Data Storytelling in COVID-19 Pandemic of Center for COVID-19 Situation Administration Facebook Fanpage

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ABSTRACT

This study aimed to investigate data storytelling strategy in COVID-19 pandemic of Thailand's COVID-19 Information Center and Center for COVID-19 Situation Administration (CCSA) by using content analysis from COVID-19 Information Center Facebook Fanpage from October 2020 to April 2021, and in-depth interview with administrator of Facebook Fanpage and communication officer of Center for COVID-19 Situation Administration. The results showed that: 1) the data storytelling of COVID-19 pandemic had been published in 725 posts with storytelling sequences, 2) the purpose of data storytelling is to provide COVID-19 information, urge the public to comply with government measures and build confidence in the implementation of government measures, 3) data storytelling content includes COVID-19 situation, government measures, and COVID-19 vaccines, 4) data storytelling type is author-driven stories and can be categorized based on data content criteria, including comparison combined with change over time, comparison, project forward, and change over time, 5) data storytelling arc is an entire data storytelling arc type, 6) Gestalt theory and 14 types of charts were applied to data visualization, and 7) data storytelling tool are Tableau, Adobe Illustrator and Microsoft Excel. Moreover, the suggestion for data storytelling type in COVID-19 pandemic is that it should include a mixed author-driven stories and reader-driven stories. Interactive media can be applied in this mixed storytelling. It will encourage audiences to participate and support to better understand of government measures.

Introduction

Corona Virus Disease or COVID-19 was first reported in December 2019 in the Wuhan, China. The virus has spread around the world. This emerging infection disease directly affects the wellness and impact global problem. The media ecosystem has also been affected due to information about the COVID-19 virus, since some media produced disinformation, which leads to difficulties of government communication and

unsuccessful measures. For this reason, the World Health Organization (WHO) defined the term "infodemic," which derives from the term "information" combined with the term "pandemic," which refers to a condition in which information is abundant both online and offline, all information is intended to spread false information for undermine correct public health practices and produce to serve the purposes of a particular group of people (World

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CONTACT

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Health Organization, 2020). The rise of infodemic and fake news leads to a major impact on the public and government sectors. Therefore, Prime Minister of Thailand set up a COVID-19 Information Center to help people who suffered from the COVID-19 pandemic. Dimensions of problems were solved, such as COVID-19 information, public health and economic social and welfare. This government organization also has responsibility for creating the right awareness and understanding of COVID-19 information to people, in order not to be panic or misunderstand when facing information disorder (Order of the Prime Minister No. 72/2020, 2020). Moreover, Prime Minister of Thailand set up Center for COVID-19 Situation Administration (CCSA) which is responsible for framing policies to manage the situation in accordance with the Communicable Diseases Act B.E. 2558, the Disaster Prevention and Mitigation Act B.E. 2550 and State Administration Act B.E. 2534. Policy framing includes public health, COVID-19 information, foreign affairs, preventive measures, and relief measures to prevent the risk and hazards of COVID-19 pandemic (Order of the Prime Minister No. 76/2020, 2020).

COVID-19 Information Center and Center for COVID-19 Situation Administration have a mission to communicate information and provide daily press conference about the COVID-19, there are many contents to communicate, such as number of infected people, COVID-19 situation in each province and total number of people who received of COVID-19 vaccine, etc. People can access through two types of media channel. First, for offline media, such as radio and television, the Office of the National Broadcasting Television and Telecommunications Commission (NBTC) has requested the cooperation of the licensee for broadcasting and television business to live broadcast of the press conference of Center for COVID-19 Situation Administration every day at 11:30 a.m. Second, for online media, they include COVID-19 Information Center Facebook Fanpage, LiveNBT2HD Facebook Fanpage, and COVID-19 Information Center Instagram Fanpage.

These media channels of the COVID-19 Information Center and the Center for COVID-19 Situation Administration have the purpose to raise public awareness of the COVID-19 virus. In particular, the campaign invites people to follow government measures and change behavior (New Normal), which communicates through data storytelling of COVID-19. It helps to communicate effectively and has great benefit to people, because it helps to understand the insight of the COVID-19, consistent opinion, force for action and impresses, which is a distinctive feature data storytelling (Vora, 2019). However, Thai Graphic Designer

Association (2022) claimed that the data storytelling of COVID-19 situation in Thailand daily report has a design problem, such as lack of data prioritization, inappropriate size and color, etc. This problem will affect both Thai and foreign citizens in the perception of information and ignorance regarding the dangers of the COVID-19 virus. For this reason, the study storytelling of COVID-19 virus of COVID-19 Information Center and Center for COVID-19 Situation Administration (CCSA) can suggest more effective improvement of the data storytelling of COVID-19 and achieve the government's goal of communication to invite people to comply with government measures. In addition, it is used as a model for research on data storytelling, which has not yet been studied in Thailand's communication sciences, as well as adapted to tell stories with information about emerging infection diseases, epidemics, disasters, or other crisis in the future.

Research Objective

To investigate data storytelling strategy in COVID-19 pandemic of COVID-19 Information Center and Center for COVID-19 Situation Administration.

## Literature Review

Definition of Data Storytelling

Data storytelling defined as a combination of data, narrative, and visuals for presenting to understand data insights. These elements are interrelated (see Figure 1). First, applying data and narrative will clearly explain to audiences. Second, applying narrative and visuals will engage the audiences. Third, applying data and visuals will help the recipients become more enlightened. And fourth, combining right data, right narratives, and right visuals together will lead to effective data storytelling and create the power of communications. The power of communications is creating changes in term of activities, lifestyle, behavior, and decision making. Moreover, it also helps keeping the presented information interesting, the audiences can remember the presentation better, it is easy to understand the data and it can be used to make decisions or take certain actions (Dykes, 2020; Sheridan, 2021; Zhao, Blount, Koesten, & Simperl, 2019). The sender would like to achieve the power of communication, it reflects data storytelling purpose in the past research. Informing, persuading, entertaining, comforting, explaining, and terrorizing are the data storytelling purposes (Lee et al., 2015; Ojo & Heravi 2018; Slaney, 2012) (see Figure 2).

Figure 1: The Three Data Story Elements Complement Each Other

Source: Dykes, B. (2020). *Effective data storytelling: How to drive change with data, narrative and visuals*. Hoboken, NJ: John Wiley & Sons

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Figure 2: Effective Data Stories Can Drive Change
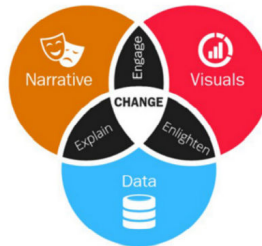
Source: Dykes, B. (2020). *Effective data storytelling: How to drive change with data, narrative and visuals*. Hoboken, NJ: John Wiley & Sons.

Data Storytelling Types

There are several data storytelling types depending on the criteria of the researchers. Dykes (2020) developed nine data storytelling types by using data content to classify. First, change over time focuses on studying, observing changes in information as time changes. Second, relationship highlighting on considering two things has some correlation, possibly a positive relationship or a negative relationship. Third, intersect revealing a set of data that trends up or down, cuts with another set of data which can be positive or negative depending on the situation. Fourth, project forward shows predictions of what will happen in the future. While there is an emphasis on the point of action, the story is considered, which displays the stopped information. This action point is followed by other points which are projected. Fifth, comparison explains the similarities and differences between two sets of data. Sixth, drill down type is a change in data from aggregated view to detailed view. Seventh, zoom out is the opposite of drill down; it shows granular view to a more aggregated view. Eight, cluster is combinations of groups which represent an opportunity or a problem. Last, nineth, outlier is unusual data, deviating from norm, this data can focus on an opportunity or problem, depending on the context.

Segel and Heer (2010) developed three data storytelling types by using audiences to classify. First, for author-driven stories type, it contains a lot of content and does not interact with the recipient or the reader. This data storytelling type is intended to provide the most effective communication. Then, for reader-driven stories, there is no prescribed ordering, no messaging, but there is a high level of interaction with the audiences. Last, for combining author-driven stories and reader-driven stories, this data storytelling type can also be divided into several categories: Martini Glass Structure, Interacting Slideshow, and Drill-Down Story.
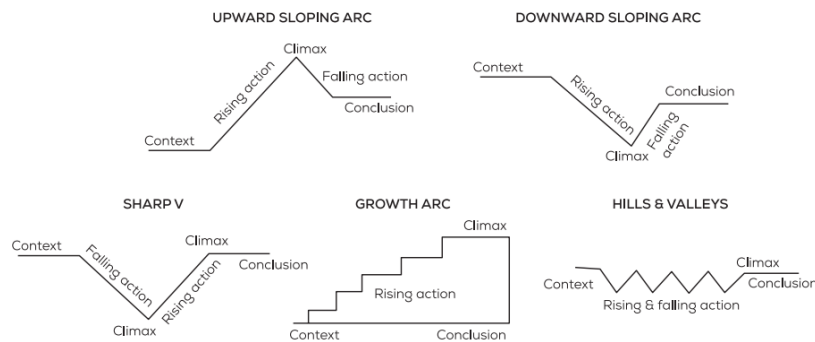
Data Storytelling Arc

Dykes (2020) found that there are three types of storytelling arc in novel: 1) Aristotle's Tragedy Structure, 2) Freytag's Pyramid and 3) Cambell's Hero Journey. Freytag's Pyramid is suitable for data storytelling. Dykes (2020) developed Freytag's pyramid to the data

storytelling arc which consists of four stages: 1) setting describes the current situation, character, and the hook to attract attention from the audiences, 2) rising insight, providing supporting details that lead to problems or opportunities, 3) aha moments, sharing the main finding or major insight, and 4) solution and next steps; it is a step with options and recommendation. In addition, Vora (2019) offers 5 types of data storytelling arc, as shown in Figure 3. There are Upward Sloping Arc, Downward Sloping Arc, Sharp V, Growth Arc, and Hills & Valleys. The data storytelling arc begins with a step of understanding the context of the data, enters the rising action stage, the falling action stage and conclusion stage. Each type of the data storytelling arc is characterized by a different narrative sequence between the rising action stage and the falling stage.

Figure: 3 The Five Types of Data Storytelling Arc

Source: Vora, S. (2019). *The power of data storytelling*. New Delhi, India: Sage.

Data Visualization Techniques

Data visualization techniques can be explained with Gestalt theory and using the chart. Gestalt theory was developed by Wertheimer, Kohler, Koffka and Lewin who were German psychologists in the 1920s. The term "Gestalt" refers to a form or shape. This theory is a theory of visual perception and supports humans to an understanding of visual design. The theory consists of principles or rules, such as the principle of proximity (explained that human beings perceive data elements when they are close to each other), the principle of similarity (described that when an object has the same properties, such as size, shape, and color etc., the same object can be grouped), and the principle of enclosure (showed that when an object is surrounded by something, such as a line or other object, human beings recognize that they are grouped) (Dykes, 2020; Knaflic, 2015).

Using the chart to design visuals, storytellers can apply several charts from visual programming tool or manual designs. Knaflic (2015) explains that there are many charts to generate data visualization, but there are only 12 types of charts for data visualizations which are sufficient for data storytelling (see Figure 4). These charts include 1) Simple text, 2) Table, 3) Heat Map, 4) Scatterplot, 5) Line, 6) Slope graph, 7) Vertical bar, 8) Stacked vertical bar, 9) Waterfall chart, 10) Horizontal bar, 11) Stacked horizontal bar, and 12) Square area. Whereas 12 types of charts are sufficient for data visualizations, Dykes (2020) claimed that when the right data is presented, data visualization must also be appropriate to represent the insights of the data. Therefore, choosing a chart for effective communication requires criteria, for example, charts that can show data comparisons include vertical bar charts, horizontal bar chart, dumbbell, slope graph, and table, charts that describe trend include a small multiple (line), column and stacked column, and stack area charts, charts that can show the composition include waffle, stacked column, pie charts and tree maps (see Figure 5).

Figure 4: The 12 Types of Charts for Data Visualizations
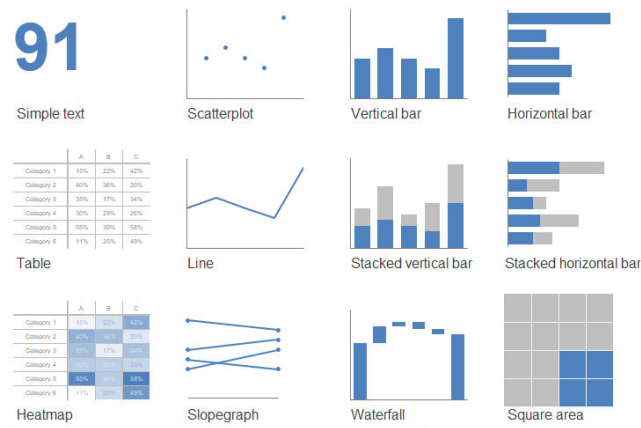
Source: Knaflic, C. N. (2015). *Storytelling with data: A data visualization guide for business professionals.* Hoboken, NJ: John Wiley & Sons.

Figure 5: Criteria for Choosing a Chart

Source: Dykes, B. (2020). *Effective data storytelling: How to drive change with data, narrative and visuals*. Hoboken, NJ: John Wiley & Sons.

Data Storytelling Tools

Biswas and Sipas (2020) studied data storytelling curriculum in America and found that 14 tools are used in data storytelling and the top five most popular tools are Tableau, Microsoft Excel, Google Studio, Datawrapper, and R studio, respectively. Each tool has different functions, such as creating graphs interactions, providing data sets, creating maps, and creating infographics, etc. Some tools may be costly or available free of charge to individuals and educational personnel. In the same way, Knaflic (2015) explained that there are several data storytelling tools, such as Microsoft Excel, Tableau, JavaScript, Processing Python, and Adobe Illustrator.

Related Research

Research related to data storytelling of COVID-19 virus were found in the research of Dey et al. (2021), which studied covid-19 vaccination data and applied the analyzed data to emphasize vaccination issues in each country around the world. This research used data from *ourworldindata.org*, *worldometer.info*, and developed Python libraries interaction data visualization. The result showed that the interaction data visualization contributed to

a better understanding of vaccination program plans in each country. Furthermore, Sakamoto et al. (2022) designed data storytelling utilizing data video, which includes the use of contact tracing application. Findings showed that when participants watched a data storytelling with a data video; they had a perception of the convenience and security of application rather than a video without data storytelling.

Other research only studied data visualization to make it easier to understand COVID-19 data. For example, Liu (2021) studied the data visualization of news during the COVID-19 pandemic of Xinhua Net news agency. The research showed that simple diagrams, traditional infographic, and advanced infographic were used in data news. And Comba (2020) summarized examples of data visualization on covid-19, including: 1) interactive dashboards to track the number of covid-19 cases and deaths in each U.S. state (The dashboards applied bubble maps with a circular radius to show the number of infected people), 2) a simulated picture of the spread of COVID-19 through the air, and 3) graph visualization, used to verify the facts of news on social media. These examples aid understanding different aspect of COVID-19 information.

In Thailand, researchers have not yet studied the data storytelling of COVID-19 virus. The researchers of communication arts studied about media exposure, awareness of COVID-19 information, media used in COVID-19, prevention campaigns and storytelling with infographic. For instance, Limsrigam, Saaithanakornkaew and Apisupachoke (2021) studied the relationship between the exposure and the perception of the information about Coronavirus 2019 through social media in Bangkok. The results showed that information exposure was positively correlated with the perception of the information from government agencies. Rungsit (2020) presents the media that used in Thailand's COVID-19 prevention campaign. Findings showed that there were various materials in campaign, such as using changed lyrics song to educate about covid19 prevention, personal media through the spokesman of Center for COVID-19 Situation Administration and the motto and symbol for the campaign etc., Maneehate and Chuathong (2020) studied health communication in COVID-19 situation of Department of Disease Control using infographic narratives. The results showed that infographic media elements in the COVID-19 situation of the Department of Disease Control, such as numeral, alphabet, text and cartoon etc., and the narration with infographic media consists of a plot, theme, symbol, and character.

Therefore, this research aimed to study data storytelling in COVID-19 pandemic and differed from the research of Dey et al. (2021) and Sakamoto et al. (2022), which is a study based on the design of data storytelling by researchers. There is also a lack of studies covering the details of data storytelling, including data storytelling types, data storytelling arc and data visualization techniques.

Methodology

Mixed methods were employed on this study. Quantitative method with content analysis was used to study data storytelling strategy (Data storytelling purpose, Data storytelling content, Data storytelling type, Data storytelling arc, Data visualization technique, and Data storytelling tool). Coding sheet is a tool for collecting data from COVID-19 Information Center Facebook Page from October 2021 to April 2022. The Facebook Page contains all COVID-19 information, including the daily press conference of the Center for COVID-19 Situation Administration. The number of posts on this Facebook page is 5,706. The posts were collected every day and had the criteria for data selection. That is, the posts must consist of three elements, including the data of COVID-19 virus, narrative, and visuals. For this reason, the Data storytelling of COVID-19 virus appears only 725 posts for collecting on the coding sheet and analyzing. Moreover, the 725 posts were sent to administrator of Facebook Fanpage to check the data storytelling purpose and the data storytelling tool. Then, the result of checking was confirmed with the finding of coding sheet. Then, qualitative method was used. In-depth interviews with administrator of Facebook Fanpage and communication officers of Information Center and Center for COVID-19 Situation Administration were conducted, for explaining the detail of data storytelling and confirming the content analysis results.

Results

General Information about Data Storytelling of COVID-19 Virus

Data storytelling of COVID-19 virus appears on the COVID-19 Information Center Facebook page for 725 posts, out of total 5,706 posts, representing 12.7 percent. Most of the data storytelling post are slideshows of the Center for COVID-19 Situation Administration on press conferences and the rest are infographics of other government agencies. The sequence of posting data storytelling started by posting a COVID-19 situation report, such as the number of infected people, cumulative confirmed cases, and cumulative deaths, COVID-19 situation report is an issue attention because it is associated with the relaxation of measures and business closure. Then, slideshows of the Center for COVID-19

Situation Administration were posted, and some slideshows were selected for the daily press conferences at approximately 11:30 a.m. which lived through radio, television, and COVID-19 Information Center Facebook page. In the final order, infographics of other government agencies were posted, the content of infographics were about government policies, measures, and vaccination campaign. Moreover, the number of data storytelling post was related with the number of infected people. When the number of infected people is high, the number of data storytelling post is high too. This means, the government wanted to communicate to the public that they can control the pandemic.

"*We must post the number of infected people in the morning before other media agencies, because we would like people to share post and trust the data from the page. Then we post the slideshows of press releases.*" (Administrator of Facebook Page, interviewee)

Data Storytelling Purpose

The audiences of data storytelling of COVID-19 virus are Thai citizens and government agencies. There are several data storytelling purposes. First, it provided the COVID-19 virus information, such as trend of infected people, trend of severe symptom, and epidemiology of the COVID-19 virus. Second, it urged people to comply with government measures through data storytelling that shows cause and effect. For instance, when people act and cooperate with government measures, the number of infected people decreases, the mortality rate declines, the public health system can accommodate patients, there are adequate bed levels for patients with severe symptoms, and the economic sector can be driven. Last, it builds confidence in the implementation of government measures. The government's message of data storytelling presented that public safety is important. Therefore, government agencies need to closely monitor the spread of COVID-19 and carefully consider various factors to relax the measures.

"*The government wants to communicate information about the COVID-19 virus so that the public can be vigilant. In the initial stages of pandemic, the epidemiology of the disease was unclear, fake news was spread, while we need to give the information on the treatment and the way to prevention from contracting COVID-19.*" (Communication officer of Information Center and Center for COVID-19 Situation Administration, interviewee)

"*Chart is also useful as it encourages people to follow government measures. It is easier to understand measure, for example, working from home helps medical worker work less hard.*" (Communication officer of Information Center and Center for COVID-19 Situation Administration, interviewee)
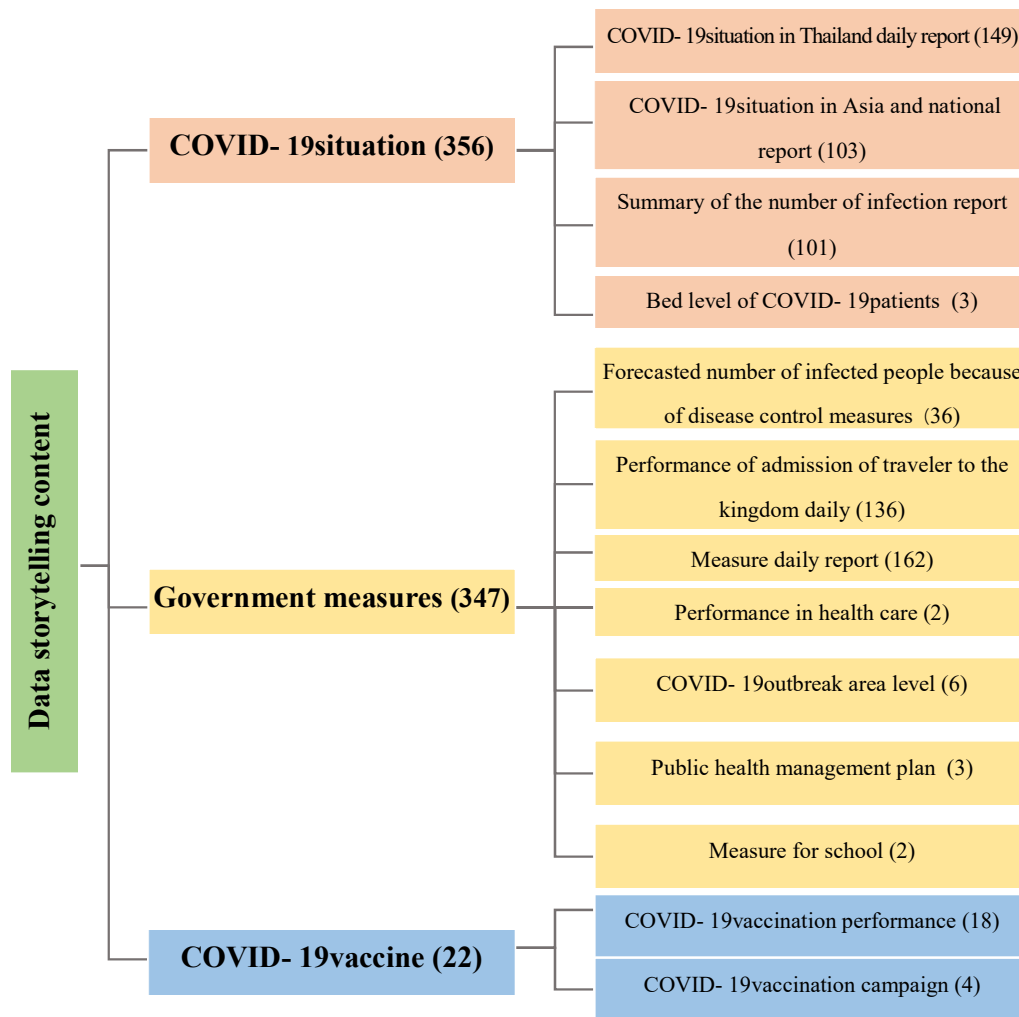
"*The data was presented on the graph, such as declining number of patients due to measures, adequate bed levels for patients, or the percentage of COVID-19 Vaccination. It helped the public to trust the state's operation.*" (Administrator of Facebook Page, interviewee)

Data Storytelling Content

Data storytelling content includes: 1) COVID-19 situation comprising the COVID-19 situation in Thailand daily report, the COVID-19 situation in Asia and national report, the summary of the number of infection report, and the bed level of COVID-19 patients, 2) Government measures, including the forecasted number of infected people because of disease control measures, performance of admission of traveler to the kingdom daily, daily report, performance in health care, COVID-19 outbreak area level, public health management plan, and measure for school, and 3) COVID-19 vaccines, including COVID-19 vaccination performance and COVID-19 vaccination campaign. The highest number of data storytelling content was COVID-19 situation. There were 356 posts, or 49.1 percent (see Figure 6).

"*There are many issues to communicate about COVID. Early in the morning, the number of infected people must be reported to inform closing areas when someone is infected, fake news that focuses on communicating people to the unvaccinated. These issues must be communicated clearly, and accurately.*" (Communication officer of Information Center and Center for COVID-19 Situation Administration, interviewee)

Figure 6 The Summary of Data Storytelling Content

		COVID- 19situation in Thailand daily report (149)
	COVID- 19situation (356)	COVID- 19situation in Asia and national report (103)
		Summary of the number of infection report (101)
		Bed level of COVID- 19patients (3)
Data storytelling content	Government measures (347)	Forecasted number of infected people because of disease control measures (36)
		Performance of admission of traveler to the kingdom daily (136)
		Measure daily report (162)
		Performance in health care (2)
		COVID- 19outbreak area level (6)
		Public health management plan (3)
		Measure for school (2)
	COVID- 19vaccine (22)	COVID- 19vaccination performance (18)
		COVID- 19vaccination campaign (4)

Note: Number in parenthesis is the number of data storytelling post.

Data Storytelling Type

COVID-19 Information Center and Center for COVID-19 Situation Administration are author-driven data story. Data storytelling type can be categorized based on data content criteria, including comparison combined with change over time, comparison, project forward, and change over time (see Tables 1 and 2). Comparison combined with change over time type showed the time changes while comparing COVID-19 data, for example, COVID-19 situation in Thailand daily reported the number of infected people, pneumonia patients, intubation patients, and dead patients that were presented from the past 14 days. This data storytelling supports to analyzing the trend of patients and compares the number of patients' type.

Comparison type explained the comparison of COVID-19 data, such as comparison of cumulative confirmed cases with cumulative deaths, comparison first dose with second dose of the vaccination, and comparisons between establishments that practice or do not comply with government measures. Project forward type found only government measures content that demonstrated the infected people in the current and forecasted the infected people in the future. Change over time type showed the COVID-19 data when the time changed. These data storytelling type related to COVID-19 situation content that presented the infected people from the past to evaluate the trend of the infected people. Moreover, comparison combined with change over time type was found the most of the data storytelling type with 338 posts, 46.6 percent.

Comparison combined with change over time type and comparison type also appeared all data storytelling content (COVID-19 situation, government measure, COVID-19 vaccine).

Table 1 Number of Posts and Percent of Data Storytelling Type

Data storytelling type	Number of posts	Percent
1) Comparison combined with change over time	338	46.6
2) Comparison	318	43.9
3) Project forward	39	5.4
4) Change over time	30	4.1

Table 2 Number of Posts Data Storytelling Type and Data Storytelling Content

Data storytelling type	Data storytelling content					
	COVID-19 situation		Government measure		COVID-19 vaccine	
	Number of posts	Percent	Number of posts	Percent	Number of posts	Percent
1) Comparison combined with change over time	101	29.9	232	68.6	5	1.5
2) Comparison	225	70.8	76	23.9	17	5.4
3) Project forward	-	-	39	100.0	-	-
4) Change over time	30	100.0	-	-	-	-

Data Storytelling Arc

Data storytelling arc is an entire data storytelling arc type which consists of four stages of storytelling. First, it is about setting provides details about the COVID-19 situation or ask open-ended questions, such as the number of infected people, the COVID-19 situation around the world, the number of ATK test results and the questioning the reasons for the need of booster vaccinations. Second, it is rising insight, a spokesperson for the Covid-19 Situation Management Center or an assistant spokesperson for the COVID-19 Situation Management Center, who provided information to support the narrative. For example, when the number of infections in the pilot provinces is likely to rise, percent of different types of medications are administered to treat patients. Third, aha moment was to tell the story so that the recipients can understand COVID-19 information. For example, the number of infected people in the pilot province is higher because of the relaxing of measures, providing different types of medications to treat patients, leading to the public health system can also provide care for patients, and getting booster vaccinations reduces the severe symptoms. Last, it is solution and next steps. This step showed the measure or policy that COVID-19 Information Center and Center for COVID-19 Situation Administration want to communicate with the public, such as asking people to refrain from traveling and campaigning for people over the age of 60 to be vaccinated.

Data Visualization Techniques

Using the Gestalt theory to tell stories with COVID-19, it was found that principles based on Gestalt theory was used (see Figures 7 to 9). Similarity principles combined with connection principle, color, and size were used to group information about the COVID-19 virus, for example, the number of infected people coming from abroad, colors and sizes were used to separate travelers from different types (test and go, sandbox, quarantine) and designed a line chart to show the linkage of daily infected people. Similarity principle, colors and sizes were applied to group data and isolate COVID-19 information, for instance, the COVID-19 situation report in

Thailand used red, green, and black to display information on new cases, recoveries, and deaths. Similarity principle combined with figure-ground principle and connection principle, for example, the results of one to four doses of COVID-19 vaccination using the similarity principle, namely color to separate the type of vaccine one to four doses, using the figure-ground principle presented through a stacked area chart that showed the cumulative number of vaccines in each dose, and using the connection principle through the line chart of one to four doses of COVID-19 vaccination during the period in the past to the present. Moreover, similarity principles combined with connection were the highest number of gestalt theory of data storytelling, with 498 posts, representing 68.7 percent (see Table 3).

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Figure 7 Similarity Principles Combined with Connection Principle to Explain the Number of Infected People Coming from Abroad
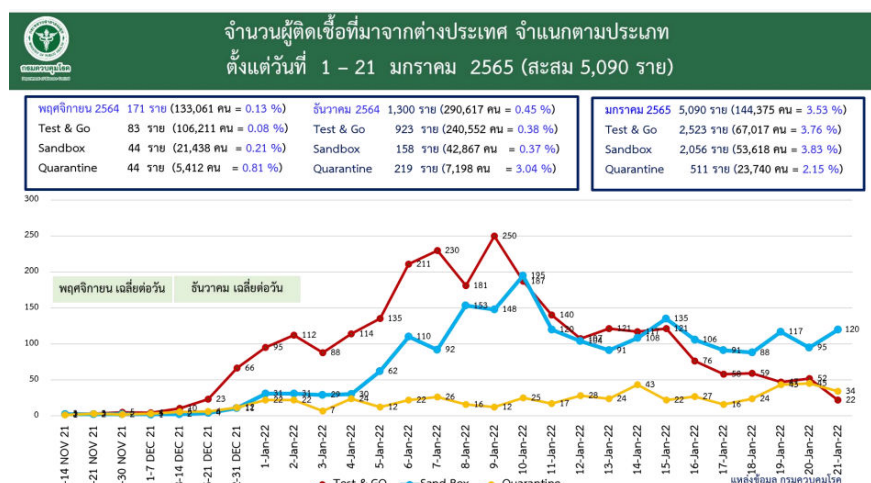
Figure 8 Similarity Principles to Explain COVID-19 Situation Report in Thailand

Figure 9 Similarity Principle Combined with Figure-Ground Principle and Connection Principle to Explain the Results of one to four Doses of COVID-19 Vaccination
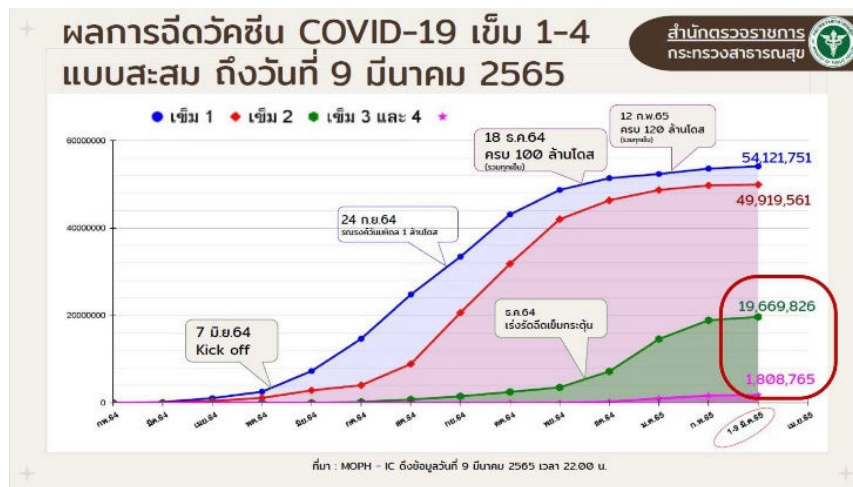

Table 3 Number of Posts Data Storytelling Type and Percent of Using Gestalt Theory

Gestalt theory	Number of posts	Percent
1) Similarity principles combined with connection principle	498	68.7
2) Similarity principle	224	30.9
3) Similarity principle combined with figure-ground principle and connection principle	3	0.4

Using charts, 14 chart types were applied, according to Table 4, of which the top three most common patterns were: line charts (249 post, 34.3 percent), text (131 posts, 18.1 percent), and bubble charts combined with table (94 posts, 13.0 percent).

Table 4 Types of Charts for Data Storytelling with COVID-19 Virus

Types of charts	Number of posts	Percent
1) Line Chart	249	34.3
2) Text	131	18.1
3) Bubble charts combined with table	94	13.0
4) Line chart combined with bar chart and Choropleth map	74	10.2
5) Pie chart	47	6.5
6) Line chart combined with bar chart and pie chart	46	6.3
7) Bar chart combined with line chart	24	3.3
8) Bar chart	16	2.2
9) Bar chart combined with pie chart	13	1.8
10) Stacked area	9	1.2
11) Choropleth map	8	1.1
12) Heat map combined with table	8	1.1
13) Heat map combined with line chart	3	0.4
14) Line chart combined with Stacked area	3	0.4

Types of charts for data storytelling in COVID-19 pandemic were for different communication objectives. For example, line charts presented the trends of infected people, pneumonia patients, and intubation patients, text shows the daily number of new cases, cumulative confirmed cases, recoveries, and deaths. This enables the public or recipients to interpret or perceive information immediately. Bubble chart was combined with a table to highlight the comparison of cumulative morbidity rates or cumulative mortality rates per one million people between Thailand and Asian countries, and choropleth maps to display the escalation of control measures in different provinces or show the number of vaccinated people in each area, etc.

Data Storytelling Tools
There were three data storytelling tools (see Table 4). First, Tableau is the most used for data storytelling with COVID-19 virus, because this software has the function of creating images or creating multiple charts and can also design many chart types to tell stories. For instance, posting proportional numbers and cumulative ATK positives in the country used a bar chart showing the number of positive ATK results and combined with line chart for showing the number of ATK positive percentages, and posting. COVID-19 cases arriving in the kingdom of Thailand used a bar chart to show the age group of infected people and a pie chart to show the number of infected people by type of travel to Thailand. Second, Adobe Illustrator was used to design the text of COVID-19 situation in Thailand daily report which presented the number of cases COVID-19, the text was designed by color and size for easy perception. Last, Microsoft Excel is a tool that used to create simple charts, such as table, bar chart, pie chart, line chart and heat map.

"Tableau is the most popular for data visualization. There are several charting features, easy to use. Data can show according to time period and the program connected to the state database. In addition, Adobe Illustrator was utilized for creating infographic of infected people and some government agencies designed simple chart by Microsoft excel." (Administrator of Facebook Page, interviewee)

Table 5 Data Storytelling Tools

Data storytelling tool	Number of posts	Percent
1) Tableau	481	66.3
2) Adobe Illustrator	131	18.1
3) Microsoft Excel	113	15.6

Discussion

The data storytelling of COVID-19 virus had storytelling sequences. The sequence of posting data storytelling started by posting a COVID-19 situation report, posting slideshows of the Center for COVID-19 Situation Administration, and posting infographic of government policies. This sequence is like the emerging infectious disease news structure, according to Sha (2018), who analyzed the SARS (Severe Acute Respiratory Syndrome) news structure from the China Daily newspaper and found that Sars mortality rates were identified first and recommendations for treatment of SARS were presented the last. Moreover, the data storytelling media include slideshows of the Center for COVID-19 Situation Administration on press conferences and infographic, which help the public to better understand the COVID-19 information. The finding is consistent with Simone et al. (2014) who studied comparing the use of infographics and newspaper articles on data storytelling with urban changes. They found that infographics can help the participant to understand urban development policies and recognize policies better than newspaper articles. In addition, Liu (2021) found that infographics were applied on news visualization of Xinhua Net news agency during COVID-19 pandemic, the infographics support audiences to have better understanding.

In-depth interview with key persons and article of Facebook posts presented that data storytelling with COVID-19 purpose includes 1) providing the COVID-19 virus information, 2) urging people to comply with government measures, and 3) building confidence in the implementation of government measures. Comparing with past research, data storytelling purposes have been found with contextual information. These include informing, persuading, entertaining, comforting, explaining, and terrorizing (Lee et al., 2015; Ojo & Heravi, 2018; Slaney, 2012), Therefore, urging people to comply, and building confidence are new findings of data storytelling purpose. Data storytelling content includes COVID-19 situation, government measures, and COVID-19 vaccines. This finding is in accordance with Kleechaya's (2019) study, which indicates that people's accessibility of health information in international spreading of emerging infection disease and their self-care from the Public Health Department of Thailand and there are many guidelines for communicating on content issues, such as providing information to raise awareness of the severity of the disease or prompting behavior modification, educating about the disease leads to understanding and proposing practical measures to keep the public safe from the disease.

Data storytelling type is author-driven stories. The COVID-19 Information Center and Center for COVID-19 Situation Administration (CCSA) is a sender who sends the COVID-19 information to public. The advantage of author-driven stories type is a linear ordering of scenes that support easy understanding of the messages. Moreover, this data storytelling type can convey heavy messages. In contrast, it does not interact with the audiences. Segel and Heer (2010) suggested that effective data storytelling should include a combination of author-driven stories and reader-driven stories and utilization of interactive media. This recommendation is consistent with Weber (2018), who explained that using interactive tools with audiences will encourage engagement and attract the attention of the audiences.

In addition, data storytelling type can be categorized based on data content criteria. This research showed that the comparison combined with change over time type and comparison type appeared in all data storytelling contents (COVID-19 situation, government measures, COVID-19 vaccines), because the characteristic of COVID-19 data is related to time changes, COVID-19 wave, and monitoring infection trends, such as comparing one to four doses of COVID-19 vaccination, comparison of the compliance or non-compliance with government measures, etc.

Data storytelling arc in COVID-19 pandemic is an entire data storytelling arc type which consists of four stages of storytelling: setting, rising insight, aha moment, and solution and next step. Dykes (2020) developed the data storytelling arc from the Freytag's pyramid arc. It is the most popular storyline that used in movies, literature, news, advertising, etc. The character drives storyline in Freytag's Pyramid arc and the data drives storyline in data storytelling arc. In addition, the data storytelling arc in COVID-19 pandemic is consistent with the

CFO (Claim or question, Fact, Conclusion) data storytelling model. This model is developed by Kosera (2017). For example, the COVID-19 formula storytelling has a storyline that begins with questioning the drug formulas used to treat covid-19 in Thailand. Next, the development of rising insight step explains the facts about the percentage of formulations that were allocated to the infected people. The allocation of the drug formulas depends on the symptoms of the infected person which makes the infected person healthy and cured. Finally, the solution and next step is concluded that the allocation of various drug formulas allows the infected person to self-medicate at home and have hospital beds adequately to accommodate the critically ill.

Data visualization technique which applied the Gestalt theory to tell stories with COVID-19, including: 1) similarity principles combined with connection principle, 2) similarity principle, and 3) similarity principle combined with figure-ground principle and connection principle. These Gestalt theories support audiences to easily understand the perception of COVID-19. Moreover, 14 types of data visualization techniques have been utilized in data storytelling of COVID-19 in which appropriate to data characteristics. However, some posts of data storytelling of COVID-19 lack of removing unnecessary noise from the chart, such as not removing gridline lines from the chart, shadows being used in bar charts, and overusing of labelling, etc. Dykes (2020) claimed that removing unnecessary noise is an important rule to help better visual storytelling. In the same way, Knaflic (2015) explained that every element used in data storytelling increases the processing burden on the recipients. Therefore, it wants to cut out unnecessary things or cut out elements that do not enrich the data. Moreover, the data storytelling tool contains Tableau, Adobe Illustrator, and Microsoft Excel, which are effective data storytelling. This finding aligned with Ojo and Heravi's (2018) study, which found that Tableau, Adobe Illustrator, Microsoft Excel were used in award winning data storytelling of digital journalism.

Conclusion

Data storytelling of COVID-19 virus is as follows. First, data storytelling of COVID-19 virus appears on the COVID-19 Information Center Facebook page for 725 posts, out of total 5,706 posts, representing 12.7 percent. The storytelling sequences started by posting a COVID-19 situation, slideshows of the Center for COVID-19 Situation and infographics of government. Second, data storytelling purposes include providing about COVID-19 information, urging the public to comply with government measures and building confidence in the implementation of government measures. The new finding of data storytelling purpose urged the public to comply and build confidence. Third, data storytelling content includes COVID-19 situation, government measures, and COVID-19 vaccines. Theses contents are appropriate and effective communication of emerging infection disease.

Fourth, data storytelling type is author-driven stories and can be categorized based on data content criteria, including comparison combined with change over time, comparison, project forward, and change over time. Data storytelling type should mix author-driven stories and reader-driven stories by using interactive media that help the public to better understanding of covid-19 information or government measures and governments can control the spread of COVID-19. Next, data storytelling arc is an entire data storytelling arc which replace the character to the data for action the storyline, and the data storytelling arc of COVID-19 is consistent with the question, fact, and conclusion. Sixth, the Gestalt theory was applied in data visualization technique to tell stories with COVID-19, including similarity principles combined with connection principle, similarity principle, and similarity principle combined with figure-ground principle and connection principle, and utilized 14 types of charts that appropriate to data characteristics. But some posts need to cut out unnecessary things or cut out elements to effective data storytelling. Last, data storytelling tool contains Tableau, Adobe Illustrator, and Microsoft Excel that support the designing of data storytelling.

Suggestions

First, the extension of this research can apply data storytelling content to evaluate the effective data storytelling by testing the perception of COVID-19 data storytelling content in the public through a questionnaire.

Second, COVID-19 Information Center and Center for COVID-19 Situation Administration should include a mixed author-driven stories and reader-driven stories by using Tableau tool that are currently in use. It can design interactive features and publish on Tableau public website or government website. The benefit of the mixed author-driven stories and reader-driven stories are helping the public to better understanding of COVID-19 information or government measures and governments can control the spread of COVID-19 epidemic.

During the last 30 to 40 years of the 20th century and continuing to the present, the need for multinational teams has grown extensively, and the trend will continue as globalization increases. Despite decades of studying and experience with cultural diversity, international work groups continue to be challenged by ethnocentrism and

prejudices. Most domestic and international workplaces include much cultural diversity, and organizational members must function in unity to be successful. There are many challenges. Martin and Nakayama (2010) list four barriers in intercultural communication: ethnocentrism, stereotypes, prejudice and discrimination. According to Marquardt and Horvarth (2001), five typical challenges for international teamwork include managing cultural diversity, differences, and conflicts, handling geographic distances and dispersion of team members, dealing with coordination and control issues, maintaining communication richness, and developing and maintaining team cohesiveness. This study argues that communication richness extends well beyond just simple translations and multiple or redundant channels, into various communication styles such as high- and low-context (direct vs. indirect), and encompass relationship development, face-saving, and power dynamics. Thus, there is critical demand for increased intercultural competence for industry practitioners. The specific purpose of this study is to examine how high- and low-context communication styles are manifest in international teamwork dynamics.

References

Biswas, M., & Sipes, C. (2020). DataViz and data storytelling education in journalism and communication programs. *Teaching Journalism & Mass Communication, 10*(2), 28-41.

Comba J. L. (2020). Data visualization for the understanding of COVID-19. *Computing in Science & Engineering, 22*(6), 81-86.

Dey, S. K., Rahman, M. M., Siddiqi, U. R., Howlader, A., & Tushar, A. (2021). Analyzing the Global impact of COVID-19 Vaccination progress: A result-oriented storytelling approach. *medRxiv*. https://doi.org/10.1101/2021.03.26.21254432

Dykes, B. (2020). *Effective data storytelling: How to drive change with data, narrative and visuals*. Hoboken, NJ: John Wiley & Sons.

Kleechaya, P. (2019). People's Accessibility of health information in international spreading of emergimg infection disease and their self-care. *Journal of Communication Arts Review, 23*(1), 29-44.

Knaflic, C. N. (2015). *Storytelling with data: A data visualization guide for business professionals.* Hobokenn, NJ: John Wiley & Sons.

Kosera, R. (2017). *An argument structure for data stories*. Paper presented at the Eurographics Conference on Visualization. https://diglib.eg.org/bitstream/handle/10.2312/eurovisshort20171129/031-035.pdf

Lee, B., Nathalie, H. R., Petra, I., & Sheelagh, C. (2015). More than telling a story: Transforming data into vissually shared stories. *IEEE Computer Graphics and Applications, 35*(5), 84-90.

Limsrigam, P., Saaithanakornkaew, S. & Apisupachoke, W. (2021). Information perception concerning novel CORONAVIRUS (COVID-19) through social media on the attitudes and preventive behaviors of citizens in Bangkok. *Journal of MCU Nakhondhat 8*(9), 18-33.

Liu, J. (2021). *Visualization of data journalism of China's mainstream media in public health emergences: Taking the data news section of Xinhua Net as an example.* Paper presented at the 5th International Conference on Machine Vision and Information Technology. https://doi.org/10.1088/1742-6596/1880/1/012038

Maneehaet, S., & Chuathong. s. (2020). Health communication in COVID-19 situation of Department of Disease Control using infographic narratives. *Journal of Mass Communication, 8*(2), 91-119.

Ojo, A., & Heravi, B. (2018). Patterns in award winning data storytelling *Digital Journalism, 6*(6), 693-718.

Order of the Prime Minister No. 72/2020, (2020). E*stablishment of the COVID-19 Information Center.*

Order of the Prime Minister No. 72/2020, (2020). *Establishment of the Center for COVID-19 Situation Administration (CCSA)*.

Rungsit, K. (2020). Media used by government sector in the COVID-19 epicdemic prevention campaign in Thailand. J*ournal of Mass Communication Technology, RMUTP, 5*(2), 77-86.

Sakamoto, Y., Sallam, S., Salo, S., Leboe-McGowan, J., & Irani, P. (2022). Persuasive data storytelling with a data video during Covid-19 infodemic: Affective pathway to influence the users' perception about contact tracing apps in less than 6 minutes. *2022 IEEE 15th Pacific Visualization Symposium*, 176-180.

Segel, E., & Heer, J. (2010). Narrative visualization: Telling stories with data. *IEEE transactions on visualization and computer graphics, 16*(6), 1067-1073.

Sha. (2018). An analysis of SARS news reports in China Daily. *Journal of Social Academic, 11*(2), 218-222.

Sheridan, S. (2021). *The basics of data storytelling*. Laramie, WY: University of Wyoming.

Simone, F. D., Presta, R., & Protti, F. (2014). *Evaluating data storytelling strategy: A case study on urban changes* Paper presented at the The 6th International Conference on Advanced Cognitive Technologies and Applications.

Slaney, M. (2012). Tell me a Story. *IEEE Computer* 4-6.

Thai Graphic Designer Association (2022). *The infographic problem of CCSA.* Retrieved from https://www.sanook.com/news/8415410/

Vora, S. (2019). *The power of data storytelling*. New Delhi, India: Sage.

Weber, W. (2018). Data stories. Rethinking journalistics storytelling in the context of data journalism *Studies in Commonication Sciences 18*(1), 191-206.

World Health Organization. (2020). *Managing the COVID-19 infodemic: Promoting healthy behaviours and mitigating the harm from misinformation and disinformation*. Retrieved from https://www.who.int/news/item/

Zhao, Y., Blount, T., Koesten, L., & Simperl, E. (2019). *Structured and uncertainty-aware data storytelling*. Paper presented at the CHI '19 Workshop on HCI for Accurate, Impartial and Transparent Journalism: Challenges and Solutions.