet the various videos that I'm using to teach my students today about this amazing piece of math!'). Questions were essential to how #Edchat functioned as a support network for these teachers. Their questions were intended to bring people together, not just to find a particular answer but to inspire ideas and demonstrate solidarity between educators facing the challenges of COVID-19.

Indeed, close examination of the content of teachers' question tweets revealed the range of challenges they faced in transitioning to emergency remote teaching. Almost all questions concerned re-thinking pedagogy; educators questioned how to perform essential elements of their teaching online (e.g., how to facilitate small group discussions, kindergarteners' play, assessment, tracking student engagement). They sought out teaching-related resources and tools (e.g., 'Has anyone had success with a specific online platform...to teach decoding online?') or offered their own digital content. A major challenge identified by all teachers was maintaining strong relationships with students online. They also raised broader, more philosophical questions regarding the nature of schooling, using terms like 'paradigm' and 'mindset' and 'new school reality'. Stephen, for instance, questioned 'why in person classes are so impactful' and Alex tweeted: 'What parts of the old "paradigm" would be maintained and what parts MUST change?' Furthermore, tweets revealed a general concern with how remote learning was going for other educators, as in this representative tweet from Nicholas: 'So my question for my PLN today is: how are you holding up with remote learning? ...'.

Emergency responders: Teachers' #Edchat network

All teachers described the composition of their #Edchat network as educators and other education-related professionals (e.g., administration, school board members, education scholars). Importantly, the teachers specified that #Edchat connected them to individuals

beyond their existing teacher-friends or in-school colleagues. They mentioned the value of #Edchat as a space that convenes teachers around the globe and felt that #Edchat exposed them to new perspectives. Nicholas explained that he discovered ideas through #Edchat that he would not otherwise. Simultaneously, #Edchat facilitated teachers' connection with other educators in their grade or content area. Both Vivian and Stephen discussed how #Edchat helped them find other kindergarten and middle school teachers with whom to share resources. Additionally, Vivian utilised Twitter and #Edchat for communication with her students' parents. She published advice and at-home activities for families on her blog and shared them through her tweets. In general, the teachers described their networks as made up of educators they respected.

When asked about specific tweets and who responded, teachers largely confirmed the network composition described earlier in the interview. They received responses from other teachers (both inside and outside their school), administrators, community members such as parents and academic experts. On the other hand, there was little engagement from international teachers and 'heavy hitters' (i.e., influential teachers with large networks) within the sample we discussed; however, teachers expressed satisfaction with the support they received and the content they were able to share or find using #Edchat. All teachers referenced the quality and diversity of their #Edchat network as reasons for turning to it for support during COVID-19-spring.

Perceived impacts on remote teaching

Overall, teachers perceived their interactions around #Edchat question tweets as positively influencing their online teaching. They explained how participating in #Edchat provided insights into what other educators were implementing during COVID-19-spring, especially those from districts further along in their transition to teaching online, inspiring them to 'try something similar'. Tweeting about challenges and concerns in the form of questions helped them garner support from the responses they received (e.g., ideas for pedagogical strategies, links to new tools). It also gave voice to their anxiety as veteran teachers navigating unfamiliar terrain (e.g., privacy issues, classroom management, 'first year teaching' all over again). Tweeting more general questions about how it was going (e.g., Nicholas: 'How are you engaging in the reality around you?') contributed to teachers' sense of solidarity in managing the transition.

Furthermore, #Edchat question tweets seemed to facilitate teachers' reflection on professional identity issues (e.g., what is 'real teaching?', what about relating to students is fundamental?, can it be done online?, can I do this?, what mindset-shift is needed?). In one case, we saw Alex's skepticism about online pedagogy (i.e., group work) in this March tweet: 'are online relationships as meaningful and "real" as the ones we create in the classroom? I don't think so..' juxtaposed with his apparent preference for online group work in this tweet two months later:

If desks are supposed to be 6 ft. apart, I'm wondering if a learning experience planned for small-group collaboration would be BETTER done remotely, in breakout rooms. Why bring them together just to keep them apart? #edchat

Although we did not observe actual teaching practices, in this case, the teacher discussed how participating in #Edchat helped with his 'mindshift' from thinking that online pedagogy is necessarily inferior to considering it as more advantageous than teaching face-to-face in certain situations. Overall, teachers expressed how the supports and interactions they sought through question tweets on #Edchat positively influenced their teaching online.

DISCUSSION

This study explored the role that social media played in teachers' emergency remote teaching response to the COVID-19 pandemic. Results provide insights into teachers' professional learning and PLN theory-in-use during times of disruption and crisis. Specifically, we interpret these findings in light of the extant literature in terms of flexible content, inquiring discourse and a just-in-time emergency response network.

Flexible content

Our findings contribute new understandings of the flexibility and adaptability of PLNs, particularly as teachers share and search for resources online. This examination of #Edchat trends across two time periods has shown that the substance of content can change even without increasing the number of tweets. That is, tweeters did not flood #Edchat with tweets in response to the pandemic; but rather, the content of #Edchat tweets shifted in 2020, as evidenced by the inclusion of novel hashtags like #remoteflearning and #distancelearning alongside #Edchat. This would suggest a shift in conversations as needed, potentially resulting in PD that reflects ideals from the literature: ongoing and responsive to individual's needs, interests, and goals (Desimone, 2009; Trust et al., 2016); accessed any time (Galvin & Greenhow, 2020; Greenhow, Galvin et al., 2020) and just-in-time (Bruguera et al., 2019; Greenhalgh & Koehler, 2017).

Because #Edchat is embedded in teachers' broader PLN, contributing in a distinct way (Stevenson et al., 2019), future research should explore how components of a teacher's professional learning network flex, adapt and inform each other (Peters & Romero, 2019). Such work would help map the complexities of how PLNs shape educators' learning, and most importantly, their teaching (Trust et al., 2016). Tapping the adaptability of their PLNs could be advantageous for educators; we recommend practitioners actively seek to flex and blend their professional learning across spaces to enrich the range of potential learning experiences available (e.g., share lesson ideas from Pinterest with a collaborative planning group and then prompt interaction on #Edchat around how the team adapted the materials).

Inquiring discourse

This study also demonstrates benefits of focussing on question tweets and the role these play within teachers' PLNs. Asking questions on social media open opportunities for teachers' professional learning (e.g. Carpenter & Krutka, 2014), but are not well-understood in Twitter broadly or in #Edchat specifically. Rather, #Edchat question tweets have only been described as uncommon (Staudt Willet, 2019) or grouped together with broader forms of discourse (Xing & Gao, 2018).

Here, we found an unexpected diversity of discourse types in question tweets. Nearly half of teachers' question tweets were self-promotional in nature, a similar percentage as all #Edchat original tweets (Staudt Willet, 2019), but the majority served to solicit ideas or share resources, extending what others have found (Trust, 2015). Our focus on question tweets foregrounded the inquiry afforded by social media, that is typically reported as uncommon in #Edchat more broadly (Staudt Willet, 2019). Moreover, our findings suggest the potential value of situating inquiries in social media for teachers' professional learning.

However, to seek (and contribute to) these inquiring discourses teachers will likely need to develop their digital literacies (Greenhow et al. 2019). For example, training or resources on how to use Twitter's advanced search options to locate and engage with question tweets

could foster teacher-centered inquiry circles as part of a teacher's PLN. Further research investigating teachers' inquiry practices on Twitter, and their influence on pedagogy and in turn, students' learning, could benefit the field's capacity to support teachers during times of transition, beyond the context of the pandemic (e.g., when moving to a new school, content area, or grade level).

Just-in-time emergency response network

The literature has shown that teachers appreciate being able to access expertise and perspectives more diverse than those available locally and tap social media networks to bridge gaps in age or experience (Davis, 2015; Fischer et al., 2019; Trust et al., 2016). Our findings reveal that teachers sought professional learning via #Edchat to bridge a *time* and *experience* gap in their local, school-based emergency PD; in posing questions, they sought responses from educators whose schools had moved to online teaching before their own and who might therefore have useful reactions to share from their experiences.

As the #Edchat network adapted to accommodate educators' need to talk about something different (e.g., online learning, help, COVID-19), in-depth examination of question tweets revealed that all four teachers sought help for an immediate challenge that has been documented in the literature as essential to quality online teaching: relationship-building (EEF, 2020; Greenhow & Chapman, 2020; Greenhow & Galvin, 2020; Protopsaltis & Baum, 2019; Tallent-Runnels et al., 2006). Research conducted during the pandemic reports that high levels of interaction (i.e., teacher-student; peer group) during online teaching are associated with high levels of student engagement (Lucas et al., 2020). Interaction during COVID-19-spring dropped quickly as schools closed and many teachers struggled to learn new skills, navigate safety requirements and facilitate access to technology (Greenhow, Lewin, et al., 2020). Our findings suggest that educators turned to *just-in-time* professional learning networks to help them meet this and other challenges of emergency online instruction.

These just-in-time networks are useful in situations beyond emergency response. That is, in addition to adapting to COVID-19 disruptions, the flexibility of accessing PLNs as needed can benefit teachers as they anticipate professional challenges. For instance, the induction literature reports obstacles associated with transitioning from teacher preparation programmes into classrooms of practice. New teachers have reported feelings of being in a survival mode (Zhukova, 2018), trying to 'sink or swim' on their own (Ingersoll, 2012), and many end up leaving the profession with regret, still committed to students but unable to continue (Dunn, 2018). Teacher departures have high costs to districts, schools and students (Carver-Thomas & Darling-Hammond, 2017). Accessing PLNs through social media when needed may help new teachers navigate expected challenges and find the necessary help to complement local, offline supports.

Further research into how to encourage and support teachers' agency in pursuing just-in-time PD, whether during an emergency like COVID-19 or during other challenging professional transitions teachers face is warranted. Another major transition for teachers is on the horizon—the transition back from emergency remote teaching—and teachers should lean into the flexibility and adaptability of their PLNs as post-pandemic education norms are explored and negotiated.

Limitations

Our study is limited by our sampling decision, such as choosing to focus on high frequency #Edchat tweeters who contributed at least 10 question tweets during the three-month period.

Our findings would likely have been different had we looked at #Edchat tweeters who posted only a single question tweet or those who did not tweet but nevertheless observed and benefitted from #Edchat questions.

CONCLUSION

Prior to the COVID-19 pandemic, teachers turned to social media to find supports for their teaching and just-in-time PD (Bruguera et al., 2019; Greenhalgh & Koehler, 2017). This study increases understanding of social media for flexible, just-in-time PD and highlights the importance and utility of teachers' questioning discourse in emergency situations. Future work should incorporate observations of actual teaching to better understand the relationship between teachers' use of such emergency professional learning response networks and their application to immediate practices (Carpenter & Harvey, 2020). In addition, research is needed that explores how the pandemic context accounted for shifts in topics and discourse, and why this may be important when activating PLNs via social media in future emergency response situations.

CONFLICT OF INTEREST

The authors report no conflict of interest; this work does not deal with commercial products.

ETHICS STATEMENT

This study was reviewed and approved by the Human Research Protection Program at Michigan State University.

DATA AVAILABILITY STATEMENT

Our code for the computational analyses is shared openly on GitHub (<https://github.com/bretsw/edchat-covid19>), and data are available upon request through Open Science Framework (<https://osf.io/gpc2d>).

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