Differences between teacher-focused Twitter hashtags and implications for professional development

Differenze tra hashtag Twitter riguardanti i docenti

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ABSTRACT Twitter hashtags may serve as valuable means for teachers' professional development. However, given the diversity of hashtag spaces and teacher needs, teachers must assess a given hashtag and compare it to their learning needs and preferences before determining whether it would be helpful. To support this reflection, I examine data associated with 60 Regional Educational Twitter Hashtags (RETHs) during the first six months of 2016 to begin describing the variety of teacher learning-focused Twitter spaces and make distinctions between them. My results indicate that these RETHs vary according to their relative focus on sharing, intimacy of personal connection, and volume of activity, each of which has implications for professional development. The dimensions resulting from this study may prove helpful for teachers, teacher educators, and hashtag coordinators.

KEYWORDS Teachers' Professional Development; Social Media; Twitter Hashtags.

SOMMARIO Gli hashtag di Twitter possono rappresentare un valido strumento per la professionalizzazione degli insegnanti. Ciononostante, vista la notevole diversità sia di tipologia di hashtag che di bisogni professionali dei docenti, gli insegnanti dovrebbero valutare un determinato hashtag e compararlo con i loro bisogni e preferenze prima di decidere sulla sua efficacia. Al fine di indagare tali aspetti, sono stati analizzati i dati associati a 60 hashtag educativi su base regionale nel corso dei primi sei mesi del 2016 per cominciare a descrivere la varietà dei tweet centrati sullo sviluppo professionale dei docenti, sottolineandone le differenze. I risultati dello studio indicano che tali hashtag hanno implicazioni sulla professionalizzazione degli insegnanti, a seconda della centratura su condivisione, legami personali e dimensione dell'attività. Le conclusioni di questo studio possono essere utili per gli insegnanti, i formatori di insegnanti e i coordinatori di hashtag.

PAROLE CHIAVE Professionalizzazione degli Insegnanti; Social Media; Twitter Hashtag.

1. INTRODUCTION

In recent years, researchers have documented teachers' use of social media tools, including Twitter, for formal and informal professional development (e.g., Greenhow, Campbell, Galvin, & Askari, 2018). Pro-

fessional development encompasses teachers' "*learning, learning how to learn, and transforming their knowledge into practice*" (Avalos, 2011, p. 10). Participation on Twitter has been found to support teachers' resource sharing and professional learning (Carpenter & Krutka, 2015; Forte, Humphreys, & Park, 2012; Visser, Evering, & Barrett, 2014). Teachers also use Twitter for other professional needs, including receiving emotional support and overcoming feelings of isolation (Carpenter & Krutka, 2015; Wesely, 2013), and building and maintaining interpersonal relationships (Carpenter & Krutka, 2015; Visser et al., 2014).

Teacher professional development is often seen as a collective, rather than individual, enterprise (e.g., Darling-Hammond & McLaughlin, 1995). Thus, although learning may be the chief concern in research on professional development, there remains considerable benefit to understanding the collectives in which learning takes place and activity within those collectives. This is especially true in the context of social media, where teachers may have many collectives to choose from. Many collectives on Twitter are created through the use of *hashtags,* key words or phrases preceded by a hash (#) sign. To benefit from Twitter hashtags (or any collective), teachers must identify those that best correspond with their professional needs and navigate the social dynamics and practices that characterize them; thus, understanding these collectives may be a prerequisite for effective learning.

However, teacher-focused hashtags can be highly diverse. #Edchat is broadly focused on education, has existed since 2009 (Anderson, 2012), and may be used in up to 7,500 tweets in a day (Staudt Willet, Koehler, & Greenhalgh, 2017). #educattentats was narrowly focused on French educators' response to terrorist attacks, was active for less than a month, and included less than 6,000 tweets (Greenhalgh & Koehler, 2017). The existing literature has done little to describe this diversity in specific terms that may be helpful for further research in teacher education and teacher practice.

The purpose of this study is therefore to begin describing the variety of teacher-focused hashtags on Twitter, including the specific ways in which they vary. This study specifically focuses on hashtags associated with either American states or Canadian provinces. These examples of Regional Educational Twitter Hashtags (RETHs) - a variation on Rosenberg, Greenhalgh, Koehler, Hamilton, and Akcaoglu's (2016) State Educational Twitter Hashtags - allow educators within specific areas to participate in professional development (Asino, Haselwood, & Baker, 2016) that is attentive to local issues or to engage in local activism (Krutka, Haselwood, & Asino, 2018). The results of this study highlight how different groups of educators and educational stakeholders have used Twitter to create different hashtag spaces with different social dynamics and practices.

2. BACKGROUND

In this section, I discuss the background information and research that informs this study.

2.1. *Overview of Twitter*

Twitter is a microblogging service, a "*social media platform for sending, receiving, and sharing short posts*" (Gleason, 2013, p. 967). On Twitter, individual users compose *tweets*; for example, my name and Twitter *handle* are displayed alongside the tweet in Figure 1. Users can also enrich these short posts. The tweet in Figure 1 *embeds* a video, *links* to a Web resource, and *mentions* another Twitter handle; one word in Figure 1 is a *hashtag*, which indexes tweets related to particular topics.

Figure 1. Screenshot of a tweet.

Twitter users can also interact with tweets. The icons at the bottom of Figure 1 depict *replying* (responding to a tweet), *retweeting* (reposting someone else's tweet), and *liking* (signalling interest or approval). *Quote tweets* (see Figure 2) embed other tweets to comment on or respond to them.

Figure 2. Screenshot of a quote tweet.

2.2. *Twitter hashtags as spaces*

Some researchers have used the *community of practice* metaphor to describe teachers' use of Twitter (e.g., Britt & Paulus, 2016; Gao & Li, 2017; Visser et al, 2014; Wesely, 2013), likely due to its prevalence in research on teacher learning. However, a community of practice is distinguished by specific features such "*an identity defined by a shared domain of interest*" (Wenger-Trayner E. & Wenger-Trayner B., 2015, p. 2), whereas educational Twitter hashtags often include participants with diverse identities (Greenhalgh & Koehler, 2017; Rosenberg et al., 2016; Veletsianos, 2017a), and other features that do not correspond with

the community of practice as strictly understood.

This study therefore joins previous work in using the *space* metaphor to describe teachers' use of Twitter (Carpenter & Krutka, 2015; Greenhalgh & Koehler, 2017; Rosenberg et al., 2016). Gee (2005) argued that social learning can happen in a distinct *affinity space*, regardless of whether a true community of practice is present. However, because the affinity space is a "*fuzzy concept*" (Gee & Hayes, 2012, p. 133) whose boundaries are being challenged (Duncan & Hayes, 2012), it remains unclear how to make distinctions between different kinds of spaces.

2.3. *Distinguishing Twitter hashtags*

Social media researchers have used Twitter trace data to describe and distinguish hashtags. Such an effort is facilitated by the Twitter *application programming interface* (API), which allows for the automated retrieval of certain kinds of Twitter data.

As educational technology researchers have turned their interest to Twitter, many have used measures based on API-derived digital data to describe educational hashtags. These measures have included:

- size of hashtags, the number of participants, or the number of tweets, over a certain timeframe (Greenhalgh & Koehler, 2017; Rosenberg et al., 2016; Britt & Paulus, 2016; Carpenter, Tani, Morrison, & Keane, 2020; Gao & Li, 2017; Veletsianos, 2017a);
- communication within hashtags, the numbers or proportions of replies, retweets, and original tweets (Greenhalgh & Koehler, 2017; Carpenter et al., 2020b; Koutropoulos et al., 2014; Staudt Willet, 2019);
- connections within and through hashtags, mentions (Staudt Willet et al., 2017; Staudt Willet, 2019), hyperlinks (Carpenter et al., 2020b; Gleason, 2013; Koutropoulos et al., 2014), or both (Veletsianos, 2017a, 2017b);
- use of media in tweets (Gleason, 2013);
- number of hashtags in tweets (Staudt Willet et al., 2017; Koutropoulos et al., 2014; Veletsianos, 2017b);
- participant commitment, the number of tweets per user (Gao & Li, 2017; Veletsianos, 2017a, 2017b) or the consistency of participation (Rosenberg et al., 2016; Britt & Paulus, 2016; Xing & Gao, 2018); and
- social networks created through retweeting, replying to, or mentioning other participants (Greenhalgh & Koehler, 2017; Rosenberg, Greenhalgh, Wolf, & Koehler, 2017; Gao & Li, 2017).

3. PURPOSE

The purpose of this study is to describe some of the variety in teacher-focused Twitter hashtags in terms of composite dimensions along which they vary. In particular, I describe how Regional Educational Twitter Hashtags (RETHs) based in the United States and Canada differ. RETHs serve as a compelling starting point for studying differences among Twitter hashtags. Because RETHs share a common purpose (i.e., locally focused professional development), differences between them can more closely be ascribed to social, cultural, or otherwise idiosyncratic differences (cf. Carpenter, Tur, & Marín, 2016). Furthermore, although teachers are likely to participate in RETHs based on geographical location, describing less-obvious differences highlights other considerations for teachers to make. Indeed, previous research (Greenhalgh, Staudt Willet, Rosenberg, & Koehler, 2018) has suggested that some teachers participate in geographically "foreign" RETHs, implying that other features are also important. This inquiry is guided by the following question: Along which composite dimensions do RETH spaces differ?

4. METHOD

This study is a quantitative content analysis that employs automated digital methods.

4.1. *Data sources*

This study focuses on 776,295 tweets (and metadata) associated with 60 Regional Educational Twitter Hashtags (RETHs). These 60 hashtags include 49 American RETHs (see Table 1) and eleven Canadian RETHs (see Table 2). These hashtags were compiled from various teacher-facing online resources in an attempt to catalog North American RETHs at the level of the state, province, or territory.

RETH	STATE	RETH	STATE
#aledchat	Alabama	#nved	Nevada
#azedchat	Arizona	#nvedchat	Nevada
#arkedchat	Arkansas	#nhed	New Hampshire
#caedchat	California	#njed	New Jersey
#coedchat	Colorado	#nyedchat	New York
#ctedchat	Connecticut	#nced	North Carolina
#edude	Delaware	#ndedchat	North Dakota
#fledchat	Florida	#ohedchat	Ohio
#gaed	Georgia	#oklaed	Oklahoma
#edchathi	Hawai'i	#oredu	Oregon
#idedchat	Idaho	#paedchat	Pennsylvania
#iledchat	Illinois	#edchatri	Rhode Island
#inelearn	Indiana	#sced	South Carolina
#ksed	Kansas	#sdedchat	South Dakota
#ksedchat	Kansas	#tnedchat	Tennessee
#laedchat	Louisiana	#txed	Texas
#edchatme	Maine	#txeduchat	Texas
#mdedchat	Maryland	#uted	Utah
#edchatma	Massachusetts	#utedchat	Utah
#miched	Michigan	#vachat	Virginia
#mnedchat	Minnesota	#wateachlead	Washington
#msedchat	Mississippi	#wvedchat	West Virginia
#moedchat	Missouri	#wischat	Wisconsin
#mtedchat	Montana	#wyoedchat	Wyoming
#nebedchat	Nebraska		

Table 1. American Regional Educational Twitter Hashtags included in this study.

RETH	PROVINCE
#abed	Alberta
#bced	British Columbia
#edtechbc	British Columbia
#mbedchat	Manitoba
#nbed	New Brunswick
#nsed	Nova Scotia
#onedchat	Ontario
#onted	Ontario
#eduqc	Québec
#saskedchat	Saskatchewan
#sked	Saskatchewan

Table 2. Canadian Regional Educational Twitter Hashtags included in this study.

I collected these data using Twitter Archiving Google Sheets (TAGS; Hawksey, 2014) and processed them with the rtweet R package (Kearney, 2017). In addition to providing a more complete set of data and meta-data, using rtweet allowed for collecting the full versions of tweets (in case of truncation) and eliminating since-deleted tweets and tweets from deleted, suspended, or private accounts (Fiesler & Proferes, 2018). I then limited my analysis to tweets composed between 1st January and 30th June 2016 and removed possible spam from the data being considered for each hashtag (cf. Carpenter, Staudt Willet, Koehler, & Greenhalgh, 2020).

4.2. *Measures*

Table 3 lists and describes the 14 measures used in this study. Each measure corresponds with formal Twitter practices and with previous research on education-focused Twitter hashtags. Table 4 shows the extent to which the 14 measures considered in this study are present in RETH spaces by displaying the descriptive statistics for these measures. These statistics help to show what the "average" RETH looks like in terms of these measures. Yet, Table 4's display of standard deviation and skew also demonstrates important limits to any discussion of typicality among these hashtags, especially in terms of the numbers of posts and handles associated with each hashtag. Table 5 displays the exact values of these measures for four RETHs and shows the relative difficulty of comparing RETHs across 14 different measures, thereby highlighting the need for summarizing these differences with a smaller number of dimensions.

MEASURE	DEFINITION
hashtags per tweet	average number of hashtags per original tweet
mentions per tweet	average number of Twitter handles per original tweet
proportion of retweets	ratio of retweets to total posts
proportion of replies	ratio of replies to total posts
proportion of quote tweets	ratio of quote tweets to total posts
proportion of tweets with embedded media	ratio of original tweets containing embedded media to total original tweets
proportion of tweets with URLs	ratio of original, non-quote tweets containing at least one URL to total original, non-quote tweets
number of posts	number of posts that include a particular RETH
number of handles	number of Twitter handles that have composed or retweeted posts containing a particular RETH
posts per handle	average number of posts containing a particular RETH per handle
sustained activity	average number of calendar weeks in which participants used a particular RETH
in-ties per handle	average number of other Twitter handles within a RETH that mention each handle in tweets
out-ties per handle	average number of other Twitter handles within a RETH that are mentioned by each handle
reciprocated ties per handle	average number of other Twitter handles within a RETH that are found to both reference and be referenced by each handle

Table 3. Measures used in this study.

COMMUNITY DIMENSION	Mean	Median	Interquartile range	Standard deviation	Skew	Kurtosis
hashtags per tweet	2.46	2.23	0.95	0.90	1.43	1.51
mentions per tweet	0.44	0.43	0.18	0.14	0.39	-0.28
proportion of retweets	0.38	0.37	0.17	0.12	0.21	-0.60
proportion of replies	0.10	0.10	0.11	0.08	0.81	0.05
proportion of quote tweets	0.07	0.06	0.03	0.02	0.42	-0.56
proportion of tweets with embedded media	0.20	0.18	0.10	0.10	1.31	1.58
proportion of tweets with URLs	0.38	0.31	0.27	0.21	0.73	-0.45
number of posts	13,290.88	7,291.50	13,712.00	17,012.01	2.32	6.14
number of handles	2,120.77	921.00	1,837.50	2,643.00	1.74	2.24
posts per handle	6.44	5.86	3.79	3.16	0.88	-0.04
sustained activity	2.04	2.00	0.42	0.35	0.81	0.84
in-ties per handle	2.40	2.24	1.02	0.92	0.60	0.05
out-ties per handle	3.15	2.95	1.33	1.09	0.54	0.34
reciprocal ties per handle	0.66	0.58	0.40	0.38	1.27	1.74

Table 4. Descriptive statistics for measures across all RETHs.

COMMUNITY DIMENSION	#bced	#moedchat	#idedchat	#sked
hashtags per tweet	2.54	2.05	1.71	4.27
mentions per tweet	0.49	0.29	0.40	0.18
proportion of retweets	0.66	0.41	0.19	0.37
proportion of replies	0.04	0.14	0.24	0.07
proportion of quote tweets	0.06	0.08	0.10	0.04
proportion of tweets with embedded media	0.21	0.14	0.13	0.11
proportion of tweets with URLs	0.46	0.22	0.15	0.57
number of posts	65091	24838	4873	331
number of handles	8304	4293	382	201
posts per handle	7.84	4.59	12.76	1.65
sustained activity	2.83	1.78	2.20	1.35
in-ties per handle	4.59	1.63	2.67	0.55
out-ties per handle	5.18	2.58	3.89	0.80
reciprocal ties per handle	0.58	0.46	1.26	0.11

Table 5. Values of measures across selected RETHs.

4.3. *Data Analysis*

To respond to this need for greater simplicity, I used principal components analysis (PCA) to summarize differences between RETH spaces. PCA reduces a set of variables (i.e., the 14 measures described above) to a smaller number of components (or composite dimensions) that retain as much variance as possible. Thus, each component represents a quantitative continuum measuring some quality that best summarizes differences between hashtags; hashtags with a higher component score can be said to have "more" of that quality, and hashtags with a lower component score can be said to have "less" of that quality.

To carry out this PCA, I used the *stats* package in R (R Core Team, 2015), standardizing the variables to account for different units of measurement (Jolliffe, 2002). To reduce the effect of outliers, I removed from consideration any hashtag whose value on any variable could be considered a "*far out*" outlier (Tukey, 1977, p. 44).

I then used the *nFactors* package (Raiche, 2010) to carry out a parallel analysis, which suggests an appropriate number of composite dimensions. Following Jolliffe's (2002) guidelines, I interpreted these components using the loadings of the original measures on the components, selected sample tweets, and simple plots. When appropriate, I selected exemplar tweets from RETHs with extreme scores on a component to

better illustrate my interpretation of that component; however, there was no systematic qualitative analysis of tweets. I also calculated the component values for the outlier RETHs and then plotted all hashtags.

5. RESULTS

Parallel analysis suggested retaining three composite dimensions (see Table 6).

ORIGINAL MEASURE	SHARING Loading on first principal component	INTIMACY Loading on second principal component	VOLUME Loading on third principal component
hashtags per tweet	0.34**	-0.13*	-0.21*
mentions per tweet	-0.01	-0.30**	-0.40**
proportion of retweets	0.13*	-0.45**	0.17*
proportion of replies	-0.25**	0.37**	0.15*
proportion of quote tweets	-0.16*	0.13*	-0.07
proportion of tweets with embedded media	0.23**	-0.07	-0.33**
proportion of tweets with URLs	0.30**	-0.23**	-0.20
number of posts	-0.19**	-0.37**	0.39**
number of handles	-0.10*	-0.35**	0.48**
posts per handle	-0.37**	0.04	-0.17*
sustained activity	-0.23**	-0.36**	-0.24**
in-ties per handle	-0.37**	-0.21*	-0.14*
out-ties per handle	-0.37**	-0.19*	-0.18*
reciprocal ties per handle	-0.36**	0.06	-0.26**

Table 6. Loadings of measures on three principal components.

** indicates component loadings whose absolute value is greater than half of the absolute value of the maximum loading for that component; * indicates component loadings whose absolute value is between a quarter and a half of the absolute value of the maximum loading for that component (see Joliffe, 2002).

5.1. *First composite dimension: Sharing*

The first dimension explains 44.8% of variance among RETHs and generally represents the level of *sharing* in RETHs. As seen in Table 6, high values on this dimension are associated with higher rates of URLs and embedded media (content being shared), hashtags (additional audiences for the content) and, to a lesser extent, retweets (additional networks for the content).

Figures 3 and 4 provide examples of what sharing looks like in practice. Both figures show tweets that contain #ctedchat, the RETH with the highest level along this composite dimension. In keeping with high levels of sharing, these tweets include media, URLs, and high number of hashtags. However, there is one noteworthy difference between these two figures. Figure 3 shares information about a summer workshop for teachers, which is relevant to RETHs' focus on teacher professional development. In contrast, Figure 4 promotes a handbag offered on an online shopping website, a likely example of spam (Carpenter et al., 2020a).

Low levels on this composite dimension are first, but not exclusively, associated with lower levels of *sharing*. Although I have generally interpreted dimensions in this study as reflecting a single concept, it is also possible to interpret a component as a contrast between two concepts (see Jolliffe, 2002 for examples). In this case, measures that contribute to lower values along this dimension (see Table 6) appear to focus more on *connecting* people to each other (e.g., through replying and quoting, which result in interpersonal ties) than on distributing and sharing content. Thus, while I describe this dimension largely in terms of sharing, low levels on this dimension are as associated with "more connection" as they are with "less sharing."

Figure 3. Example of sharing practices to disseminate relevant information.

Figure 4. Example of sharing practices to disseminate irrelevant information.

5.2. *Second composite dimension: Intimacy*

The second dimension explains an additional 17.5% of variance among RETHs. In PCA, a subsequent composite dimension represents the "*main source of variation*" (Jolliffe, 2002, p. 67) after the preceding dimension has been accounted for. In this case, after accounting for the level of sharing (or connecting) within a RETH, this dimension makes the next-most important distinction.

This second dimension represents the *intimacy* of a RETH relative to a certain amount of connection. While the first dimension indicates the overall *amount* of connection happening within a hashtag (in contrast with sharing), this dimension instead indicates the *nature* of that connection. I have described this in terms of intimacy, by which I mean whether posts connect with people in specific, personal ways or in wide, broadcasting ways. In short, more intimate RETHs are more characterized by more personal connections between participants. Less intimate RETHs may still have high levels of connection, but less personal and more distant.

This interpretation is based on the data in Table 6. High levels on this composite dimension are associated with higher proportions of replies and, to a lesser extent, quote tweets, which both involve a targeted response to a single tweet, suggesting attention to a single person and therefore a certain level of intimacy (though, of course, true intimacy extends beyond the number of people addressed in a message). For example, the author of the tweet in Figure 5 is replying to a specific Twitter user. This level of interpersonal connection can be said to be more intimate in that the focus is on a single tweet. Figure 6 can also be said to be engaging in connecting activities; in addition to addressing the general #oklaed audience, the author of this tweet has connected with two other Twitter users (through mentions, which use the @ character to indicate a Twitter username) and two other Twitter spaces (through hashtags). This broad connecting with several people and spaces at once, while useful, cannot be said to be intimate in the same way.

Figure 5. Example of more intimate connections among RETH participants.

Figure 6. Example of less intimate connections among RETH participants.

5.3. *Third composite dimension: Volume*

The third dimension explains an additional 14.7% of variance among RETHs; using the guidelines described above, this RETH can be understood to represent the volume of activity within a RETH relative to the level of connection present within it. Higher values on this composite dimension are associated largely with the numbers of posts and handles within a RETH, with a smaller role played by the proportions of retweets and replies within that RETH (see Table 6). Each of these measures has an intuitive connection to a RETH's sheer size.

In contrast with the previous dimensions, specific tweets are unhelpful as examples for demonstrating what this dimension reflects in practice. Indeed, this dimension is best understood by aggregate activity. For example, while Table 4 suggests that the average RETH saw 13,290.88 posts (composed by 2,120.77 distinct handles) over these six months, Table 5 shows how wildly these numbers vary. A hashtag like #sked (331 posts by 201 handles) would be on the low end of this dimension, the high end being characterized by hashtags like #bced (65,091 posts by 8,304 handles).

5.4. *Summary*

My analysis resulted in the identification of three dimensions which summarize how RETHs vary. The first dimension indicates the amount of *sharing* (in contrast with connecting) that happens within a hashtag. The second dimension describes the *intimacy* of the connecting activity within a hashtag (after accounting for the general amount of connecting). Finally, the third dimension distinguishes high-volume RETHs from low-volume RETHs.

Figure 7 shows how all of the RETHs considered in this study are distributed along these three dimensions. In this table, sharing is represented by the x-axis, intimacy is represented by the y-axis, and volume is

represented by color. The values on each axis represent the range of values along each PC given the value of each measure for each RETH (e.g., Table 5) and the loading of those measures on each component (i.e., Table 6). The bulk of RETHs appear to have relatively-high levels of intimacy; intuitively, the relative few RETHs with lower levels of intimacy (at the bottom of Figure 7) appear to generally have higher levels of volume (though the state of Washington's #wateachlead is a notable exception). These RETHs also appear to have higher levels of connection, which is consistent with the distinction between more intimate and less intimate forms of connection made with Figures 5 and 6. There are relatively few RETHs that have high sharing values (on the right side of the figure) as opposed to high connecting values (on the left side of the figure). In broad terms, distribution along the y-axis (i.e., intimacy) increases as RETHs move to lower values along the x-axis (i.e., more connecting than sharing). Taken together, these findings suggest that interpersonal connection within RETHs happens in a number of ways and that the relative level of intimacy within a RETH is a major distinction between it and others.
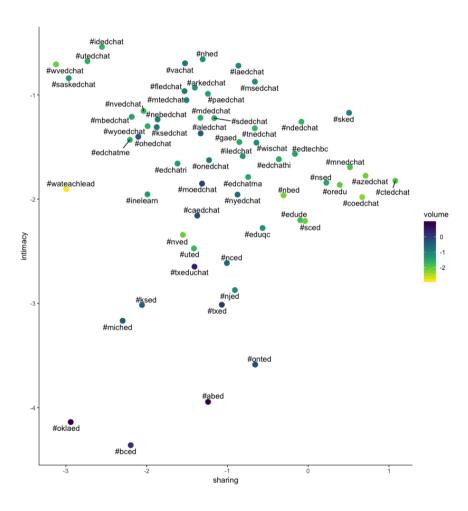

Figure 7. RETHs plotted along the three composite dimensions that best describe variations between them.

6. DISCUSSION

Acknowledging differences between teacher-focused hashtags is important for multiple stakeholders. The differences identified in this study are simple, high-level descriptions that cannot account for all of the complexity of teachers' use of hashtags, including any emergent practices or patterns that would only be obvious from a qualitative content analysis of tweets. Nonetheless, given the scale of the data here considered, these differences can be said to be *general* in that they describe patterns across dozens of hashtags. Furthermore, although it may be intuitive that teacher-focused Twitter hashtags differ, understanding that hashtags differ is not the same thing as being able to describe those differences. Thus, a large-scale quantification and interpretation of differences between hashtags draws stakeholders' attention to initial differences worth considering.

Teachers may therefore use the dimensions identified in this study as preliminary guidelines for considering "*[w]hich space(s) are most conducive to [their] professional growth*" (Krutka, Carpenter, & Trust, 2017, p. 249). These dimensions are derived from, and therefore most applicable to, differences between these 60 RETHs. It is important to acknowledge that there are many teacher-focused hashtags that are not associated with a geographical focus. However, these quantified dimensions represent general Twitter activity and are, therefore, not themselves attentive (or limited) to geographical issues. Indeed, Carpenter and colleagues (2020) found that *"[d]espite many differences between the states of California and Michigan (e.g. population, economy and culture), the #caedchat and #miched hashtags were alike in various ways.*" (p. 15). Without qualitative content analysis, which is beyond the scope of this study, it is impossible to know how much of the activity within RETHs is actually regionally specific. Furthermore, research has shown that at least some participants in a given RETH come from outside of that geographic region (e.g., Greenhalgh et al., 2018). Thus, previous research, and this study's focus on general Twitter activity, suggest that these findings may be applicable to hashtags other than RETHs, though caution and reflection are warranted.

Other stakeholders may also benefit from these preliminary guidelines. For example, teacher educators have begun introducing pre- and in-service teachers to Twitter as a current or future learning resource (Greenhalgh, Rosenberg, & Wolf, 2016; Carpenter et al., 2016; Luo, Sickel, & Cheng, 2017). Being able to articulate simple-but-general ways in which hashtags differ may help teacher educators guide teachers in reflecting on their needs and identifying resources that assist with those needs (although teachers will ultimately need to also make deeper, more specific considerations). Finally, hashtag leaders or coordinators (cf. Britt & Paulus, 2016) may also benefit from considering where their hashtag falls along these distinctions. Although this study generally assumes that teachers freely choose to use hashtags, social media may also be used in mandated, formal professional development or other classes (e.g., Greenhalgh et al., 2016; Greenhow, Staudt Willet, Rosenberg, & Koehler, 2018; Veletsianos, 2017b), instructors of these classes may also use these dimensions to reflect on what kind of activity to value or encourage.

6.1. *Sharing*

The first composite dimension emerging from this study generally represents the level of sharing within a hashtag (in implicit contrast to connection). Carpenter and colleagues (2020b) similarly noted that levels of retweeting and hyperlinking varied between the hashtags that they considered. Some teachers use Twitter to "*personalize their professional development by self-selecting resources and opportunities*" (Visser et al., 2014, p. 404), and a heavily sharing-focused hashtag like #ctedchat or #azedchat may serve as a helpful "*information neighborhood*" (Burnett, 2000), where social interaction, while not entirely absent, is subordinate to the provision and seeking of information. If teachers in Connecticut or Arizona identify as what Prestridge (2019) calls *info-consumers*, "*who scan Twitter for ideas and/or resources that meet their curriculum needs*" (p. 151), their local hashtags may be effective resources.

6.2. *Intimacy*

The second composite dimension emerging from this study indicates the intimacy of a hashtag. As described in Section 5.1, low levels on the first dimension indicate not only lower levels of sharing but also higher levels of connection, which is also valued by teachers using Twitter. By focusing more specifically on the intimacy of connection within a hashtag, a teacher can identify those that are more helpful for their needs. For example, Staudt Willet (2019) has found that even though exploring ideas and sharing emotions are both valued by teachers, a given learning space on Twitter may be better at one than the other. Similarly, Carpenter et al. (2020b) found "*substantial differences among... various hashtags in terms of what percentages of traffic were replies*" (p. 12).

Teachers in the American state of Kansas have two RETHs to choose from, which may illustrate the value of considering intimacy. Teachers who are seeking connection in general terms - for example, seeking to join a participatory community (Visser et al., 2014) or just trying to overcome feelings of isolation (Wesely, 2013) - may be satisfied with either #ksedchat (which is more intimate) or #ksed (which is less so). In contrast, a teacher specifically seeking emotional support (Carpenter & Krutka, 2015) may need a more intimate setting (i.e., #ksedchat) to benefit from interpersonal connections. However, as previously noted, true intimacy is more than just a function of the number of people involved in a conversation - furthermore, even true emotional intimacy may not be freely offered to newcomers.

6.3. *Volume*

The third composite dimension emerging from this study indicates the volume of activity of a hashtag relative to its level of connection. This dimension has unsurprising associations with distinctions made in the existing literature. Rosenberg and colleagues' (2016) earlier work on RETHs highlighted considerable diversity of volume between them, and Carpenter et al. (2020b) also noted "*substantial variation in traffic*" (p. 9) across 16 teacher-focused hashtags.

Volume can be either advantageous or disadvantageous for a given online group (Butler, 2001), teachers should not assume that a *bigger* hashtag is necessarily a *more effective* hashtag. A hashtag with more activity suggests that more information, resources, and connections will be available to its participants (e.g., Rosenberg et al., 2016; Staudt Willet, 2019). However, the volume of activity in a given Twitter hashtag may overwhelm teachers (Staudt Willet, 2019); this is particularly true when a hashtag is associated with synchronous chats (Britt & Paulus, 2016; Luo et al., 2017). Furthermore, Figure 7 suggests a generally inverse relationship between the volume of a RETH and its intimacy, creating a possible tension between two different considerations.

7. LIMITATIONS AND FUTURE APPLICATIONS

Despite the theoretical and practical insights described above, there are obvious limitations to this study that should mediate the interpretation and application of these insights. From a methodological point of view, this study is entirely descriptive, and these findings should not be presented as evidence of any kind of established causal relationship. Furthermore, my use of digital methods and my related focus on Twitter practices that are easily quantifiable and likely to be widespread limit the nuance of my distinctions between different hashtags. In particular, passive participation is an important element of learning in social media spaces (Romero-Hall, 2017) that does not register in this kind of analysis. Similarly, this study does not acknowledge that patterns of activity in a hashtag may change depending on context (Greenhalgh et al., 2020; Carpenter et al., 2020b). In summary, the results and implications presented in this study are largely

speculative and should be understood as such.

Although these limitations do not prevent this study from providing helpful guidelines or serving as a model for future research, further practical limitations should be noted. As previously acknowledged, RETHs represent only one part of the landscape of Twitter hashtags related to teacher professional development (see, for example, Carpenter et al., 2020b); furthermore, this data, collected in 2016, may differ from the contemporary RETHs landscape. However, the dimensions emerging from this study parallel findings and distinctions emerging from the broader literature on teacher learning through Twitter, suggesting that they may still be fruitfully applied.

8. CONCLUSION

Technologies are repurposed by different groups for different ends, and Regional Educational Twitter Hashtags (RETHs) are no exception. The composite dimensions established in this study demonstrate that RETHs differ in terms of how much they focus on sharing, how intimate interpersonal connections within them are, and the volume of activity that they contain. RETHs differ along each of these dimensions, thereby demonstrating that these hashtag spaces, like others, are defined by different practices, different social dynamics, and presumably different goals. As teachers, teacher educators, and hashtag coordinators consider these differences, they will add important nuance to the affordances of social media for teacher learning.

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