A longitudinal comparison of public libraries’ posting activities on Twitter in April of 3 years, pre-, during, and post-COVID-19

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Abstract

The purpose of the study was to observe how public libraries' communication on Twitter has been changed before, during, and after the COVID-19 outbreak. A total of 40 active, public library Twitter accounts were used for data collection and analysis. The tweets examined were a combination of original tweets (n = 2623) and retweets (n = 666) posted from other Twitter accounts on the public libraries’ Twitter feeds. A content analysis scheme was used to analyze topical aspects of the tweets. The study found that public libraries were more active in communicating information on social media during the COVID-19 lockdown period. Promoting library events/programs, communicating library operations to patrons, and highlighting library resources for literacy are common in public libraries’ Twitter communication throughout the 3 years period. The study also observed strong associations between the content types of posts and the contextual aspects of the libraries, including an emergency situation such as the COVID-19 lockdown, the size of the population served by the library, and the state in which the library was located. In other words, the study provides evidence that public libraries use different communication strategies on Twitter depending on factors such as community emergencies, service population size, or geographic location. The results of this study illustrate that through social media usage, public libraries demonstrate their competence as public agencies in managing their services, as well as their commitment to the core value of information access and service provision to users, even in the face of unprecedented crises.

Keywords

Public libraries, Social media, Twitter, COVID-19, Tweet categorization, Communications, Marketing

Introduction

This research examines changes in the communication patterns of public libraries on Twitter across the 3 months of April 2019, April 2020, and April 2021 – that is, before, during, and after the COVID-19 pandemic lockdown. The COVID-19 global pandemic affected billions of people, tearing them away from their normal lives. In March 2020, many countries including the U.S. declared the outbreak a national emergency and issued regional stay-at-home orders. Libraries were forced to close their physical doors and adjust their operations and provision of information services for patrons. In the survey conducted by the Public Library Association (PLA) during March 24-April 1, 2020, 98% of public libraries reported that their buildings had closed. Despite the physical closures, most of these libraries extended online renewal policies, expanded online checkout services, and added virtual programming (American Library Association [ALA], 2020). This trend was confirmed by the Institute of Museum and Library Services (IMLS) Public Library Survey (Institute of Museum and Library Services, 2022), which indicated that 93% of public libraries continued to provide services to the public even while their buildings were closed. In June 2020, the American Library Association (ALA) posted guidelines for reopening libraries (Chmara, 2020). Subsequently, public libraries began to resume their operations and service provision while adopting new safety measures and quarantine protocols. In addition, public libraries continued their operations by shifting their service provision to the online environment, and undertook new efforts to ensure access to library resources and services for their communities. In
doing so, public libraries offered a wide range of initiatives and innovative services for their patrons, including digital and virtual programming, pick-up services, expansion of Wi-Fi spots, and partnerships with healthcare professionals to provide health-related information services (ALA, 2020; Goddard, 2020; Kostagiolas and Katsani, 2021).

In the midst of this crisis and the subsequent adjustment of library operations and service provision, communication was key for public libraries as they sought to raise awareness of continued library services and to ensure ongoing connection with patrons. At the same time, use of and access to information and services remained crucial for millions of people attempting to maintain their professional and personal lives while disconnected from their normal ways of life during lockdown. In this environment, social media sites became a vital outlet for people seeking information, connection, and community (Schumacher and Kent, 2020). Consequently, public libraries utilized social media as an important strategy in their mission to maintain connections with their patrons, ensure continued information exchange, and promote library services to their communities (Kostagiolas and Katsani, 2021).

Many public libraries have used social networking platforms to promote their services and resources to patrons. While Twitter is the second most popular social networking site used by public libraries, following Facebook (OCLC, 2018), the Pew Research Center reports that the use of Twitter is growing among various populations as a means to receive news, connect with friends, and share information (Shearer and Gottfried, 2017). Despite this growth, researchers have focused less attention on public libraries’ use of Twitter as compared to Facebook (Choi and Harper, 2019). Nevertheless, Twitter is considered a useful social media platform for public libraries seeking to promote community engagement (Cavanagh, 2016). Many libraries use Twitter to provide timely updates about new resources or current events (Palmer, 2014). During the physical closures caused by the pandemic, embracing Twitter as a communication channel would have been a strategic way for public libraries to reach their communities and potentially expand their audiences. It can be assumed that operational changes to libraries due to the COVID-19 outbreak would be reflected in a shift in libraries’ communication patterns on Twitter. Hence, the aim of this study was to observe changes in public libraries’ Twitter usage before, during, and after the COVID-19 outbreak. Understanding how public libraries deliver communication content on social media in different circumstances will bring new insights and suggest future improvements for the communication strategies of public libraries. Specific research objectives of the study are two-fold: to identify differences in the distribution of content types of tweets, and to observe any trends in user engagement with tweets across the pre-, during, and post-lockdown time periods.

Related Studies

Public libraries employ social media to reach out to and connect with communities beyond the physical location of the library and to inform patrons of library services. Twitter is considered a helpful tool for public libraries seeking to engage with patrons and develop a community for communication and relationship-building (Cahill, 2011; Cavanagh, 2016). Public libraries using Twitter tend to focus on sharing information about library programs to generate interaction with Twitter users (Aharony, 2010; Collins and Karami, 2018; VanScoy et al., 2018). Previous studies also report that public libraries use Twitter actively during crises or emergencies, such as hurricanes (Han, 2019; Liu et al., 2017; Yang and Ju, 2021).

Likewise, public libraries have increased their use of social media during the COVID-19 pandemic and lockdown period (Library Journal, 2021). Accordingly, researchers have examined how public libraries communicated with their patrons in order to stay connected and relevant to their communities during the lockdown period. By examining 80 public library announcements relating to the COVID-19 pandemic from March 14 to April 12, 2020, Wang and Lund (2020) determined that most announcements were related to library operations, suspension of library programs, and promotion of available electronic resources. Alajmi and Albudaiwi (2021) examined the tweets of 38 public libraries in New York City between December 2019 and April 2020. Their findings revealed that a majority of tweets (85.5%) were related to general library service updates, recommendations for readings, library programs, and promotion of available electronic resources. Alajmi and Kim (2021) also analyzed tweets of 57 public libraries in five different states in the United States during April 2020. Their analysis shows that the public libraries most frequently used their Twitter feeds to post content about library activities, programs, or events, including a wide variety of workshops, meetings, seminars, story times, book clubs, or other public programs taking place remotely via a communications technology like Zoom. The study also found that a significant number of public libraries’ tweets were related to various helpful resources for learning, education, or fun activities available outside of the libraries themselves. Their findings show that while public libraries used Twitter as a communication channel to extend a wide range of traditional services and share diverse information during the pandemic, there was a relatively low focus on sharing community information and addressing information related to the pandemic. Rathi (2021) reported a case of Twitter use by a large public library in the Western region of Canada during the initial pandemic phase between mid-March and mid-August, 2020. Based on analysis of 150 tweets, he determined that a large number of tweets were about the library’s programs.
and services (42.7%), as well as library operations (24.0%), resources (18.7%), health and hygiene (8.0%), and other (6.7%).

As the condition of the COVID-19 pandemic has evolved, research has emerged that analyzes social media posts to show how public libraries have employed different service operation strategies over time. Rubenstein et al. (2021) compared and analyzed 441 Facebook posts from 16 small public libraries in four states (North Carolina, Vermont, Michigan, and Oklahoma) over 3 months (March, July, and December 2020). Analyzing Facebook posts that focused on health and wellness information and services, the researchers noted changes in the public libraries' service provision strategies as the pandemic progressed. Facebook posts made in March illuminated a shift in library operations from normality to closures and cancelations of programs, while posts made in July show how libraries developed different strategies for program provision, and posts made in December represent the adaptation of libraries to the new normal. The researchers argue that the public libraries used the social media platform Facebook to stay connected to their communities, keep residents informed, and continue to serve the health and wellness needs of their patrons. Everist (2021) also examined changes in library operations and services between the pre-pandemic and the pandemic era for 21 public libraries in North Carolina, analyzing library announcements on websites and social media (mainly Facebook) posts relating to the COVID-19 pandemic for the period of March 10, 2020 through March 31, 2021. From the content analysis, she found that curbside pickup, virtual programming, limited building use, free exterior Wi-Fi, and book delivery were offered during the COVID-19 crisis. She further found that, in the course of reopening after the lockdown, these library systems initially prioritized computer use and checkout in their social media posts, while activities and services requiring indoor space, like library programming, were less frequently mentioned.

A number of studies have also investigated operational changes and communication strategies of public libraries in other countries during the COVID-19 pandemic. Koulouris et al. (2021) conducted an online survey of Greek libraries to explore their social media use and library operations during COVID-19. They found that the majority of respondents (63%) focused their efforts on the promotion of existing electronic resources; however, these respondents did not fully utilize social media for service provision. In comparing usage of digital library resources from the Njegoš public library in Serbia between 2019 and 2020, Ćirić and Ćirić (2021) found that peaks in the popularity of the digital library in 2020 were connected to significant points in time over the course of the pandemic. Their analysis of the origin of the links from which readers accessed the digital library revealed that the majority (59%) came from Facebook. Their finding provides evidence that social media posts were an effective way for promoting the digital library during the pandemic lockdown. Skare (2021) reported a similar practice of Facebook use by the Tromsø Public Library in Norway during the first period of lockdown. The Tromsø Public Library used Facebook to inform their users about digital resources and practical issues concerning the availability of services. Solis and Kear (2020) noted that while prior to COVID-19 Croatian public libraries did not often use Facebook to share content, they quickly adopted Facebook to share quality content and information for people following the outbreak.

These previous studies provide early evidence that public libraries used social media actively, and that use of social media focused on library operational changes and available digital resources during the early lockdown period. However, most of the previous studies were based on a limited number of public libraries or a short time period. After a few months of the COVID-19 lockdown, public libraries gradually re-opened, moving forward while grappling with the many constraints and uncertainties caused by the virus. As conditions evolved, public libraries must have considered new strategies for utilizing both physical and virtual space to maintain services for their patrons. Again, public libraries had to shift their operations. Thus there remains a need to determine how the social media communication of public libraries has shifted to reflect the operational changes over the pre-, during, and post-pandemic periods. Studies employing a systematic examination would offer evidence of public libraries’ social media communication at different time periods, presenting data and analysis valuable for improving understanding of public libraries’ communication strategies and practices.

The main goal of the current study is to examine changes in communication strategies and user engagement on Twitter during different time periods reflecting the pre-, during, and post-COVID-19 pandemic era. Specific research questions to be addressed are as follows:

- What types of content did public libraries most frequently communicate via Twitter before, during, and after the pandemic? Is there a difference in the distribution of content types over time?
- Is there a significant difference in the distribution of posting frequency and content types among the libraries depending on the size of population served by the library, or the state in which the library is located? And,
- How has user engagement on Twitter shifted during the different time periods?
Table 1. The number of original tweets by public libraries per state in April of 3 years.

|          | CA (n = 8) | IL (n = 7) | MA (n = 10) | NJ (n = 3) | NY (n = 12) | Total |
|----------|------------|------------|-------------|------------|-------------|-------|
| 2019     | 221        | 144        | 94          | 46         | 230         | 735   |
| 2020     | 137        | 353        | 149         | 95         | 320         | 1054  |
| 2021     | 199        | 229        | 86          | 30         | 290         | 834   |
| Total    | 557        | 726        | 329         | 171        | 840         | 2623  |

Method

The study examined 40 public libraries’ Twitter posts during the months of April in 2019, 2020, and 2021 for a longitudinal comparison of original tweets and retweets.

Data Collection

The sources of the data and the methods used in the current study were derived from the authors’ previous study of tweets posted by 57 public libraries in five states during April 2020, when all public libraries were physically closed due to COVID-19 (Choi and Kim, 2021). In the previous study, the authors chose the five states reporting the highest number of COVID-19 cases (New York, New Jersey, Massachusetts, Illinois, and California) (Centers for Disease Control and Prevention, 2021) and selected public libraries from those states in order to examine their communication activities on Twitter. Using the IMLS Public Libraries Survey Fiscal Year 2017 (Institute of Museum and Library Services, 2020), the authors collected a list of public libraries in the five states. The authors sampled 10% of the public libraries from the list, totaling 220. By checking the libraries’ websites for Twitter links and conducting searches on Twitter for the libraries’ accounts, the authors identified eligible Twitter accounts of 57 libraries across the five states for inclusion in the data analysis.

For this study with an aim to discover any changes in communication patterns among the sampled public libraries’ Twitter feeds over time – including a normal time before the COVID-19 lockdown, a time during the COVID-19 lockdown period, and a time after the COVID-19 lockdown period – the authors performed a longitudinal study, returning to the same libraries’ Twitter accounts to collect tweets from April 2019 and April 2021, adding to those previously collected from April 2020 (see Table 1). The state of California first issued a stay-at-home order in mid-March of 2020, and New York, New Jersey, Massachusetts, and Illinois did so by the end of March (Mervosh et al., 2020). While the state of Massachusetts ended the state of emergency in June 15, 2021, the four other states have maintained emergency measures beyond a year of 2022 as new COVID-19 variants continue to spread and vaccination rates remain variable (National Academy for State Health Policy, 2022). Thus, the public libraries in the five different states were in the similar COVID-19 regulations during April 2020 and April 2021.

From this review, the authors identified 40 public libraries’ Twitter accounts active during all 3 years. In other words, 13 Twitter accounts (25%) were removed because the accounts had posted no tweets during either April 2019 or April 2021. From these 40 Twitter accounts, the authors collected tweets over a 1-month period from April 1 to 30 in 2019, 2020, and 2021. The authors collected 2623 original tweets and 666 retweets, yielding 3289 posts in total. Other data collected included the following elements of original tweets: the numbers of comments, likes, and retweets associated with each tweet, and the hashtags and embedded media types included in each tweet.

Data Analysis

In order to detect how a crisis (the COVID-19 pandemic) affected public libraries’ communication content on Twitter, the study used the content category scheme which was developed and applied in the authors’ previous study. Table 2 shows the content categorization scheme. The content category scheme was developed through consultation of previous content categorization frameworks developed by Shiri and Rathi (2013) and Han (2019). As the content categorization framework includes regular communication content related to library-related topics as well as community-related topics, it is able to reflect themes of content during a normal time as well as any emergency. The framework is thus useful for observing variations in communication focuses among public libraries before, during, and after COVID-19.

Twitter account holders can read another account’s tweet and repost it to their own Twitter feed. This retweet can represent the engagement of a Twitter account holder within a broader network. By analyzing the content of such retweets, researchers can determine what content public libraries judge worthy of passing along to their patrons (Ehrlich and Shami, 2010). Table 3 details the content categories developed by the authors for the analysis of retweets.

By using coding of tweets in April 2020, the reliability of the coding categories was tested by comparing two sets of codes assigned by two coders. The intercoder reliability was 0.84 for original tweets and 0.96 for retweets according to Holsti’s (1969) reliability formula. For the rest of the dataset, individual tweets were reviewed and coded based on the content categorization scheme. Each author separately evaluated and coded one-half of the dataset of...
Table 2. Content category scheme for tweet content analysis.

| Main category                          | Sub-category                                                                 | Description                                                                 | Examples                                                                                     |
|----------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Library services                       | Library events/programs/resources related to COVID-19                      | A tweet that includes an event or program that a library provides virtually or on site in response to COVID-19 | Webinars, resources, and book recommendations about COVID-19; a mask giveaway event          |
|                                        | Library events/programs/activities NOT related to COVID-19                 | A tweet that includes an event or program not related to COVID-19 that a library provides for children or for the general public | Story time; storytelling; writing club; family night; teen events; music performance; yoga; knitting; book clubs; author talks; workshops on resume or employment opportunity; workshops on finances; virtual simulation event; computer tutoring |
|                                        | Library collections and services for information and resources              | A tweet that includes recommendations of books/library resources as advisory services, or links to library collections | Book recommendations; book reviews; e-books; links to library collections                      |
| Library operations                     |                                                                            | A tweet that includes information about the operation, news, announcements, or promotion of a library | Operation hours; due dates; fines; library closures; curbside pick-up; event cancellations; event calendars; newsletters; membership (library card); library policies; patron surveys; library’s SNS promotion; greetings from library staff; board of trustees meeting; library’s reply to a Twitter user |
| Community-related information          | Local community news, announcements, or resources related to COVID-19       | A tweet that includes community news, announcements or resources about COVID-19 | COVID-19 status; testing information; general guidelines; assistance available; tips or resources for wellness and health; new mask policies; CDC’s no-sew face mask (using a bandanna, coffee filter, and hair ties/rubber bands); best practices for when you get home after work; a list of essential needs during stay-at-home |
|                                        | Resources/news/events/online free resources NOT related to COVID-19        | A tweet that includes information about a topic other than COVID-19 for the general public from sources outside of a library | Local news; events held by other libraries or organizations; free online content; census; election; Chromebook swap event; student resources from a school district; resources for online learning; job postings |
| Other                                  |                                                                            | A tweet that is not categorized into any other categories or is about humor, entertainment, or social interaction | Greetings; celebration; inspiring messages; Earth Day celebration; a virtual tour of a museum or an aquarium; nature sounds; a virtual trip to the Grand Canyon |
tweets, and then exchanged coding results to review the other’s coding independently. In order to assure the quality of data analysis and results, two authors reviewed and discussed the coding results together, reaching a final code agreement that assigned one coding to each tweet for the entire dataset.

The data analysis is descriptive based on counts and percentages of the frequency distribution of posts by content types and other elements on the posts per year. In order to examine the difference of the distribution of posts per content type over time and among different library groups by size of population served by the library and by the state in which the library is located, a chi-square independence test was used because the variables were a categorical type. In conducting the chi-square test, the authors verified that its assumptions were met, including whether there must be at least five expected frequencies in each group of categorical variables or that no more than 20% of all cells have an expected frequency less than five. A $p$-value less than 0.05 indicates statistical significance. SPSS was used to perform a descriptive analysis and a chi-square test.

**Findings**

Overall, the number of posts made during the early COVID-19 period, April 2020, was higher than the number made during the time periods before and after the pandemic. On average, the libraries made 18.36 posts in April 2019, 26.35 posts in April 2020, and 20.85 posts in April 2021, as shown in Table 4. The frequency of posts increased from 2019 to 2020, and decreased from 2020 to 2021.

**Difference of post distributions by years**

Seven categories of tweet content were compared in the different time periods. Table 5 shows the percentages of frequency distributions of posts that fall into each category. The analysis of the post frequency shows that posts about library events had the highest frequency over time, followed by posts about library operations and library resources.

A chi-square test of independence was performed to assess the difference of the distribution of posts by content type over time. The test showed that there was a significant difference between these variables ($\text{Chi-Square} = 245.48$, $\text{df} = 12$, $p = 0.000$). In other words, the distribution of posts by content type was related to the time period.

The comparison of the distribution of posts per content type over the 3 years period shows that the distribution of posts about library events was much lower in 2020 (29.0%) compared to 2019 (49.1%) and 2021 (50.5%); the distribution of posts of community-related information was much higher in 2020 during the pandemic (21.3%), compared to before (6.7%) and after the pandemic (9.6%); the distribution of posts on library resources in 2020 (18.0%) was higher than in 2019 (15.5%) and in 2021 (15.7%); and the distribution of posts on library operations was higher in 2019 (26.0%) than in 2020 (20.2%) and 2021 (21.1%) (see Table 5). The differences in the distribution of posts clearly resonate with the impact of the COVID-19 lockdown on public libraries’ operations, reflecting the cancelations of planned events and the shift toward focusing on promoting access to library resources while transitioning to online operations. However, it is noticeable that throughout the 3 years, public libraries continued to make a large portion of the posts about library events/programs, suggesting that

### Table 3. Content category scheme for retweet content analysis.

| Category                | Description                                                                 | Examples                                                                                   |
|-------------------------|-----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| Open resources/services | A retweet that includes information, resources, or news about learning, reading, or literacy from an agency or individual other than a library | Learning; activities; resources; book recommendations                                      |
| Library-related         | A retweet that includes news or information about libraries, or library resources from libraries | Digital content from Overdrive, hoopla, Libby; thank you message about libraries; National Librarian Day/National Library Week |
| Local community-related | A retweet that includes local information, resources, assistance, support, or community events | Food pantry; census; a call for action                                                     |
| COVID-19-related        | A retweet that includes information, announcements, or resources regarding COVID-19 and health related information | Selfcare during stay-at-home; a safety reminder from the Mayor; recommendation for face covering |
| Other                   | A retweet that includes informal communication, humor, or others              | Humor; Earth day                                                                         |

### Table 4. Descriptive statistics of original posts per year.

| Year | N=40 | Mean | Mode | Median | SD   | Maximum | Total |
|------|------|------|------|--------|------|---------|-------|
| 2019 | 18.36| 2    | 12   | 17.92  | 73   | 735     | 735   |
| 2020 | 26.35| 2    | 14   | 28.87  | 99   | 1054    | 1054  |
| 2021 | 20.85| 3    | 13.5 | 19.27  | 76   | 834     | 834   |
despite the COVID-19 emergency and the abrupt need for physical closures, libraries made a clear effort to maintain typical library services.

**Posting activities among libraries by a service population size**

A majority of public libraries in the United States are small, serving a community of fewer than 25,000 people with only limited resources and facing many operational challenges (Chase, 2021; Swan et al., 2013). But such small public libraries are nevertheless committed to serving patrons and offering innovative and responsive services while acting as a community place (Chase, 2021). It is important to examine how communication on Twitter differs among public libraries based on the size of their service population, as this information offers insight into how public libraries employ communication tools strategically to connect with their patrons and to serve the unique needs of their communities. To facilitate data analysis, service population sizes were grouped into four ranges: <10,000, 10,000–25,000, 25,001–100,000, and >100K, with population sizes obtained from the IMLS Public Libraries Survey Fiscal Year 2019 (Pelczar et al., 2021).

Table 6 shows numbers of posts per year by different libraries grouped according to the size of their legal service population. The comparison of the frequency of posts shows that, during the pre-pandemic month of April 2019, the larger the service population of the library, the more posts the library made. However, during April of 2020 and 2021, mid-size libraries serving populations of 25,001–100,000 produced more Twitter posts, outperforming the other groups of public libraries. In contrast, the frequency of posting by large libraries serving more than 100K drastically dropped from 2019 to 2020, and then increased again from 2020 to 2021. According to Library Journal’s 2021 budgets and funding survey results (Peet, 2021), large library systems experienced a decrease of staffing in 2020. The decrease in posting in 2020 may reflect this staffing constraint; due to staff furlough caused by the pandemic, remaining staff in large libraries were diverted from posting on social media platforms to other, more immediate duties or new assignments (Balzer, 2020; Corsillo, 2020). With regard to small libraries serving populations of less than 25,000, their posting activities had not yet returned to the pre-pandemic level in 2021. This may reflect operational constraints that small libraries endured as the pandemic situation evolved.

A chi-square test of independence was performed to assess the difference of the distribution of posts by content type over time among the groups of libraries based on the size of population. The test showed that there was a significant difference between these variables (Chi-Square = 48.29, df = 18, p = 0.000). In Table 7, frequencies of posts per library group by population size are compared to determine any notable differences. The comparison shows that the distribution of posts on community information among mid-size libraries with service populations of 25,001–100,000 (15.1%) was higher than the distributions in other groups of libraries. Large-size libraries with service populations of more than 100K tended to produce more posts on library events (41.3%) than other groups of libraries, while small libraries with service populations of below 25,000 produced more posts about library resources.

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**Table 5.** Frequency distributions of posts per content type during different time periods.

| Content Type                                             | 2019   | 2020   | 2021   | Total  |
|----------------------------------------------------------|--------|--------|--------|--------|
| Library events/resources related to COVID-19             | 0 (0.0%)| 14 (1.3%)| 5 (0.6%)| 19 (0.7%)|
| Library events/programs NOT related to COVID-19          | 361 (49.1%)| 306 (29.0%)| 421 (50.5%)| 1088 (41.5%)|
| Library collections and resources                        | 114 (15.5%)| 190 (18.0%)| 131 (15.7%)| 435 (16.6%)|
| Library operations                                       | 191(26.0%)| 213 (20.2%)| 176 (21.1%)| 580 (22.1%)|
| Community news or resources related to COVID-19          | 0 (0.0%)| 54 (5.1%)| 7 (0.8%)| 61 (2.3%)|
| Resources/news/event/free resources from sources outside of a library NOT related to COVID-19 | 49 (6.7%)| 224 (21.3%)| 80 (9.6%)| 353 (13.5%)|
| Other                                                    | 20 (2.7%)| 53 (5.0%)| 14 (1.7%)| 87 (3.3%)|
| Total                                                    | 735 (100.0%)| 1054 (100.0%)| 834 (100.0%)| 2623 (100%)|

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**Table 6.** The number of original posts by a size of populations per year.

| LSA range                    | 2019   | 2020   | 2021   |
|------------------------------|--------|--------|--------|
| <10,000 (n=7)                | 58 (7.9%)| 52 (4.9%)| 49 (5.9%)|
| 10,000–25,000 (n=13)         | 195 (26.5%)| 382 (36.2%)| 215 (25.8%)|
| 25,001–100,000 (n=12)        | 234 (31.8%)| 432 (41.0%)| 346 (41.5%)|
| >100K (n=8)                  | 248 (33.7%)| 188 (17.8%)| 224 (26.9%)|
| Total                        | 735 (100%)| 1054 (100%)| 834 (100%)|
Posting activities among libraries in different states

The study also examined the distribution of content types of original tweets among the libraries in five states over time. A chi-square test of independence was performed to assess the difference of the distribution of posts by content type over time according to the states in which the libraries were located. The test showed that there was a significant difference between these variables (Chi-Square = 324.11, df = 24, p = 0.000). Table 8 illustrates frequency distributions of posts by content type per library group for each of five states. The comparison of the distribution of content types shows that the distributions of posts on library events and COVID-19 related library services were higher among public libraries in Massachusetts (55.9% and 2.1%, respectively) than in other states; posts about library resources were more frequent among public libraries in Illinois (19.6%) than in other states; posts about library operations (27.5%), community news and announcements (15.8%), and resources available externally (29.2%) were most common among the libraries in New Jersey, compared to other libraries in other states. This finding may indicate that while public libraries tend to use Twitter to promote library services or materials, certain public libraries may also employ a different strategy of Twitter use that emphasizes sharing information available in the community to meet user’s needs, depending on the library’s setting and circumstances.

Use of media in a tweet

Figure 1 shows percentages of posts with or without media per year. Use of media in posts increased each year as the frequency of posts without media decreased from 2019 (8.8%, 65 posts out of 735) to 2020 (5.1%, 54 posts out of 1054) to 2021 (2.2%, 18 posts out of 834). In general, the number of posts containing a mix of different media types, rather than only a single media type like a URL or a photograph, increased from 2019 to 2020 and 2021 (See Figure 1). In particular, the number of posts with both a URL and a photograph shows a drastic increase in frequency, more than doubling in 2020 (42%, 443 posts out of 1054) and 2021 (39.8%, 332 posts out of 834) compared to 2019 (16.1%, 118 posts out of 735). Video use shows an increase from 2019 (1.8%, 13 posts out of 735) to 2020 (3.0%, 32 posts out of 1054) and 2021 (4.4%, 37 posts out of 834). The increasing use of different media in posts indicates the

| Content type | <10,000 (n = 7) | 10,000–25,000 (n = 13) | 25,001–100,000 (n = 12) | >100K (n = 8) |
|--------------|----------------|-------------------------|--------------------------|--------------|
| Library events/resources related to COVID-19 | 1 (0.6%) | 6 (0.8%) | 9 (0.9%) | 3 (0.5%) |
| Library events/programs NOT related to COVID-19 | 51 (32.1%) | 324 (40.9%) | 418 (41.3%) | 295 (44.7%) |
| Library collections and resources | 35 (22.0%) | 158 (19.9%) | 141 (13.9%) | 101 (15.3%) |
| Library operations | 50 (31.4%) | 162 (20.5%) | 215 (21.2%) | 153 (23.2%) |
| Community news or resources related to COVID-19 | 0 (0.0%) | 17 (2.1%) | 36 (3.6%) | 8 (1.2%) |
| Resources/news/event/free resources from sources outside of a library NOT related to COVID-19 | 17 (10.7%) | 105 (13.3%) | 153 (15.1%) | 78 (11.8%) |
| Other | 5 (3.1%) | 20 (2.5%) | 40 (4.0%) | 22 (3.3%) |
| Total | 159 (100%) | 792 (100%) | 1012 (100%) | 660 (100%) |

Table 7. Frequency distributions of posts by content type per library group based on population size.

| Content type | NY (n = 12) | MA (n = 10) | CA (n = 8) | IL (n = 7) | NJ (n = 3) |
|--------------|-------------|-------------|------------|------------|------------|
| Library events/resources related to COVID-19 | 6 (0.7%) | 7 (2.1%) | 2 (0.4%) | 4 (0.6%) | 0 (0.0%) |
| Library events/programs NOT related to COVID-19 | 351 (41.8%) | 184 (55.9%) | 261 (46.9%) | 265 (36.5%) | 27 (15.8%) |
| Library collections and resources | 142 (16.9%) | 41 (12.5%) | 91 (16.3%) | 142 (19.6%) | 19 (11.1%) |
| Library operations | 198 (23.6%) | 58 (17.6%) | 133 (23.9%) | 144 (19.8%) | 47 (27.5%) |
| Community news or resources related to COVID-19 | 8 (1.0%) | 2 (0.6%) | 7 (1.3%) | 17 (2.3%) | 27 (15.8%) |
| Resources/news/event/free resources from sources outside of a library NOT related to COVID-19 | 112 (13.3%) | 14 (4.3%) | 45 (8.1%) | 131 (18.0%) | 50 (29.2%) |
| Other | 23 (2.7%) | 23 (7.0%) | 18 (3.2%) | 23 (3.2%) | 1 (0.6%) |
| Total | 840 (100%) | 329 (100%) | 557 (100%) | 762 (100%) | 171 (100%) |

Table 8. Frequency distributions of posts by content type among libraries per state.
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evolving approach that librarians have taken in using Twitter to draw patron attention and to make information more accessible.

Use of hashtags

Twitter users commonly include hashtags in tweets to represent topical aspects or a community of interest (Son et al., 2020). An analysis of hashtags in public libraries’ tweets provides an interesting insight into how libraries’ highlight information for their patrons.

Out of 2623 tweets in total, about 63.6% (1669 tweets) did not include a hashtag. The remaining posts (954, 36.4%) contained 2956 total hashtags. The comparison of hashtag use per year shows an increase of hashtags from 31.8% of posts (234 posts out of 735) in 2019–38.9% (410 posts out of 1054) in 2020 and 37.2% (310 posts out of 834) in 2021 (See Figure 2).

To identify popular hashtags and gain a sense of the common areas of focus in public library communication on Twitter, the most frequently used hashtags were counted. Hashtags were considered frequent if they appeared a minimum of 10 times, without controlling for qualities such as uppercase or lowercase, synonyms, and so forth. Figures 3 to 5 show wordclouds of the most frequently used hashtags over the 3 years. These hashtags are mostly related to the libraries themselves, such as #NRPL (New Rochelle Public Library), #ocpl (Orange County Public Libraries) and #@NewRochelle, and major community or civic events such as #NationalLibraryWeek, #2020Census, or #nationalpoetrymonth.

User engagement with tweets

Engagement in social media is often measured using the number of likes, comments, and retweets for each post (Muñoz-Expósito et al., 2017). In order to identify any change in user engagement during the different time periods, the number of likes, comments, and retweets was examined. Overall, the analysis revealed that there was minimal engagement with the libraries’ posts. Comments were not frequent; only 3.9% (102 posts) out of the total posts (2623) had comments, while the remaining posts (96.1%, 2521 posts out of 2623) had no comments. Likes were the most common type of user engagement, with 47% of posts, (1170 posts out of 2623) having at least one like, compared to retweets (19.7%, 557 posts out of 2623) during the 3 years period, as shown in Figure 6. It is also noticeable that there was more user engagement in 2020, during the height of the pandemic, compared to either 2019 or 2021.

A subsequent question concerns what type of content drew user engagement. Table 9 presents distributions of posts by content type per type of user engagement—comments, likes, and retweets—over the 3 years. The comparison of the distributions of posts shows that the posts that generated the most user comments were about resources or information available outside of the library (26.5%), followed by posts about library events (25.5%), and posts about library operations (21.6%). Posts about library events drew the most user engagement in the form of likes and retweets, followed by posts about library operations and resources or information available outside of the
library. Overall, posts about library events, library operations, and community information and resources generated the most user engagement.

**Library’s retweet content analysis**

It is worthwhile to note that there is a gradual increase in the number of public libraries that retweet content by other users on Twitter from 2019 (15 libraries out of 40, 37.5%) to 2020 (18, 45%) to 2021 (20, 50%) (See Table 10). The number of total retweets in April 2020 (375) is the highest, compared to 2019 (101) and 2021 (190).

In order to investigate any change in retweeting patterns on the public libraries’ Twitter feeds, a total of 666 retweets were analyzed and coded into five categories. As shown in Table 11, the comparison of the frequency of each retweet content category in 3 years reveals that the frequencies of two categories were higher in 2020 than in 2019 and 2021: external resources available in the community and local community-related information. This
Table 9. Distributions of posts by content type per user engagement.

| Content type                                                                 | Comments (n = 102) | Likes (n = 1170) | Retweets (n = 557) |
|------------------------------------------------------------------------------|--------------------|------------------|--------------------|
| Library events/resources related to COVID-19                                 | 1 (1.0%)           | 7 (0.6%)         | 5 (0.9%)           |
| Library events/programs NOT related to COVID-19                              | 26 (25.5%)         | 455 (38.9%)      | 221 (39.7%)        |
| Library collections and resources                                            | 20 (19.6%)         | 177 (15.1%)      | 73 (13.1%)         |
| Library operations                                                            | 22 (21.6%)         | 281 (24.0%)      | 150 (26.9%)        |
| Community news or resources related to COVID-19                              | 3 (2.9%)           | 34 (2.9%)        | 13 (2.3%)          |
| Resources/news/event/free resources from sources outside of a library NOT related to COVID-19 | 27 (26.5%)         | 176 (15.0%)      | 78 (14.0%)         |
| Other                                                                        | 3 (2.9%)           | 40 (3.4%)        | 17 (3.1%)          |

Table 10. The number of public libraries that retweet by year.

| Year   | By how many libraries (N=40) | Total Retweets | Maximum |
|--------|------------------------------|----------------|---------|
| 2019   | 15 (37.5%)                   | 101            | 33      |
| 2020   | 18 (45%)                     | 375            | 181     |
| 2021   | 20 (50%)                     | 190            | 107     |

Table 11. Distribution of retweets by content type per year.

| Year   | Open resources/services | Library-related | Community-related | Covid-19 related | Other     | Total          |
|--------|-------------------------|-----------------|-------------------|------------------|-----------|----------------|
| 2019   | 10 (9.9%)               | 63 (62.4%)      | 10 (9.9%)         | 0 (0%)           | 10 (9.9%) | 101 (100%)     |
| 2020   | 84 (22.4%)              | 115 (30.7%)     | 93 (24.8%)        | 51 (13.6%)       | 32 (8.53%)| 190 (100%)     |
| 2021   | 28 (14.7)               | 99 (52.1%)      | 31 (16.3%)        | 23 (12.1%)       | 9 (4.7%) | 190 (100%)     |
finding suggests that public libraries were more active in resharing outside information during the pandemic crisis. In contrast, the frequency of retweets of library-related posts decreases from before the pandemic in 2019 to during the pandemic in 2020, but increases in 2021, after the pandemic. This trend may indicate that as public libraries were gradually heading back to normal operations in the later months of 2020 and in 2021, more public libraries were returning to their pre-pandemic practices of posting library-related tweets and sharing such tweets when posted by other libraries.

**Discussion**

The comparison of the frequency of posts in April 2019, 2020, and 2021 shows that public libraries tended to post more tweets during the COVID-19 lockdown compared to before and after the pandemic. While social media use has been a common practice for library promotion and marketing, this result indicates that during the crisis of the COVID-19, the social media platform Twitter was a vital tool for public libraries to serve patrons remotely and to promote awareness of the libraries’ continuity of services and available resources.

Previous studies have found that promotion of library events and programming is prominent in public libraries’ social media usage (Aharony, 2010; Collins and Karami, 2018; VanScy et al., 2018). The same pattern is salient in this longitudinal comparison of original posts on Twitter in three different time periods. It is evident that promoting library events/programs, communicating library operations to patrons, and highlighting library resources for literacy are common in public libraries’ Twitter communication throughout the 3 years period. In particular, the finding that posts about library events and programming remained the most frequent type of post despite the lockdown supports the many reports of public libraries offering virtual programming during the lockdown period. This finding indicates that despite the unprecedented pandemic and resulting constraints, public libraries remained committed to engaging their communities through public programming. It is also noticeable that during the early lockdown period of April 2020, the frequency of posts on library resources was higher than before and after the lockdown. This trend indicates that during the lockdown public libraries pivoted to promoting available digital resources in order to ensure that patrons knew they could still access information and library resources remotely. However, while an increased emphasis on digital materials was expected to continue after the lockdown (Peet, 2021), these findings show that posts about library resources actually decreased from 2020 to 2021. This finding likely stems from the reopening of libraries in 2021, which allowed patrons to once again check out physical books, resulting in less need for emphasis on digital materials. In other words, the results of this study illustrate that through social media usage, public libraries demonstrate their competence as public agencies in managing their services, as well as their commitment to the core value of information access and service provision to users, even in the face of unprecedented crises.

The study found significant differences in the distribution of posts by content type during the 3 years period. Among those differences, one notable trend is the increase in frequency of posts on community-related information during the COVID-19 lockdown. In addition, the data revealed an interesting pattern regarding the frequencies with which libraries retweeted posts over the 3 years period. During the pandemic, the libraries retweeted posts about external resources and local community-related information from other Twitter feeds more than pre- and post-pandemic. These changes may suggest that during the crisis, public libraries focused on amplifying community information which the libraries deemed important for supporting patrons’ lives. By doing so, public libraries may use social media to establish their identity as a community agency capable of facilitating community connection or building a network of critical information available in the community. The changes in content types of posts and retweets may also represent a shift in the libraries’ communication strategies for social media during the COVID-19 crisis. In particular, Yang and Ju (2021) illustrated that public libraries utilized Twitter to play a role as “an emergency information hub” during a disaster (p. 1), connecting their patrons to information related to the disaster from external agencies. Evidently, public libraries exploit Twitter not only to promote their own services, but also to remain relevant to users and to function as a community center that is responsive to and engaged with any special situations taking place in the community.

The current study also observed strong associations between the content types of posts and the contextual aspects of the libraries, including an emergency situation such as the COVID-19 lockdown, the size of the population served by the library, and the state in which the library was located. In other words, the study provides evidence that public libraries use different communication strategies on Twitter depending on factors such as community emergencies, service population size, or geographic location. These findings indicate that public libraries employ different Twitter strategies to connect to their communities in distinct ways depending on local needs. As there is little known about how public libraries set directions for their social media practices or assess the impact of those practices, future research is desirable to further characterize public libraries’ social media communication strategies.

Researchers have reported that library social media usage suffers from a lack of user engagement or interaction (Skare, 2020, 2021). This study also found that user engagement was not frequent for most of the posts made...
over the 3 years period. However, the study did find that levels of user engagement were higher during and after the pandemic than before. The growth of user engagement with the libraries’ tweets during the pandemic is attributable to the nationwide lockdown, during which social media and online platforms were the only options for access to libraries. This finding indicates that to some degree, the social media platform Twitter helped libraries extend the reach of their services and information resources, and has the potential to improve user engagement. However, the comparison of the frequency of user engagement shows a decrease of engagement between 2020 and 2021. Once user engagement has been created, libraries should seize the opportunity to maintain and develop their engagement going forward. To achieve this, libraries must determine what content sparked their users’ engagement. This study’s analysis identified that posts drawing the most user engagement contained information or news related to library events or community-related information. This finding suggests that in order to engage with users and retain their users on social media, public libraries may need to not only focus on promoting library activities, services, and resources, but also to share information related to the community which the library supports. In other words, diversifying content topics on social media is critical for libraries seeking to improve user engagement, and one of the crucial goals of public libraries’ social media use should be sharing information about their communities as well as promoting library-related services.

In summary, a longitudinal study of social media communication by public libraries around the COVID-19 crisis suggests that social media plays a vital role in helping libraries promote and disseminate library services to the community, demonstrate their continuity of services, and communicate changes of operational routine and practices as conditions evolve. In other words, the use of social media can become an intentional part of a library administration’s communication strategy, especially during a crisis. By using social media, public libraries enhance their visibility within the community and serve as a community center.

**Conclusion**

This study has focused on the nature of public libraries’ communication on Twitter and how this communication varied during different situations – a normal time, during a crisis, and after the crisis. The study demonstrates that public libraries were more active in communicating information on social media during the COVID-19 lockdown period. The study also found that posts about library events and programming remained the most frequent type of post despite the lockdown. Another noteworthy finding is the increase in frequency of posts on community-related information during the COVID-19 lockdown. During the pandemic, the libraries retweeted posts about external resources and local community-related information from other Twitter feeds more than pre- and post-pandemic. The study’s findings suggest that the COVID-19 pandemic has provided an opportunity to confirm that public libraries must not neglect the use of social media; rather, public library administrations should become intensive and intentional in ensuring effective social media usage.

By examining and comparing tweet content before, during, and after the COVID-19 lockdown, this study contributes to building a better understanding of the pandemic’s impact on public library operations and communication strategies, and provides insight into the development of future library communication strategies. The study detected changes in the characteristics of public libraries’ communication strategies over time as the COVID-19 pandemic emerged and progressed. Despite the limited sample size, the study helps illustrate how public libraries adjusted their social media usage to meet the needs of patrons during an unprecedented pandemic. The framework of content categories developed for this study is also significant and can serve as a useful tool to elucidate patterns of public libraries’ social media usage and to strengthen understanding of public libraries’ communication over an extended period of time. The framework could also be used as a guide for public libraries seeking to diversify their messages on social media. Using the framework will help public libraries develop a concrete communication strategy that focuses on using social media to meet community needs and to improve the visibility of the library within the community.

The current study has limitations. This study looked at tweets from 40 public libraries in five states within a 1 month period in 3 years. This study is mainly descriptive, not intended to generalize the findings. The size of the dataset would need to be expanded in terms of quantity of libraries included, length of time period studied, and number of locations included to observe more general patterns of communication strategies among public libraries. While this study looked exclusively at Twitter, it would be interesting to explore if libraries employ any different strategies across different social media platforms. As social media use often reflects management competence, future study may be needed to examine how social media use can be integrated with library management planning and activities, and to determine how social media use is related to library performance.

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