Facebook Post Data: A Primer for Educational Research

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The analytic code and other files (except for the historical data, which must be accessed through CrowdTangle) is available at https://osf.io/jhnrb/?view_only=43f2da07eee14feb90fcb1755bbdbcfe.

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Abstract

Facebook is widely used and researched. However, though the data generated by educational technology tools and social media platforms other than Facebook have been used for research purposes, very little research has used Facebook posts as a data source—with most studies relying on self-report studies. While it has historically been impractical (or impossible) to use Facebook as a data source, the CrowdTangle platform allows academic researchers to freely access the massive collection of posts on public Facebook pages and groups. In this paper, we first outline how interactions and textual features in these public Facebook data in concert with established methods from educational data mining and learning analytics can be used to scrutinize educational discourse and knowledge sharing at scale. We then provide a primer that offers considerations for researchers before collecting these data (i.e., conducting research ethically and framing the study). The tutorial also covers matters directly pertaining to using CrowdTangle: accessing the CrowdTangle platform, uploading or identifying pages (or groups), and downloading historical data and it includes code using the statistical software and programming language R. We conclude with ideas for future directions for using Facebook posts as data with a focus on how educational researchers can leverage the scale of the available data and the time periods for which data is available to study educational affairs (i.e., issues or topics) and individuals (i.e., people or organizations) and to scrutinize how Facebook itself is used.

Social media has transformed the physical boundaries of learning and sense-making (Schrader, 2015), and consequently, societal changes brought about by social media have spilled over into the educational domain. These changes range from novel forms of educational institutions to engaging parents. They communicate with the parents of students and the public (Willis & Exley, 2018), engaging with social media platforms to foster and complement in-classroom learning (Akgunduz & Akinoglu, 2016). As data amasses that represent the use and interactions with these platforms, educational researchers, too, have leveraged these data to study learning (Fischer et al., 2020).

In this paper, we introduce Facebook posts as a data source that have not yet been studied to the degree that its size, granularity, and feature richness warrant—and as the enduring popularity of this particular platform warrants (Gramlich, 2021). Public Facebook pages that include fine-grained and time-stamped post data have been underappreciated as a data source due to limited access and a lack of methodological tools to work with them. These data have been receiving ample attention from educational research when coming from platforms such as Twitter (Rosenberg et al., 2020), Pinterest (Dedrick et al., 2020), and Instagram (Douglas et al., 2019). Meanwhile, prior educational work on Facebook has been largely reliant on surveys and qualitative investigations (Martin et al., 2018; Chugh & Ruhi, 2018; Niu, 2019) or has only studied slices of Facebook data, with the platform being described as a vector for learning and communication (Aydin, 2012). We situate Facebook as a foundry of public data on educational resources among prior works that have used social media to study education. We build two bridges. First, we connect research potentials of Facebook data to established methodologies in learning analytics and educational data mining. Second, we relate Facebook data to digital trace data that has been studied in the context of other social media platforms (e.g., Twitter, Pinterest) to highlight shared challenges and affordances.

Next to bridging adjacent research communities and their methodologies with Facebook data, this paper is intended to serve as an entry point for researchers wanting to use Facebook data in their own work. To achieve this, we next give the reader a sense of the capabilities and potentials of this data source while providing a practical case study and tutorial on how to access and analyze Facebook data themselves.

Literature Review

This literature review is organized around three statements about what Facebook data is—beginning with how Facebook data is a form of digital trace data. We then describe how Facebook data can be used in similar ways as other social media data and how this data source has particular affordances and strengths for educational researchers.

Facebook Post Data is Digital Trace Data

Educational data mining and learning analytics describe emerging disciplines using advancements in computation and data availability for scientific inquiry into educational processes. While educational data mining has been historically focused on developing methodologies to explain learning through data, learning analytics has focused on understanding and optimizing learning through analyzing and reporting educational data (Siemens & Baker, 2014). Quantitative analyses of research topics in both areas suggest that learning analytics and educational data mining have recently converged on an increasing focus on student behaviors (Lemay et al., 2021). Fine-grained interaction data have been used to quantify and study procrastination in higher education learning management systems (Park et al., 2018). Conversely, coarse-grained student course pathways through higher education have been used to

create semantic vector representations of courses to improve academic outcome prediction (Luo & Pardos, 2018; Pardos & Nam, 2020).

This increased focus on behavioral data is encoded in the current relationship between social media, learning analytics, and educational data mining. Manca et al. (2016) describe how methodologies for mining interaction data from learning management systems lend themselves to social media interaction streams. Kitto et al. (2015) describe how research can integrate learning artifacts and resources from social media into existing learning management system courses to foster engagement and learning. Vivakaran and Maraimalai (2019) employ social network analysis to interaction data from networked learning in a Facebook group. Wu (2021) infers higher education course performance from Facebook text message classifications. These studies demonstrate the feasibility and efficacy of using Facebook data to infer academic outcomes and explain learning with educational technologies. Yet, it is worth delineating Facebook trace data from data in more traditional educational technologies such as tutoring systems and learning management systems. Most notably, due to the absence of instruction and grading on Facebook, these trace data can not be used for knowledge inference, disengagement detection during problem-solving, and learning rate analysis, among others (Fischer et al., 2020). Conversely, the emphasis of Facebook data on time-stamped text-based transactions comes with affordances of methodologies developed and validated in other online learning environments. For example, NLP applications and other text-based algorithms can help identify urgency and learner needs from forum posts in MOOCs (Almatrafi et al., 2018). Furthermore, the ability to link external web pages and media on Facebook comes with the affordance of understanding the content spread and topical trends over time. We go on to discuss these affordances and challenges of Facebook trace data.

To effectively leverage these affordances of Facebook data, there is a lack of a general, flexible approach or, perhaps, a methodology for data collection and processing of public Facebook post data to apply nascent methods from learning analytics and educational data mining to them. This study provides a practical framework to leverage these types of Facebook data, including discussing emerging research directions that they enable.

Introducing Facebook data as digital trace data that educational researchers—and, especially educational technology researchers— can use is notable in light of the prior research on Facebook that has been conducted. Systematic reviews have shown that much of the research on the educational uses of Facebook and K-12 teachers' use of social media has relied on a single research approach: self-report surveys (Niu, 2019; Greenhow et al., 2020). However, Greenhow et al. note that other methods, both more traditional and newer (e.g., data mining), have complemented studies based on teachers' self-reports of their experiences with social media or the benefits they achieve from their use. Notably, using what scholars have termed digital trace data (Hakimi et al., 2021) invites new means of studying social media platforms such as Facebook. In particular, this applies to methods suited to analyze large, complex data sets that often number in the millions of data points. For example, Carpenter et al. (2020) accessed data on millions of tweets posted to one or more of 16 education-related hashtags—after which they examined when, how, and by whom these hashtags were used.

Given the features of Facebook and those of digital trace data, it would be reasonable to think that many studies have used Facebook as a source of data. However, while digital trace data has been used to study many features of other social media platforms—especially Twitter—few studies have studied Facebook using its data instead of collecting data through users' self-reports (Niu, 2019). This gap in what research has been done may be important. We have learned

how other platforms play a prominent role in education through studies that use large sets of digital trace data accessed through the platform. Facebook may play a similar role, but we do not know because Facebook has been closed to researchers. Furthermore, the exclusive focus on the platforms that have permitted access to data may introduce bias regarding the nature of the explanations researchers develop and the representativeness of samples drawn from a single platform (Tufekci, 2014).

Facebook Post Data Can Be Used In Similar Ways as Other Social Media Data

Many researchers have focused on *affairs* (e.g., Carpenter et al., 2020; Greenhow & Gleason, 2014; Rosenberg et al., 2020; Staudt Willet, 2019). For example, Greenhalgh and Koehler (2017) studied how French educators prepared for and supported one another in the days following a terrorist attack using the #educattentats hashtag (one that combined French words for education and terrorist attach). To do so, the authors used the Twitter Archiving Google Sheet; Hawksey, 2014) and web scraping of Twitter to access and record the content (or message) of every post and associated information, such as when the post was created and how many retweets and likes posts received. Using this data, the authors used qualitative methods and the aforementioned data mining methods to examine and report the purpose of the tweets, including the hashtag.

Prior works have also examined *individuals*, that is, people or organizations (cf. Gleason, 2016; Romero-Hall, 2018; Trust et al., 2016). For example, Veletsianos and Kimmons (2016) used Twitter's Application Programming Interface (API) to programmatically (using code) identify all of accounts that posted one or more tweets to the hashtag for the 2014 American Educational Research Association (AERA) annual meeting. Then, the authors accessed the most recent 3,500 tweets from all those individuals. Finally, the authors examined some key metrics that could signal the degree to which individuals are influential within educational research, finding that individuals identified as professors had more followers. However, a minimal variation in follower counts was strictly due to being a professor: many other factors other than one's professional role seem to matter on this platform.

Facebook Post Data Has Specific Affordances and Constraints

Technologies of any kind have specific affordances for the types of activity that are possible or easy to carry out—and constraints upon activity (Kennewell, 2001; Tufekci, 2014). In prior research, these affordances and constraints have been identified as conditions that impacted the collection and analysis of data in a way similar to how traditional research methodologies have intrinsic strengths and weaknesses. For instance, Greenhalgh and Koehler (2014) wrote that they could not determine who liked certain tweets, only that tweets received a particular number of likes. Furthermore, Veletsianos and Kimmons were able to access the most recent 3,500 tweets of individuals; tweets posted further in the past could not be accessed. Similarly, certain features of Facebook data afford and constrain how researchers can use this data source.

A review found four of the 15 most cited articles published over a decade in 65 educational technology and instructional design journals were on Facebook (Bodily et al., 2019). An important detail is that practically all of this prior research has documented the effects of Facebook as a tool for teaching and learning (Chugh & Ruhi, 2018; Niu, 2018). For instance, a systematic review of prior research on using Facebook has shown that the platform can have educational benefits—such as enhancing teacher-student interactions and improving students' academic achievement. At the same time, the platform has potential drawbacks—such as educators being more active on the platform than their students when Facebook is used as a part of courses (Chugh & Ruhi, 2018). This is different from how many learning analytics and

educational researchers have used digital trace data to study a range of educational technologies (including other social media platforms) in that the platform is considered an educational technology tool, rather than a source of data. Yet, reviews of prior research have pointed to some of the methodological shortcomings of the extant research on Facebook: around two-thirds of the studies using experimental designs relied exclusively on self-report surveys. This may lead to biased findings of how positively students view the use of the platform as a part of their coursework (Niu, 2019).

Niu (2019) points explicitly to *quantitative content analysis* of posts themselves—rather than surveys of Facebook—as a methodological approach for making more valid inferences about students' use of the platform. A few studies have employed a content analytic approach using Facebook posts to make inferences about the depth of conversations among teachers in Facebook groups (Liljekvist et al., 2021; Lundin et al., 2020; van Bommel et al., 2020). Other studies used posts to measure the depth of participation on the platform (Bowman & Akcaoglu, 2014), but such uses are limited. Notably, these studies involve the analysis of a select sample of posts. Lundin et al., for instance, examined the linguistic differences in 79 posts receiving many comments or likes in a group focused on flipped classrooms. Liljekvist et al. and van Bommel et al. qualitatively coded 553 posts to one of six mathematics- or Swedish-language education-focused groups on Facebook. They established the Pedagogical Content Knowledge (Liljekvist et al., 2021) and the depth of the interaction in the discussions that took place in the context of posts and comments in response to group posts. As noted, these studies have involved manually collecting data from the platform. In these cases, the researcher must manually access and screenshot or copy and paste posts and their content into a spreadsheet or document for subsequent analysis. In this way, studies have yet to take advantage of one of the key affordances of digital trace data: it can be analyzed at a heretofore impractical scale (Greenhow et al., 2020).

Though limited, several educational research studies have used digital trace data from Facebook in more automated (rather than manual—by hand—ways). One reason this may be is that Facebook post data has been more difficult for scholars to access. Tufekci (2014) wrote about this almost one decade ago, though the situation has fundamentally been the same until the CrowdTangle platform became available to academics and journalists: “While Twitter has been closing some of the easier means of access, the bulk of Facebook is largely inaccessible except by Facebook’s own data scientists” (p. 506). Tufekci contrasts mostly private Facebook data with the mostly public Twitter data, arguing that the accessibility of Twitter data and its “simple and clean structure” (p. 506) has made its use widespread. The few, recent educational research studies that leverage the scale of social media data in a way that is different from and complementary to the more selective sampling approach used in other research. Such work uses the CrowdTangle platform that provides access to Facebook data at a previously difficult or prohibitively large scale. This is both an affordance and constraint in that massive amounts of data—but only of a certain kind (public pages and groups)—may be collected. CrowdTangle has substantial functionality, but some key limitations: It cannot access nor help identify threaded discussions that take place in comments, or the contents of comments, for that matter. Also, private posts are strictly inaccessible.

Still, CrowdTangle has been fruitfully used in several past educational research studies. The work of Barnes and colleagues is especially noteworthy in this respect. Barnes (2021), for example, used the CrowdTangle platform to access Facebook data to document interactions with media stories shared on public Facebook pages or in public Facebook groups about English-language teaching in Australia. Specifically, Barnes qualitatively coded conversations and

debates about the value of two English-language teaching (and reading) approaches, *Universal Synthetic Phonics* (or "phonics") and *Whole Language*, finding that advocates of the different approaches to teaching used social media to frame and shape the debate.

Other studies have used CrowdTangle to access the contents of the posts of United States schools and school districts, finding that these educational institutions have posted an enormous number of messages: around 17 million through the end of 2020 (Rosenberg et al., 2022). The authors further hand-coded a subset of Facebook posts with images to infer the estimated number of posts with identifiable students in their dataset via regression modeling. They then engineered features based on account-level Facebook post activity (e.g., the total number of posts) and school district features joined from the NCES database to model the relationship between these features and student identifiability in posts. Research on these posts has also illustrated the kinds of educational technologies schools and districts most often mention in posts using a descriptive, quantitative approach (Kimmons et al., 2021; Kimmons & Rosenberg, 2022). For example, the authors employed algorithms for automatically detecting common prefixes and suffixes to keywords in posts (e.g., “education”) and extracted common domains in shared web links (e.g., ‘youtube.com’). Though there are now a few examples of the use of Facebook post data, their number is limited because there are so few examples of the use of Facebook post data for educational research, it may be challenging for us as educational technology researchers to see its use. In part to address this, we next provide a primer for how this data can be used.

Primer: United States School Districts on Facebook

This section provides a guided framework to employ public Facebook data for research, from crafting a research question and gaining access to the platform through which one can access Facebook data to presenting the results using an open-source software tool, *R* (R Core Team, 2021). Specifically, this section discusses the following six steps:

1. Conducting ethical research
2. Framing the research
3. Accessing CrowdTangle
4. Creating and uploading a list of pages to CrowdTangle
5. Downloading Historical Data Using CrowdTangle
6. Analyzing data using R, including data cleaning and exploratory data analysis

1. Conducting Ethical Research

We consider ethics before framing a study and developing research questions. Greenhalgh et al. (2020) suggest first considering human subjects research: just because social media data may be publicly accessible does not mean that ethics-related procedures do not apply. As analyses of social media often do not strictly fall under human subjects research, one may think that ethical considerations matter less than they do in other research projects. However, Greenhalgh et al. point out that even research that is not within the purview of Institutional Review Board approval because it is not considered human subjects research should still be the focus of reflection and care. Other educational technology researchers and writers have made similar points (cf. Kimmons et al., 2018; Krutka et al., 2019; Watters, 2014).

This is a guiding point: just because it is easy to collect data from social media (and Facebook, particularly) does not mean that human subjects protections do not apply. We point out three additional ethical lenses we have found useful in framing and curating our past research data sets. First, large-scale Facebook data rich in features invites to collect large amounts of features that seem (and only seem) to come at no cost. However, we recommend limiting the number of features in a data set to what is strictly necessary based on a priori research questions

and hypotheses. In conjunction with de-identification procedures, this limits the probability of unintended reidentification of groups or individuals in these data, particularly when publicly released (cf. Zimmer, 2017). Second, it is good practice to update data sets as a subset of public social media posts are regularly deleted. API terms compliance and ensuring users' right to delete public posts also percolate to research data sets. We recommend developing an automatic pipeline of downloading, pre-processing, and storing Facebook data while deleting historical versions of the data set to be updated. Third, we suggest caution when sharing excerpts of social media posts. Individuals or organizations are not likely to anticipate that what they share could be included in a research study (Fiesler & Proferes, 2018). Therefore, it is prudential for researchers not to share direct quotations or screenshots of individual social media posts. When it is deemed to be important to share an individual post, modifying the post (or creating a composite of similar posts) to make it more challenging to identify the individual account from which the post originated can balance between a research need and the ethical imperative of respecting the privacy of social media users.

2. Framing the Research

When one has access to social media data, the temptation may be to describe and present the data: The data is often rich and exciting—worthy of sharing. However, research can have a much more substantial impact when framed in light of particular ideas, theories, and findings from other research. Fundamentally social media research is not different from research on or with data generated from other contexts for research (like classrooms). Social media research requires careful framing. Greenhalgh et al. (2020) also select several considerations concerning how to frame social media research; we briefly summarize the considerations selected here:

1. Consider underlying worldviews and the assumptions one brings to research
2. Articulate the research design and methods.
3. Use a conceptual framework
4. Specify the target phenomena or unit of analysis.

This tutorial considers research questions about affairs and individuals. Questions may target each individual—or their intersection. For this tutorial, we explore relatively simple questions that have only a minimal bearing on the considerations for framing research described earlier.

On an affair, we will consider the days immediately before and during the closure of schools during the COVID-19 pandemic's early stages. Our question is: When did districts first post about the COVID-19 pandemic? We might be interested in variations in activity and interactions related to individuals. Are the largest districts receiving more interactions? Those in cities? We ask: Which districts' pages received the most interactions throughout 2021? As already suggested, these are relatively straightforward questions, but answering them will touch on many aspects involved in various research studies using Facebook data.

3. Accessing CrowdTangle

Like many social media platforms and digital data sources, it is necessary first to register or apply to access the data. While some websites allow registering with a username and other information to access data, the platform used to access Facebook data, CrowdTangle, requires a brief application to screen for allowed use; Twitter has a very similar process.

As of early 2022, the application has the following prompts in addition to basic information (name, email, and institution):

- In one paragraph, please describe what your research is about

- In one paragraph, please describe your plan for using CrowdTangle data to support your research

We and others who have applied have promptly heard a response from CrowdTangle that our application was approved. Graduate students are also eligible to apply for CrowdTangle.

4. Creating and Uploading a List of Pages to CrowdTangle

The next step assumes an approved application. There are many ways to use CrowdTangle.[1] Here, we focus on *using a list of pages* to access historical data. We use a list of pages because doing so allows one to identify multiple pages—even hundreds or thousands—and to download posts from those pages in a single step.

How does one identify the pages to add to a list? In past research, we web scraped the pages—accessed the pages using code—of every United States school district's homepage, identifying links to a Facebook page. Pages can also be identified manually, from collections of pages identified by others and through searching with keywords through CrowdTangle itself.

For this tutorial, we have created a list of the 100 largest United States school districts' (based on the number of students enrolled in the district) Facebook pages. Notably, we identified pages for all the districts, pointing to how widespread the use of Facebook by educational institutions such as schools or districts might be.

The first step is to log in to CrowdTangle. After logging into CrowdTangle, from the CrowdTangle homepage, adding a list requires navigating to "+ Create List" and "For Pages." At the top of the next page is a blank field for the list's name. We recommend naming this something short and easy to type; we used 100-largest-school-districts for the name. After naming the list, it is populated with the list of pages. We used a Google Doc to create the list of pages. Note that there must be two columns, and they must be named 1) Page or Account URL and 2) List. There can also be other columns with other information, but these two must be present. In the Page or Account URL are the URLs to the Facebook pages for the districts; this is—obviously—different for each district. The List column is the same for every district: it is the name of the list, 100-largest-school-districts; we copied and pasted this to be the same for every district.

Here are what the first ten districts look like in this spreadsheet; there are 100 districts in total in the spreadsheet (Figure 1).

Page or Account URL	List
https://www.facebook.com/NYCschools	100-largest-school-districts
https:/www.facebook.com/losangelesschools	100-largest-school-districts
https:/www.facebook.com/chicagopublicschools	100-largest-school-districts
https:/www.facebook.com/miamischools	100-largest-school-districts
https:/www.facebook.com/clarkcountyschooldistrict	100-largest-school-districts
https:/www.facebook.com/browardschools	100-largest-school-districts
https:/www.facebook.com/hillsboroughsch	100-largest-school-districts
https:/www.facebook.com/houstonisd	100-largest-school-districts
https:/www.facebook.com/orangecountypublicschools	100-largest-school-districts
https:/www.facebook.com/pbcsd	100-largest-school-districts

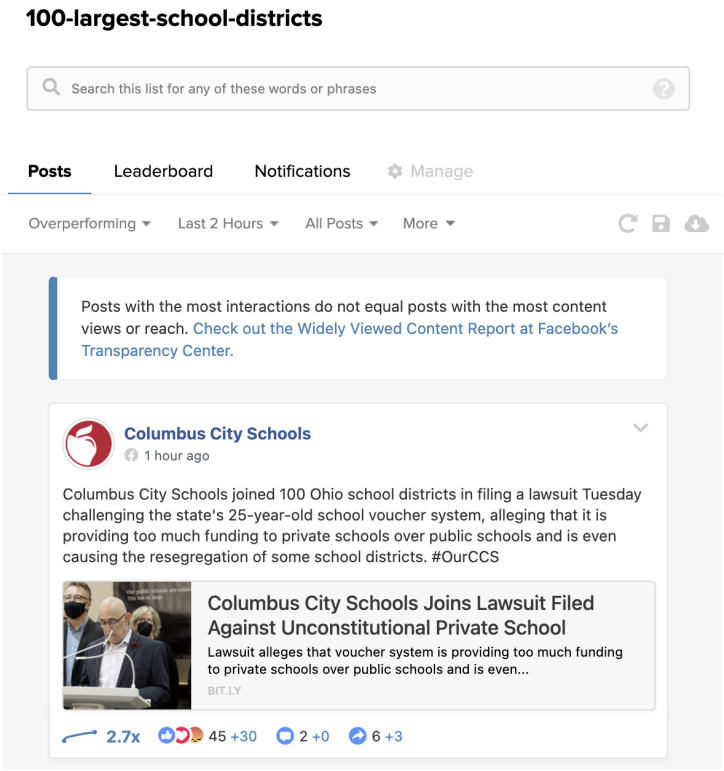
Figure 1.

[1] Resources for getting started with CrowdTangle
https://www.crowdtangle.com/resources/best_practices

The first two columns and ten rows of the spreadsheet we created for the Facebook pages for the 100 largest school districts

The next step is to click on the gear symbol and "Batch Upload" in the top-right corner of the CrowdTangle homepage. This is where the spreadsheet with the list we have just created is uploaded. The upload screen requires a CSV - a comma-separated value file - which may be generated directly from the aforementioned Google Sheet. After uploading the CSV and waiting a few moments, navigating to the newly created list, that is, 100-largest-school-districts, displays the most recent posts by the pages included in the uploaded list, as shown below in Figure 2.

Figure 2.
The homepage for the list once the batch upload has been completed with one recent post displayed



Notice that the total number of pages amounts to 95, less than 100. This is because five of the 100 pages we identified were ineligible to be accessed through CrowdTangle. Reviewing the email that CrowdTangle automatically sends following a batch upload, we can see that those pages not uploaded were because "Producer doesn't meet the eligibility criteria or doesn't exist." This likely means that those pages were private and therefore are not accessible via CrowdTangle.

At this point, we could carry out analyses within CrowdTangle. For instance, navigating to the "Leaderboard" for the 100-largest-school-districts list shows us some interesting statistics for the 95 pages. However, we can do much more with the data if we download it and then use other tools to analyze it in the way we see fit. We describe how to do this in the next step.

5. Downloading Historical Data Using CrowdTangle

Having uploaded a list, we can now download historical data for any period of activity by one or more pages. To do so, we can navigate again to the gear symbol in the top-right of the page, then to "Historical Data."

To download all information on districts' posts during 2021, we select that we want to choose the 100-largest-school-districts as the list for the search scope. We do not make any changes to filter what is returned in the section on the types of posts and specify January 1, 2021-December 31, 2021 as our date range. See Figure 3 for the parameters used for the query.

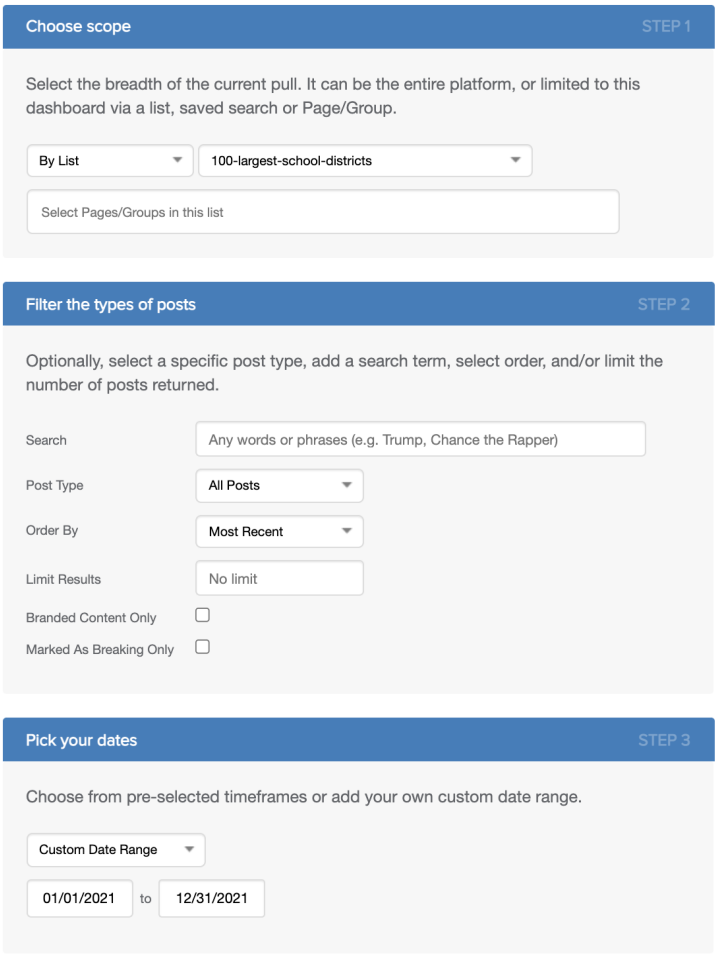


Figure 3.
Settings to download all the posts for 2021 for the pages on the 100-largest-school-districts list

We then click "Fetch History" at the bottom. CrowdTangle will send an email including a download link when the posts are ready to download—typically within a few minutes. We can then replicate this step for the 2019 and 2020 years, changing the dates; accordingly, we must do this step as there are more than 100,000 posts per year—the limit for a single historical data request. We note that this process can be automated by sending API requests via the python requests package or directly from the shell via cURL or Wget.[2] Next, we will explore how to analyze this data to answer our two questions.

6. Analyzing Data Using R

[2] See for example <blinded for peer review>

We have now downloaded the CSV file. We can upload this to Google Sheets or open it with Microsoft Excel to inspect the data or, if we prefer, analyze it using these or other tools. In this primer, we use R, a statistical software and programming language well suited for analyzing digital (and other large or even messy) sources of data. An introduction to R is beyond the scope of this primer. Still, interested readers may find chapters 5 and 6 of Estellado et al.'s (2020) Data Science in Education Using R useful for getting started.

When did districts first post about the COVID-19 pandemic? To answer this question, we:

1. Load required packages (add-ons to R).
2. Read (open) the data in R and join the three separate data sets (prepare it for analysis by processing the date variables.
3. Employ general data cleaning procedures to the data.
4. Use regular expressions to identify mentions of "covid" (with any capitalization).
5. Create a visualization of the mentions of COVID-19 by month.

We elaborate on data cleaning to emphasize the importance of this often under-appreciated data analysis step. We do so regarding the affordances and concomitant data cleaning steps associated with Facebook data. First, engagement metrics are always collected at the time of download, that is, the number of likes in one's data set may or may not be biased for very recent posts and depending on how old the post is, given that the general traffic on Facebook is not constant across time. We recommend adding a column in each data set (or in the filename at the download time) that documents that time of download. That information may also be used as a control variable in inferential modeling. Second, linking the page URLs in the Facebook data accessible through CrowdTangle to the original URLs uploaded to CrowdTangle can prove difficult in some cases. We provide an R script to facilitate this key process. Third, many columns exported from CrowdTangle are read into R as the incorrect data type (e.g., numbers are read as character strings). This requires the variable type to be specified or manually changed within R. These steps are specific to this data set, but steps like this pertain to most learning analytics analyses (Estrellado et al., 2020; Krumm et al., 2018). We note that researchers may wish to further process the data, such as by identifying each URL (i.e., external web link) mentioned in Facebook posts with a unique code to permit fine-grained sequential analyses of content spread across accounts. This would require preprocessing URLs to a standardized form, for example, by removing internet protocol prefixes (e.g., "https://") from these URLs. Strategies used to prepare other complex, digital sources of data sources (e.g., Estrellado et al., 2020; Krumm et al., 2018) can inform adequate preprocessing practices.

The result of our data analysis steps is presented in Figure 4. From this figure, we can see that the first mentions of COVID-19 were—as could be predicted—in March 2020. COVID-19 was mentioned most frequently during that month. However, there were peaks—particularly around August 2021, when school was returning. At that time, there were ample concerns about variants of the virus. Extensions of this initial analysis could examine the content, tone, or type of post and how these varied from before to during the earlier and later stages of the pandemic. Further, extensions could examine bigrams of words or other common words in the posts shared in Spring 2020 to understand whether there were posts that did not include the searched term ("covid" with any capitalization) but that were about this topic to deepen this analysis

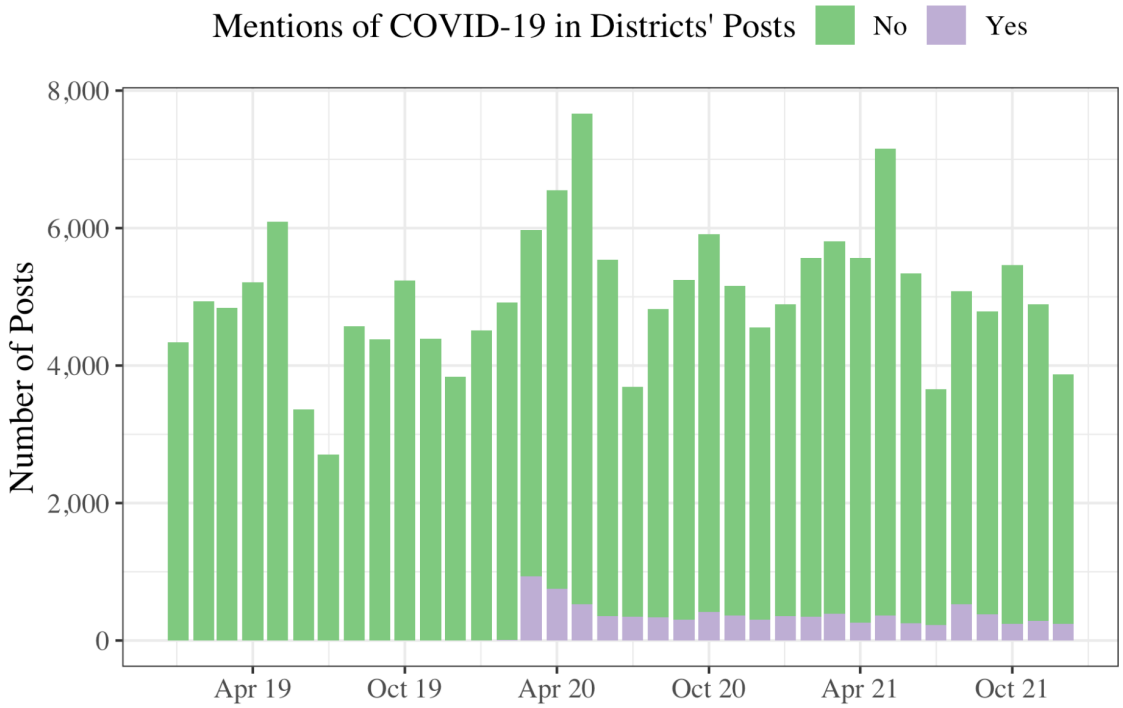


Figure 4
Mentions of COVID-19 in districts' posts on Facebook from 2019-2022

What relates to people interacting with districts' posts? To answer this question, we may skip the first two steps as those were already carried out for the above analysis; if the above analysis is not carried out, then steps one and two must be carried out first. Having loaded packages and the data, we:

1. Create summary statistics for a) total interactions (i.e., comments, likes, shares, "angry," etc.) and b) mean interactions per post, c) the year the page and determined, d) the number of followers of the district's page, and the size of the district (ranked within the top 100 largest districts based on the number of students enrolled).
2. Join these variables together into a single time.

We present the results of this analysis for the ten largest districts below in Table 1.

Table 1
Characteristics of the Facebook pages for the ten districts with the most total interactions

District	Total Interactions (3 Years)	Mean Interactions Per Post	Page Created	Followers	Size of District (Rank)

Pasco County Schools (FL)	833,676	660.59	2012	59,803	48th
Mobile County Public Schools (AL)	746,151	319.96	2009	56,477	78th
North East Independent School District (TX)	720,586	161.85	2014	38,368	62nd
Dallas ISD (TX)	719,973	149.18	2010	84,468	16th
Douglas County School District (CO)	631,237	226.08	2010	30,214	57th
Northside ISD (TX)	610,842	279.94	2009	57,491	61st
Hillsborough County Public Schools (FL)	602,330	363.94	2012	68,076	7th
Fort Worth ISD (TX)	507,828	94.95	2009	48,276	38th
Polk County Public Schools (FL)	503,935	213.35	2010	50,510	27th
Anne Arundel County Public Schools (MD)	472,360	148.26	2012	66,743	39th

As for above, the code to replicate each of these steps is included in supplementary material A. These results show that some districts receive many likes—posts by Pasco County Schools alone, for instance, have received nearly one million likes over the past three years; on average, their posts receive around 660 interactions. Notably, that district is not among the largest in the United States—its size is 48th of the 100 largest districts. Moreover, apart from Hillsborough County Public Schools (also in Florida), most of the districts were not among the very largest, suggesting that interactions with districts' pages on Facebook are a function of factors other than the mere number of students (and students' parents) in the district. This suggests that future research could explore what factors—the type or content of the post, for instance, demographic information or how Facebook fits within the district's communication plan—help to explain these differences in interactions.

Discussion

At the outset, we motivated this paper based on the value of digital trace data for studying educational technology tools broadly and social media platforms specifically. We argued that there are opportunities to explore affairs and individuals using digital data that researchers can access through Facebook. Using the posts of the 100 largest school districts to illustrate how Facebook data can be accessed and analyzed through CrowdTangle and R, respectively, this study demonstrated one approach to using such data.

The pages we accessed should not necessarily be taken as a recommendation by others to study the posts of school districts. Research on Twitter has evolved in manifold ways, addressing a wide variety of topics that were difficult, if not impossible, to have planned to have addressed. For instance, how could researchers have planned to study a network that emerged in the days following a national tragedy (e.g., Greenhalgh & Koehler, 2017)? Thus, in this section, we

describe two general future directions for research on Facebook, noting that there are many further worthwhile ideas for studies that involve education-related Facebook data that are difficult to anticipate.

Future Directions for Educational Research With Facebook Poists

We have integrated the limited prior research employing public Facebook data among other subject concentrations on Facebook in education (e.g., learning analytics and educational data mining) and application areas of Facebook as an educational technology (Taecharungroj, 2013). This begs the question of how synergies between the data sources and methods we introduced in this study and these areas of educational technology research embark on synergistic future research directions. We offer three broad directions around the scale, broad time horizons, and ability to interrogate the use of Facebook as a platform and enumerate concrete applications for each.

First, researchers may consider scale. Specifically, researchers may consider creating lists of pages other than the largest school districts in the United States—especially at a large scale, as the wide use of Facebook can enable large-scale analyses. There are many education-related pages (and groups, which—if they are open—may also be accessed with CrowdTangle) beyond those of schools and districts that others may know about and use. We argue that public Facebook data at scale particularly lends itself to discourse analysis on educational technologies (Oshima et al., 2012) and the study of topics, events, people, and organizations over time. There are examples of research on other platforms that do this (cf. Carpenter et al., 2020; Staudt Willet, 2019; Staudt Willet & Carpenter, 2020; Veletsianos & Kimmons, 2016). Knowledge-sharing practices in affinity spaces and interest groups on Facebook, as studied in other social networks (Sharma & Land, 2019), are another fruitful avenue to leverage public Facebook data to study the platform's educational merits. A particular strength of public Facebook data is the potential to study affairs that span multiple Facebook groups, different from past research that examined one (Lunden et al., 2020) or a few (Liljekvist et al., 2020; van Bommel et al., 2020) groups. These groups may be mined through social network analysis and natural language processing while being complemented with discourse analyses (Moser et al., 2013).

Furthermore, researchers might consider examining the many individuals related to teaching, learning, and educational systems on Facebook. Past research on K-12 educational institutions has yielded several insights into the technologies schools and districts communicate about (Kimmons et al., 2021; Kimmons & Rosenberg, 2022), for instance. Future research might investigate interactions with posts from these and other educational institutions, such as early childhood institutions, post-secondary institutions, and the myriad organizations that support or advocate for educators. There are opportunities to study the content of such posts using linguistic techniques such as those used by Barnes (2021)—and used by Supovitz and Reinkordt (2017) in other (Common Core State Standards) contexts. Linguistic lenses into public Facebook posts may also reconnect to prior work on educational technologies. These posts may reveal unique observations regarding the degree of technology adoption and discourse on educational technology across different geographic and socio-economic spheres. We note that research on people (rather than organizations) is likely more challenging to carry out at scale. The individuals—including educators and educational leaders—are likely not public and may require additional consent from individuals, as compared to Twitter, where individual profiles are accessible and fall under public data under Twitter's research agreements.

Second, researchers should consider time. Historical access to data means that it is possible to "time travel" and to access data long after it is possible to—for instance—ask

teachers what they thought of a specific topic (like a technology) or an event (like a policy change). As for scale, the ability to time travel may be a fruitful avenue for educational technology researchers to consider. One author of this paper conducted a very brief study to understand what schools and districts posted during the early stages of the COVID-19 pandemic (Rosenberg & Nguyen, 2020). What were districts posting in—for instance—a decade ago, in 2011, and what can such posts and where they take place tell us about teaching, learning, and educational systems? Again, this recommendation is not limited to schools' and districts' posts. It invites us to think broadly about what may have been posted on a public page or group on Facebook and whether and how such posts could be helpful from the vantage of educational technology research. For this and the above recommendation, what researchers know best—affairs that may have occurred through or with specific individuals—may be good starting points for research.

Last, we think there is the potential to use CrowdTangle to study Facebook as a platform. This idea for future research differs from the others, which draw on the capabilities of Facebook post data for understanding what we described as affairs and individuals. For this direction, we suggest that Facebook data can be used to scrutinize how Facebook is used. Scholars have recently critiqued how educational technology platforms (such as Google Classroom, Teachers Pay Teachers, and Pearson) at the K-12 and higher education levels have become widespread without sufficient inquiry into how these platforms are designed, marketed, and used (Krutka et al., 2021; Perrotta et al., 2021; Shelton et al., 2021; Williamson, 2021). Facebook, too, is extremely widely-used by educational institutions (Rosenberg et al., 2022), and the accessibility of post data through CrowdTangle can allow researchers to study how Facebook's design (and business-related incentives) may shape its use. Future research may examine how educational institutions and individuals posting in public Facebook groups use the platform with a critical lens

Limitations

We acknowledge limitations of digital trace data in the context of Facebook posts. As Stier et al. (2020) note, using self-report and digital trace data are not in conflict: They lend complementary insights that can address the weaknesses of the other (Stier et al., 2020), and the same researchers often use them—even in the same studies (Al Baghal et al., 2020; Vraga & Tully, 2020). But, while digital and self-report methods are not in opposition, the insights offered by studies using self-report and digital trace data are complementary and different (Stier et al., 2020). Research can garner such insights whether posts were one day or one year ago, allowing researchers to understand what was posted long after the collection of self-report data is possible. Moreover, while self-report data are likely a better data source for understanding people's preferences, beliefs, and reflective thoughts, what people post can also reveal what they pay attention to, say, and amplify. This paper in no way is meant to imply that asking people (including educators) about how they use Facebook through self-report surveys is not likely to be a valuable activity: as a review of past research on Facebook (e.g., Liljekvist et al., 2021) has illustrated, these studies are worthwhile. Moreover, self-report data can complement the data accessed through Facebook. A longitudinal study of the posts by an educational technology company from the first to the most recent post could be complemented by interviews with or surveys of the creators or users of that technology; both can illuminate different aspects of the role of technology in education.

Conclusion

This study is intended as a call for researchers to consider public Facebook posts as a vector for studying educational discourse, use of, and knowledge sharing on Facebook at scale. We urge educational technology researchers to think broadly about the data sources, research questions, and analyses to be carried out. How other fields, like public health (Ayers et al., 2021) and information science (Théro & Vincent, 2022), use data from the most widely-used social media platform informs research in educational technology and its adjacent fields of educational data mining and learning analytics. We stress that public Facebook data may inform perceptions and adoptions of technology across space and time while offering rich interaction, textual, and network data to understand how these phenomena change over time. Just as creative research has invited new possibilities for teaching and learning using social media and other digital spaces, research that uses Facebook as a data source can also improve educational processes while highlighting drawbacks or negative aspects of this platform.

Compliance With Ethical Standards

- The author(s) have no relevant financial or non-financial interests to disclose.
- This work did not involve human participants and so was not subject to ethics/Institutional Review Board approval.
- Because this work did not involve human participants, obtaining informed consent was not relevant.

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