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U.S. State Education Agencies' Use of Twitter: Mission Accomplished?

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Abstract

This study examined how Twitter was used by all U.S. state education agencies (SEAs) for public engagement in education. Drawing on the ecological model of communication, this study analyzed the latest 71,913 tweets from 40 SEAs that had official Twitter accounts. The results of correlation analysis indicate no significant relationship between the SEAs' presence on Twitter and the SEAs' targeted Twitter users, denoting that the SEAs' well-intentioned efforts in communicating with stakeholders and the public by using Twitter might fall short of the public's preferable medium for receiving information. In addition, the results of content analysis suggest that the SEAs primarily used Twitter for one-way asymmetrical information broadcasting, leaving Twitter's two-way symmetrical communication functionality largely untapped. Findings are discussed with respect to the implications for educational organizations' effective use of Twitter through the public's increased participation and collaboration.

Keywords

Twitter, communication, communication technologies, organizational communication, education

Social media has been gaining a foothold in education. Students use social media to complete homework-related tasks and maintain friendship (Weeden, Cooke, & McVey, 2013). Teachers use social media to create an alternative platform of instruction (Aydin, 2012; Kurtz, 2009) and build professional learning communities (Cho, Ro, & Littenberg-Tobias, 2013). School principals and superintendents use social media to enhance the communication between schools, districts, and the public (Cox & McLeod, 2014a, 2014b; Y. Wang, Sauers, & Richardson, 2016). Furthermore, social media in education goes far beyond individuals' use of social networking sites. At the school district level, 99 of the 100 largest U.S. districts created the districts' official Twitter account and 34 of those districts' superintendents had created their individual Twitter account; more intriguingly, the superintendents were more interactive than the districts on Twitter and the public expressed less negative sentiment toward the superintendents than the corresponding districts (Y. Wang, in press-b). However, there has been scant attention to how Twitter has been used at the state level by state education agencies (SEAs). Thus, this study investigates how Twitter has been used by all SEAs for public engagement in education. Among an ever-growing number of social media tools, Twitter was chosen in this study because of its unique features in facilitating communication, which will be introduced in detail in the next section. Furthermore, this study zooms in on SEAs, because the Obama Administration's Open Government Initiative (Obama, 2009) and the new digital government strategy (The White House, 2012) called for government agencies to harness new technologies to increase participation, transparency, and collaboration with the public. As of 2012, more than 1,000 Twitter accounts were created by 698 departments, agencies, and initiatives of the U.S. federal government (Mergel, 2012). In fact, in addition to Twitter used by government agencies (Thackeray, Neiger, Smith, & Wagenen, 2012; Waters & Williams, 2011), the organizations in a multitude of sectors—including charities (Barnes, 2010b), nonprofit advocacy organizations (Auger, 2013), and for-profit corporations (Barnes, 2010a)—have established their presence on Twitter to share information, build communities, and solicit help from Twitter users to fulfill the organization missions (Lovejoy & Saxton, 2012).

In the context of education, the research on educational organizations' use of Twitter is scarce. Yet the limited evidence suggested that the SEAs in 36 of 51 states, including the District of Columbia, had adopted Twitter by 2012 in an effort to "share information and news . . . communicate about complicated matters of public policy that have a direct impact on educators, students, administrators, and the general public" (Reform Support Network, 2012, p. 5). The Reform Support Network's report created a baseline measure of the

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SEAs' adoption of Twitter, and pinpointed the two end points of SEAs' communication on Twitter: the SEAs on one end, stakeholders (i.e., students, parents, communities, educators, and administrators) and the general public on the other end. The report, however, did not take a step further to examine whether there was a disconnection between the two communication end points. The possible disconnection scenarios are as follows: The SEA uses Twitter to communicate with the stakeholders who are largely not Twitter users, or the SEA does not use Twitter to communicate with the stakeholders who are largely Twitter users. Taking into account that Twitter is used by only 23% of Internet users in the United States (Duggan, 2015), the first purpose of the current study is to examine whether the SEAs' presence on Twitter varied by the geographic distribution of the SEAs' targeted Twitter users.

Twitter, by its nature, empowers rapid information dissemination and encourages information exchange (Demirbas, Bayir, Akcora, Yilmaz, & Ferhatosmanoglu, 2010). However, prior research revealed a persistent problem: The organizations in many sectors primarily use Twitter for one-way asymmetrical information broadcasting, despite the two-way symmetrical communication functionality of Twitter (Auger, 2013; Lovejoy, Waters, & Saxton, 2012; Waters & Jamal, 2011; Waters & Williams, 2011). As a result, scholars lamented the lost communication opportunities because Twitter's two-way symmetrical communication potential was not fully harnessed (Lovejoy et al., 2012). In fact, government agencies' one-way asymmetrical information broadcasting on Twitter is deemed as the initial stage of social media-based public engagement, which is followed by (a) co-production in which government agencies and the public collaboratively develop and deliver government services, and (b) crowdsourcing solutions in which government agencies leverage public knowledge and talent to develop innovative solutions to large-scale social issues (Bertot, Jaeger, Munson, & Glaisyer, 2010; Lee & Kwak, 2012). Considering the dominant one-way asymmetrical information broadcasting pattern of the organizations in other sectors on Twitter, the second purpose of the present study is to assess whether the SEAs' Twitter use suggests a similar one-way asymmetrical information broadcasting pattern, leaving the two-way symmetrical communication functionality of Twitter largely untapped.

Theoretical Framework

The ecological model of communication, laid out by Foulger (2004), provides a framework to understand the mechanism of the SEAs' communication on Twitter. In his model, Foulger identified four key communication constituents: messages, people, language, and medium/media. The current study applies Foulger's model to the SEAs' communication on Twitter. Each of the following sub-sections introduces a key communication constituent followed by its application in the SEAs' communication on Twitter.

Message

A message is created to "communicate something that we imagine such that another person can correctly interpret the message and thus imagine the same thing" (Foulger, 2004, para. 20). Foulger further states that "messages are the central feature of the model and the most fundamental product of the interaction of people, language, and media" (para. 16). In line with this definition, the messages for stakeholders and the public—constructed by the organizations on Twitter—serve the purpose of fulfilling organization missions. A few examples could suffice. For public health organizations, the messages of the communication on Twitter were the awareness of health issues (Vance, Howe, & Dellavalle, 2009) and public health emergencies or outbreaks (Sutton, 2010). For the 200 largest U.S. charitable organizations, the primary message was the awareness of the charities' mission, followed by fundraising (Barnes, 2010b). For nonprofit advocacy organizations (e.g., National Rifle Association, Brady Campaign, Planned Parenthood, and the National Right to Life Committee), community building was the most prevalent message in their social media communication (Auger, 2013). In agreement with the recent literature suggesting that enhancing government openness and public engagement are the goals of government agencies' use of social media (Lee & Kwak, 2012), the Reform Support Network's (2012) report indicated that the SEAs' goal of using Twitter is public engagement in education reform. As a result, this study contextualizes the message of the SEAs' communication on Twitter as public engagement in education, which is the fundamental product of the SEAs' communication with stakeholders and the public.

People

The people, in Foulger's (2004) ecological model of communication, are primarily the message creators and consumers at either end of the communication process. Message creators and consumers are not set in stone. In fact, their relationships, as Foulger put, are reflexive and introspective. First, the reflexive relationship is established when message consumers reply or provide feedback to message creators, and when message creators listen to the feedback and adapt the messages accordingly. As a result, message creators become consumers, and vice versa. Take Waters and Williams' (2011) study on government agencies' use of Twitter as an example. As message creators, government agencies (e.g., National Aeronautics and Space Administration, the Library of Congress, the Department of Homeland Security, and the Center for Disease Control) posted the tweets regarding announcements and reports. In an attempt to become the consumers of the messages created by a large base of Twitter users, in approximately 4.1% of the tweets, government agencies asked for specific feedback.

In addition to a reflexive relationship, an introspective relationship is shared between message creators and consumers (Foulger, 2004). That is, the messages are created from the creators perspectives, and are interpreted by the consumers within their perspectives. It is likely that the message interpreted by the consumers is not the same one that the creators intend to communicate. For instance, in an effort to shape a positive public perception of the New York Police Department (NYPD), NYPD invited Twitter users to share photos with a member of the NYPD by posting a tweet (http://twitter.com/NYPDnews) saying, "Do you have a photo w/ a member of the NYPD? Tweet us & tag it #myNYPD. It may be featured on our Facebook." Unfortunately, NYPD's well-meaning message was received in a negative way when some Twitter users tagged violent arrest photos to NYPD's Twitter feed (Goodman, 2014).

Drawing from the reflexive and introspective relationships between message creators and consumers (Foulger, 2004), two challenges emerge in the SEAs' effective communication on Twitter. First, the SEAs, as the message creators on Twitter, need to translate their Twitter presence into a source of education information for the message consumers. To do so, the SEAs' presence on Twitter should be aligned with the geographic distribution of the SEAs' targeted Twitter users (i.e., stakeholders and the public); otherwise, the message sent by the SEAs would not optimally reach the target audience on Twitter. In other words, a disconnection–between message creators and consumers–comes into existence when a state has relatively very few Twitter users whereas its SEA uses Twitter frequently. The existing literature documented a consistently higher percentage of urban dwellers using Twitter than suburban and rural residents (Duggan, 2015; Pew Research Center, 2013; Pew Research Internet Project, 2014), and the overrepresentation of Twitter users in populated regions in the United States, in comparison with the U.S. population (Mislove, Lehmann, Ahn, Onnela, & Rosenquist, 2012). In particular, the Midwest was significantly underrepresented in Twitter users. According to prior literature, this study hypothesized that the SEAs in populated states are likely to establish their presence on Twitter in an effort to cater to the states' high percentage of Twitter users. Thus, the first hypothesis is posited:

> **Hypothesis 1:** There is a positive association between the SEAs' presence on Twitter and the states' population density per square mile.

Furthermore, a state with a larger number of student enrollment is assumed to have a larger number of parents—the stakeholders who are among the SEAs' target audience on Twitter. Based on this assumption, it is hypothesized that the SEAs in the states with a large number of student enrollment are likely to establish their presence on Twitter. Thus, the second hypothesis is as follows:

> **Hypothesis 2:** There is a positive association between the SEAs' presence on Twitter and the states' student enrollment.

If the two hypotheses are supported, then the two end points of SEAs' communication on Twitter are well aligned, allowing the information to flow smoothly between SEAs and their targeted Twitter users. If the hypotheses are rejected, then a disconnection might exist between the SEAs' Twitter presence and the geographic distribution of their targeted Twitter users. In other words, the messages created by the SEAs on Twitter would not reach the SEAs' target audience in an effective and efficient manner, which might force stakeholders and the public who are Twitter users to resort to other sources of information. An example from the public health field serves as a cautionary tale. A study of more than 5,300 tweets during 2009 H1N1 outbreak reported that government and health agencies, such as the U.S. Centers for Disease Control and Prevention and World Health Organization, were rarely the *direct* references in the tweets (Chew & Eysenbach, 2010). Instead, Twitter users primarily referred to the mainstream and local news websites as the sources of information on H1N1 outbreak. In the case of SEAs' communication on Twitter, the SEAs' message—public engagement—might not be well received or well interpreted by Twitter users if (a) a densely populated state's SEA has not established a presence on Twitter, and/or (b) the SEA's Twitter presence does not function as a source of information.

The SEAs' second challenge in effective communication on Twitter is for the SEAs to function as the consumers of the messages created by Twitter users. The SEAs become the message consumers when the SEAs ask for and listen to feedback from stakeholders and the public. Therefore, as message consumers, the SEAs need to engage in two-way symmetrical communication in addition to one-way asymmetrical information broadcasting. A persistent problem with government agencies' use of Twitter is the prevalence of one-way asymmetrical information broadcasting, rather than two-way symmetrical conversations (Waters & Williams, 2011). The exception is that the government agencies were more likely to engage in two-way symmetrical communication on the Web when they were faced with the crisis that might tarnish the organizations' reputation (Coombs, 2007). The research on nonprofit organizations revealed the similar domination of one-way asymmetrical information broadcasting in organizations' Twitter use (Lovejoy et al., 2012). To date, very limited literature has addressed educational organizations' use of Twitter. Thus, this study examines whether the SEAs' use of Twitter has the similar prevalent one-way asymmetrical information broadcasting pattern, leaving Twitter's two-way symmetrical communication functionality underused.

Language

Language, in Foulger's (2004) model, is invented to construct messages. Following this definition, the language used

Table 1. Examples and Descriptions of the Symbols in Tweets.

Twitter account	Symbol	Example tweet	Description
@MOEducation	#	Missouri Schools Show Growth in #STEM Education http://t.co/Zh0uWzyj0D	The hashtag #STEM means the keyword or topic in the tweet, posted by Missouri Department of Elementary and Secondary Education (@MOEducation), is STEM.
@AlabamaDeptofEd	RT	RT @ACT: New STEM score and career readiness indicator among enhancements coming to the ACT in 2015. http://t.co/GnPOYEQuWw	Alabama Department of Education (@AlabamaDeptofEd) forwarded ACT's (@ACT) tweet to Alabama Department of Education's Twitter followers by retweeting ACT's tweet.
@OHEducation	t.co	SAVE THE DATE—2014 Ohio Report Card Webcast http://t.co/dMgCAMeJvt #ohioed	A web page link—Uniform Resource Locator (URL)—was referred in the tweet posted by Ohio Department of Education (@OHEducation).
@codepted	via	Denver Teaches Us All a Lesson: Engaging Educators Can Strengthen Reform http://t.co/L36kaZXbmL via @HuffPostDenver #edcolo #denver	The content in Colorado Department of Education's (@codepted) tweet comes from the Huffpost Denver (@HuffPostDenver).
@WisconsinDPI	@	We say "bon 35e anniversaire" to @MilwaukeeMPS French Immersion School! http://t.co/qU5jNGGOHt #Wiedu	Milwaukee Public Schools (@MilwaukeeMPS) was mentioned or replied by Wisconsin Department of Public Instruction (@WisconsinDPI).

in the communication on Twitter is the language used by millions of Twitter users in their tweets. The "Twitter language" is novel in many ways in comparison with the languages—such as English, Spanish, and French—Twitter users speak in offline, face-to-face conversations. Each tweet must not exceed 140 characters, which explains why Twitter is also called micro-blogging. Despite the 140-character limit, rich information can be communicated by using the "Twitter language" characterized by the symbols of #, RT, t.co., via, and @. Table 1 presents examples and descriptions of the symbols in "Twitter language."

Three symbols—hashtag (#), retweet (RT), and shortened web links (t.co)—are considered as the indicators of one-way asymmetrical information broadcasting (Lovejoy et al., 2012). The first indicator is hashtag, which is a word or phrase preceded by the # symbol. A hashtag helps categorize tweets, because it functions as a label or a tag. For instance, the tweets related to the National Security Agency Surveillance programs are categorized by the hashtag #NSA (Reddicka, Chatfieldb, & Jaramilloa, 2015). The second indicator of one-way asymmetrical information broadcasting is retweet, which extends the scope of the initial tweet by spreading the tweet to another Twitter user's followers. Retweeting is similar to the "forward" function in email, which demonstrates the message consumer forward the message to those on the message consumer's contact list. The third indicator is the shortened web link which bypasses the 140-character limit. A Twitter user can refer to a web link—Uniformed Resource Locator (URL)—in a tweet so that tweet readers are directed to a web page that provides rich information. Twitter automatically shortens all URLs to a http://t.colink. Along with these three one-way asymmetrical information broadcasting indicators, the current study adds "via @username" symbol as the fourth indicator, which suggests the content in the tweet comes from a particular Twitter user.

The two-way symmetrical communication in tweets, however, is indicated by the @ symbol (Lovejoy et al., 2012). For instance, the Ohio Department of Education (@OHEducation) replied in a tweet to a Twitter user, "@UserID Good, glad to hear it." This tweet was not only received by a particular Twitter user (i.e., @UserID) but also viewable by those who follow @OHEducation and @UserID on Twitter. Granted, the mentioned Twitter user might not necessarily reply to the Georgia Department of Education's tweet that says, "@UserID Our standards tell the what, but how teachers get there is up to each district. Teachers know what's best. #askgadoe." Yet this category of tweets—the tweets with the @ symbol—at least showcases the SEAs' responsiveness and invitation to Twitter users to engage in two-way symmetrical communication.

Medium

A medium, defined by Foulger (2004), is "a system that enables the construction of messages using a set of languages such that they can be consumed" (para. 17). Unlike websites that are limited in collaborative scope, Twitter, as a communication medium, empowers dynamic, interactive communication through two major features: (a) the brevity of tweets, and (b) multiple access portals. First, the brevity of no more than 140 characters in each tweet encourages Twitter users to post instantaneous updates. It is not uncommon to see a tweet that is composed of one short sentence, such as the three seemingly plain words "Four more years." in President Obama's (@BarackObama) tweet posted after winning 2012 Presidential Election. The 140-character limit, in fact, speeds up information diffusion. This is primarily because unlike writing a blog

post, crafting a tweet does not necessarily require much investment in time and efforts in content generation (Demirbas et al., 2010; Park, 2013). Second, Twitter is readily accessible with different portals, including desktop computers, laptops, smartphones, and tablets (Twitter, 2014). In fact, Twitter was originally developed for mobile phones (Marwick & Boyd, 2011). A recent study reported that 71% of Twitter users used a mobile device to post a tweet (Strategy Analytics, 2013). As a consequence, Twitter users' preference for mobile devices adds to the immediacy of communication.

The aforementioned two features of Twitter prompt users to create abundant, constantly updated tweets that serve as a source of information and a proxy for public opinion. A prime example is that the news of Osama bin Laden's death broke first on Twitter through a tweet posted by Keith Urbahn, a staff member of former Defense Secretary Donald Rumsfeld at 10:24 p.m. on May 1, 2011 (Myers, 2012). One minute later, the Urbahn's tweet was retweeted by the *New York Times* reporter, Brian Stelter. By the time of ABC, CBC, and NBC's coverage at 10:45 p.m., around 21 min had passed since the Urbahn's tweet. In addition to the tweets from government staff members and mainstream media, the tweets from ordinary citizens in breaking news—such as the plane crash in New York's Hudson River (Beaumont, 2009), the earthquake and tsunami in Japan (Sakaki, Okazaki, & Matsuo, 2010), and the Wisconsin labor protests (Veenstra, Iyer, Hossain, & Park, 2013)—have been transforming journalism. Moreover, Twitter has been used as a proxy to gauge public opinion. For instance, a sentiment analysis of 32 million tweets regarding the 2012 U.S. Presidential Election showed that Obama led Romney in the number of positive tweets in general over the election period, which was in match with the election outcomes (Jahanbakhsh & Moon, 2014). This might explain why Twitter is now considered as real-time "social sensors" for event detection and public opinion mining (Crooks, Croitoru, Stefanidis, & Radzikowski, 2013; Preethi & Ajit kumar, 2015; Siqi, Lin, Jehan, & Venu, 2011; Weiler, Grossniklaus, & Scholl, 2015), including detecting seasonal flu trends (Achrekar, Gandhe, Lazarus, Yu, & Liu, 2011), identifying public opinion on healthy food (Widener & Li, 2014), as well as predicting political elections (Jahanbakhsh & Moon, 2014; Wang, Can, Kazemzadeh, Bar, & Narayanan, 2012).

Organizations have been using Twitter as a medium to harness its potential in communication. As of 2012, approximately 72% of nonprofit organizations, which participated in Nonprofit Social Networking Surveys, had been using Twitter for communication (Nonprofit Technology Network, 2012). In addition, 96% of the 200 largest U.S. charities that responded to a nationwide survey reported they had been using Twitter (Barnes, 2010b). In comparison with traditional websites used primarily to share information, Twitter is a more interactive communication medium for nonprofit organizations' dialogic community-building practices, including giving recognitions and thanks, acknowledgment of current and local news, mentioning and replying to other Twitter users publicly, and response solicitation (Lovejoy & Saxton, 2012).

In the current study, following the paradigm of ecological model of communication, Twitter is the communication medium on which SEAs are on one end, stakeholders and the public are on the other end. By using a unique "Twitter language"—characterized by the symbols of #, RT, t.co., via, and @—many SEAs construct the messages in an attempt to engage stakeholders and garner the public's support for education. Twitter users then receive and interpret the tweets, and have the opportunity to reply to the SEAs' tweets and/or retweet them. As a result, the communication process becomes an ongoing loop between the SEAs and other Twitter users on the medium of Twitter.

In sum, Twitter appears to add value to the SEAs communication efforts in public engagement. The limited prior research only hints the large extent of the SEAs' adoption of Twitter for communication (Reform Support Network, 2012). However, we do not know whether a disconnection exists between the two end points of the SEAs' communication on Twitter. Moreover, we do not have a deep understanding of how Twitter has been used by the SEAs across the United States, in particular whether the SEAs have been taking advantage of Twitter's two-way symmetrical communication functionality. This study aims to shed light on these issues by answering the following four research questions:

Research Question 1: What is the relationship between the SEAs' presence on Twitter and the states' population density per square mile?
Research Question 2: What is the relationship between the SEAs' presence on Twitter and the states' elementary and secondary school student enrollment?
Research Question 3: To what extent have the SEAs been using Twitter for one-way asymmetrical information broadcasting?
Research Question 4: To what extent have the SEAs been using Twitter for two-way symmetrical communication with stakeholders and the public?

Method

For the purposes of this study, the SEAs are considered to be using Twitter if the SEAs' website homepages indicated institutionally maintained Twitter accounts. For instance, most SEAs embedded the Twitter logo of a blue Twitter bird in their website homepages, and cross link from their websites to their Twitter profiles. Four more SEAs have established their presence on Twitter, since the Reform Support Network's (2012) report of 36 SEAs on Twitter.

Data Sources

The data in the current study were collected from three sources. First, the data on the states' population density per

Table 2. Summary of SEAs' Presence on Twitter.

	2009	2010	2011	2012	2013	2014
Number of SEAs joined Twitter	20	10	5	4	0	1
Total number of SEAs on Twitter	20	30	35	39	39	40
Overall percentage of SEAs on Twitter	39.2%	58.8%	68.6%	76.5%	76.5%	78.4%

Note. SEA = state education agency.

square mile were retrieved from the U.S. Census Bureau (2013). Second, the data on the states' elementary and secondary school enrollment were retrieved from the National Center for Education Statistics (2013). Third, the Twitter data were collected from the SEA public Twitter profiles. A total of 71,913 tweets were archived from 40 states' (including the District of Columbia) Twitter accounts by using TwimeMachine (www.twimemachine.com) on June 17, 2014. Twitter has a limit of providing up to 3,200 recent tweets. Therefore, for those states exceeding 3,200 tweets in their Twitter accounts, only the latest 3,200 tweets were extracted. Moreover, each SEA Twitter account's metadata were collected—including the overall number of tweets, the number of followers and following, and when each SEA created its presence on Twitter.

Data Analysis

To understand the relationship between message creators and consumers of the SEAs' communication on Twitter, the point biserial correlation was performed. The dichotomous variable of the SEA's presence on Twitter (having/not having a Twitter account) was correlated with the continuous variable of the states' population density per square mile and the states' student enrollment, respectively. Subsequently, a content analysis was conducted to determine the prevalent communication pattern in the SEAs' use of Twitter by coding the language (i.e., #, RT, t.co, via, and @) used in the tweets. Furthermore, the top 30 most frequently used words and hashtags, as well as the SEAs' most mentioned Twitter users, were identified by counting their frequency in the 71,913 tweets analyzed in the current study.

Results

The SEAs' Presence on Twitter

The SEAs in 40 states, including the District of Columbia, had been using Twitter as of June 2014 (see Table 2). The first SEA that created its presence on Twitter is the Georgia Department of Education, registering the Twitter account @GaDOEnews on January 22, 2009. By the end of 2009, a total of 20 SEAs had already established their presence on Twitter. Both Hypotheses 1 and 2 were rejected, because the correlation results suggest non-significant relationships between the variables. Specifically, there is no or negligible relationship between the SEAs' presence on Twitter and the states' population density per square mile, $r(49) = .035$, $p = .806$, and a substantially weak correlation between the SEAs' presence on Twitter and the states' student enrollment, $r(49) = .186$, $p = .191$.

The SEAs' Communication on Twitter

The 40 SEA Twitter accounts had an average of 6,406 Twitter followers, ranging from a minimum of 152 to a high of 30,100 followers. Given that the median SEAs' Twitter following is 303, the SEAs appear to be selective in whom to follow on Twitter. The SEAs posted an average of 2,503 tweets since they established their presence on Twitter, which is equivalent of 12 tweets per week. Table 3 displays the descriptive statistics of the 40 SEA Twitter accounts.

One-way asymmetrical information broadcasting. The majority of SEAs' tweets (n = 46,251, 64.32%) provide URLs that took the tweet readers to a non-Twitter website. For instance, the Florida Department of Education (@EducationFL) posted the tweet "Parental involvement is so important—find out how one Florida teacher made 30 minutes turn into a 98% pass rate: http://t.co/D9TIg8lk," which took the tweet readers to the Florida Department of Education Commissioner's blog. The Maryland State Department of Education (@MdPublicSchools) posted the tweet, "The Washington Post says student improvement should be embedded in evaluation programs. http://t.co/XUuBXzNr," which took the readers to an article published in *The Washington Post*.

Nearly half of the tweets (n = 33,797, 47.00%) have at least one hashtag that can be used to categorize and organize the tweets. For instance, the hashtags #ohioed #commoncore were used in the tweet "In Common Core, Teachers See Interdisciplinary Opportunities http://t.co/EchsdAmsZz #ohioed #commoncore," indicating the tweet was related to the topics of education in Ohio (#ohioed) and the Common Core State Standards (#commoncore). By doing so, Twitter users can readily find the tweets on education in Ohio by searching on Twitter with the hashtag #ohioed and the tweets on Common Core State Standards with #commoncore. Moreover, many SEAs used their state-relevant hashtags consistently, such as #vted (education in Vermont), #ohioed (education in Ohio), #uted (education in Utah), and #vt (Vermont). Table 4 shows the top 30 most frequently used hashtags. Furthermore, the hashtags #commoncore and #ccss

Table 3. Descriptive Statistics of the 40 SEA Twitter Accounts.

	Minimum	Maximum	*M*	Median
Follower	152	30,100	6,406	4,746
Following	1	3,737	637	303
Overall tweets	118	12,000	2,503	1,918
Average tweets per week	1	46	12	8

Note. SEA = state education agencies.

Table 4. Top 30 Frequently Used Words, Hashtags, and Mentioned Twitter Users in SEAs' Tweets (*N* = 71,913).

Words	Frequency	Hashtags	Frequency	Twitter users mentioned/replied	Frequency
School/schools	15066	#vted	3091	@bcassellius	244
Student/students	9248	#ohioed	2036	@wisupttonyevers	171
Teacher/teachers	7925	#wiedu	1885	@govpetershumlin	155
Education	6198	#uted	1593	@usedgov	118
State	5715	#vt	1216	@flgovscott	106
New	4850	#commoncore	1189	@kycommissioner	105
Today	3984	#uen	871	@uenpd	102
Board	3821	#edchat	810	@arneduncan	101
Year	3266	#sboe	790	@milken	85
Great	3133	#ccss	771	@tneducommish	85
High	2919	#meschools	716	@mocommissioner	76
Now	2743	#gadoe	597	@govmarkdayton	71
Day	2653	#education	578	@janetbarresi	69
Learning	2351	#edchatri	524	@ccsso	67
Week	2067	#kydoe	487	@hendersonkaya	64
Standards	1964	#stem	463	@billhaslam	61
Thanks	1933	#iaedfuture	434	@mdoebowen	58
Check	1922	#teachers	377	@moeducation	58
Meeting	1900	#kyed	358	@vermontnea	56
Public	1778	#ff	356	@sueconutah	54
Program	1738	#edcolo	346	@macys	49
News	1734	#thankateacher	333	@governoromalley	46
College	1681	#students	329	@flcollegesystem	45
Core	1658	#sctweets	311	@educationweek	41
National	1609	#netde	306	@ucet	41
Help	1603	#edude	292	@duvalschools	38
Kids	1581	#ohedconf	287	@mndepted	38
Read	1576	#mostandards	286	@engageny	35
Common	1466	#vtcte	268	@terrybranstad	35
Work	1444	#edtech	267	@mdcps	32

Note. SEA = state education agency.

were among the most used hashtags, implying the close interplay between Common Core State Standards and SEAs.

Retweets constitute 29.76% (n = 21,402) of all analyzed tweets. For instance, in the tweet "RT @UserID: Florida high school and college students get access to online developmental ed classes. http://t.co/gUD9JwzUbY," the original tweet posted by the Twitter user (@UserID) was forwarded to the Florida Department of Education's (@EducationFL) Twitter followers. In the tweet "RT @UserID: State to spend more to help English Language Learners http://t.co/s1IZf6NMOU #heartlandaea #iaedfuture," the original tweet was forwarded to the Iowa Department of Education's (@IADeptofEd) Twitter followers.

Only 3.39% of tweets contain the "via @username" symbol, denoting that a very small percentage of SEAs' tweets used the content directly from a particular Twitter user. For instance, the Ohio Department of Education posted the tweet directly from the Twitter user (@educationweek) on the website of *Education Week*, "Education Week: Schools Are Using Social Networking to Involve Parents http://t.co/

e2zhdEF2 via @educationweek #ohioed"; the Maine Department of Education posted the tweet directly from the Twitter user (@usedgov) on the website of the U.S. Department of Education, "$200 Million Now Available for Race to the Top Round Three | U.S. Department of Education http://t.co/GCknuJrT via @usedgov."

Two-way symmetrical communication. The proportion of the SEAs' tweets that demonstrate two-way symmetrical communication is considerably lower than those indicating one-way asymmetrical information broadcasting. Only 11,076 (15.40%) tweets from the 40 SEA Twitter accounts mentioned and/or replied to other Twitter users. By examining the Twitter users' self-reported profiles on Twitter, it was found that despite public engagement in education as the SEAs' purpose of using Twitter, commissioners of the SEAs and governors were the most frequently mentioned Twitter users, as seen in Table 4. Upon a close examination, when commissioners were mentioned in the tweets, the SEAs were tweeting on behalf of their commissioners, lacking the two-way symmetrical communication. For instance, the Kentucky Department of Education (@KyDeptofEd) posted the tweet, "@kycommissioner sharing w/ #KBE KDE's plan to implement new science standards in 2014-15 but K-PREP science test won't be administered."; the Tennessee Department of Education (@TNedu) posted the tweet, "@TNedu-Commish says new educator evaluation system is the #1 driver of positive change and student results in TN #LegAcad." When governors were mentioned by the SEAs on Twitter, the tweets read like press release, lacking the two-way symmetrical communication as well. For instance, the Florida Department of Education (@EducationFL) posted the tweet, "When asked about education, @FLGovScott thanked Commissioner and SBOE, mentioned 'great proposal' to make sure we had Florida standards."; the Minnesota Department of Education (@MnDeptEd) posted the tweet, "Did you know? @GovMarkDayton budget invests $1Mil in Bullying Prevention. A School Climate Center will help cultivate safe schools #BetterMN."

In addition to frequently mentioning the commissioners and governors on Twitter, the SEAs mentioned and replied to school districts' Twitter accounts, broadcasting student achievement on Twitter. For instance, the Florida Department of Education (@EducationFL) tweeted, "Five @HillsboroughSch H.S. seniors have been named as U.S. Presidential Scholars Program candidates!"; the Tennessee Department of Education (@Tnedu) tweeted, "@score-4schools Excited to find out! It's going to be a great event to recognize TN schools & districts!"

After distinguishing the tweets suggesting mentioning Twitter users from the tweets replying, it is found that only 4,822 tweets (6.71%) of all 71,913 tweets posted by the SEAs were truly conversational. For instance, the Ohio Department of Education (OHEducation) replied, "@UserID Can you DM us your phone number so I can have a senior staff member call you directly? Sorry for the delay."; the Georgia Department of Education (@GaDOEnews) replied, "@UserID Thanks for your feedback. We are taking all comments into careful consideration as we work through developing SLOs."

Discussion

Implications of Key Findings

As organizations in an array of sectors have been using Twitter to communicate with the public, this study examined the SEAs' presence on Twitter and how Twitter has been used by the SEAs. To fulfill the first purpose of this study, two hypotheses were tested by performing point biserial correlation between the SEAs' presence on Twitter and the states' population density per square mile and the states' student enrollment, respectively. The results rejected both hypotheses, showing no significant relationship between the SEAs' presence on Twitter and the SEAs' target audience on Twitter. This finding suggests a disconnection between the two end points of the SEAs' communication on Twitter.

One explanation of the communication disconnection might be the top–down decision-making process on government agencies' adoption of social media. The finding that 78.4% of all SEAs had established their presence on Twitter is similar to the overall U.S. local and state government agencies' social media adoption rate at 84% (Mergel, 2013). To interpret these findings from an organizational perspective, it is particularly important to take into account the social context of the organizations' adoption of Twitter. In general, the decision of technology adoption is made top–down and rollout throughout bureaucratic settings such as government agencies where organizational culture is characterized as hierarchical, top–down, and siloed (Lee & Kwak, 2012; Mergel, 2014). It is therefore possible that in response to the Obama Administration's Open Government Initiative (Obama, 2009), many SEAs created a Twitter account in an attempt to enhance participation, transparency, and collaboration with the public. It is desirable and commendable that the SEAs have been taking the initiatives to provide stakeholders and the public with an alternative communication medium on Twitter. However, the SEAs' presence on Twitter is only the first step of nurturing Twitter-based public engagement. To translate the SEAs' presence on Twitter into the social capital that can be mobilized to fulfill organization missions, the key is the underlying open, transparent organizational culture that appeals to the public and sustains their engagement in education.

The mismatch—between the SEAs' presence on Twitter and their targeted Twitter users—is by no means presented as a reason for the SEAs to reduce or avoid the use of Twitter. Instead, the finding calls the SEAs' attention to be prudent in strategically considering how to use Twitter to their advantage. As the SEAs forge ahead with the adoption of Twitter, the

SEAs need to develop a plan in which Twitter is part of the overall communication strategy. Ideally, the SEAs' presence on Twitter should be consistent with the geographic distribution of Twitter users. Prior literature suggests Twitter users were overrepresented in populous states (Mislove et al., 2012); this study, however, found that the SEAs in some densely populated states had not created their presence on Twitter by the time of this study. An effective communication calls for the message creators and consumers to tune into the same communication medium; otherwise the disconnection between the message creators and consumers undermines the effectiveness of communication, leading to misunderstanding and misinformation. Applying the findings of this study, the SEAs' overall communication strategy needs to be diversified by factoring in the public's preference for receiving information.

To achieve the second purpose of this study, a content analysis of the SEAs' 71,913 tweets was conducted to examine the Twitter use patterns. Consistent with prior literature on Twitter use by the organizations in other sectors (Auger, 2013; Lovejoy et al., 2012; Waters & Jamal, 2011; Waters & Williams, 2011), this study reveals the dominance of one-way information broadcasting in the SEAs' communication on Twitter. Considering that Twitter has become a medium of information sharing and news reporting (Demirbas et al., 2010), this finding implies that the communication medium of Twitter might speed up the diffusion of information sent from the SEAs to Twitter users. This study also found that the SEAs used Twitter to inform the public by replicating the existing website content in the tweets, as evidenced by the high percentage (64.32%) of tweets with URLs. While the SEAs' communication efforts frequently provide online information, the organizations' broadcasting existing information on Twitter is considered as the lowest degree of online engagement (Mergel, 2014), lacking bidirectional interactions between the SEAs and other Twitter users. If the SEAs' purpose of using Twitter is public engagement in education as noted in the literature (Reform Support Network, 2012), then the public might not be truly engaged when the SEAs used Twitter to prevalently broadcast existing information on websites, frequently mention commissioners and governors, and post less-than-140-character press release. These Twitter use practices were necessary because they served the purpose to inform the public; however, they were also deemed as the initial stage of social media-based public engagement (Bertot et al., 2010; Lee & Kwak, 2012). To fully capitalize on Twitter's interactive potential in communication, the SEAs need to explore how to use Twitter to mobilize the public to collaboratively develop and deliver education, and to leverage the public knowledge and talent to develop solutions to education issues (i.e., crowdsourcing solutions).

Limitations of the Study

Some limitations of this study should be noted. First, this study only focuses on SEAs' social media communication on only one medium—Twitter. It is unclear how other social media tools have been used by the SEAs concurrently for public engagement. Consequently, caution must be exercised when generalizing this study's findings to other popular social media platforms such as Facebook or YouTube. Second, this study did not examine SEAs' two-way communication in Twitter chat—"a thematic multilogue (i.e., a many-to-many conversation focused on a given theme/topic) often situated within a community of practice and/or community of interest" (Megele, 2014, p. 47). In a Twitter chat, participants use a consistent hashtag in all tweets. For instance, educators use #edchat for the education-themed conversation on Twitter (Carpenter & Krutka, 2014); the U.S. Secretary of Education Arne Duncan served as the guest moderator of #edtechchat—an hour-long live Twitter chat in which thousands of Twitter users participated (Stevens, 2013; Waldman, 2015). Therefore, despite the limited use of mentions/replies in tweets in Twitter chats, the Twitter chat hashtags (e.g., #edchat and #edtechcht) might still suggest two-way communication. Third, the indicators in this study might not be clear-cut in suggesting one-way information broadcasting or two-way communication. For instance, while an SEA's tweet containing only a URL is considered as one-way information broadcasting, it is possible that URL is where the SEA posted an online survey to solicit feedback from stakeholders. In this case, manual coding appears to be the most accurate approach to categorize one-way information broadcasting or two-way communication. However, the indicators proposed in this study are of great value to identify the general patterns of Twitter use in big data research in education, when millions of tweets render manual coding appalling labor-intensive, time-consuming, and potentially impractical (Y. Wang, in press-a). Fourth, while the current study finds evidence of a prevalent one-way information broadcasting pattern in the SEAs' use of Twitter, an array of questions remained unanswered. For example, what are the reasons behind the SEAs' dominant one-way information broadcasting on Twitter? What are the characteristics of the tweets that warrant SEAs' reply? Are there any factors that discourage the SEAs' two-way communication on Twitter? What did the SEAs communicate with on Twitter? Who are communicating with the SEAs on Twitter?

Suggestions for Future Inquiry

The limitations of this study provide new opportunities for future inquiry. First, it is recommended that future researchers interview the people who manage the SEA Twitter accounts to gain their insights into how the SEAs' internal organizational communication mechanism affects the SEAs' external communication with stakeholders and the public on Twitter. Second, given the popularity of Twitter chats among educators (Carpenter & Krutka, 2014), how SEAs use Twitter chats for two-way communication is certainly an intriguing question awaiting answers. In addition, it would be helpful to

examine the demographics of the SEAs' Twitter audience and extract the topics from the SEAs' tweet content. Finally, this study sets the stage for future large-scale studies on Twitter used by districts and schools, and examine whether any different Twitter use patterns exist at state, district, and school level.

Conclusion

In sum, the large extent of the SEAs' adoption of Twitter is accompanied by a low level of Twitter-based public engagement. This study finds a disconnection on the Twitter communication medium between the SEAs' presence of Twitter and their target audience. In addition, the SEAs appear to be using Twitter as an alternative channel to broadcast existing information rather than creating conversations and engaging with stakeholders and the public. The findings of this study are important for both academics and practitioners. For academics, this study has laid the foundation for further research that will shed light on social media's emergent role in organizational communication. For practitioners, the findings of this study raise the awareness of effective use of Twitter by educational organizations and leaders against the backdrop of Open Government Initiative (Obama, 2009) aiming to harness new technologies in government to increase participation, transparency, and collaboration with the public.

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