Approaches to Data Visualization in Technical Communication Research: A Systematic Literature Review

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***Abstract* – This paper is a systematic literature review that examines approaches to data visualization suggested in technical communication research. The review is composed of 23 peer-reviewed research articles published between 2018–2022 in the journals IEEE, JBTC, TC, and TCQ that are used to identify the best practices for designing understandable, effective, and efficient visuals. The research findings suggest that the best approaches to data visualizations in technical communication are clear and ethical data and designs, consideration of graph type and components, a focus on accessibility and interactivity, and the use of aesthetic design, as well as tools like Gantt charts, GIMP, Privacy Rating, and WAVE. The paper concludes with a list of 5 recommendations for technical communicators to create effective and engaging data visualizations.**

Keywords–Data visualization, technical communication

I. INTRODUCTION

Data visualizations–charts, graphs, or other visuals used to represent or convey information–can be complex and difficult to understand. It is the job of technical communicators to make data visualizations understandable to an audience, allowing the audience to interpret the data accurately. Barriers to accurate data interpretation include unclear or misleading data visualizations, ineffective or confusing visualization tools or practices, and inaccessible visualizations. This paper is a systematic literature review of 23 peer-reviewed articles regarding the approaches to data visualization recommended by technical communication researchers. This paper discovers best data visualization practices in terms of suggested techniques, tools, and trends.

My research questions are:

1. What approaches to data visualization are recommended by technical communication researchers?
2. What data visualization techniques and tools increase the efficacy of data visualizations?
3. What overall trends in data visualization in technical communication does the literature suggest?

This paper summarizes current research via a literature review, exploring approaches to data visualization in technical communication and describing practical strategies such as techniques and tools for effective and efficient data visualization design. My research seeks to understand what approaches to data visualizations in technical communication are suggested by technical communication researchers, what techniques and tools make data visualizations effective and efficient for users, and what overall trends in data visualization can be identified in current research.

Principal findings of this paper suggest that the best approaches to data visualization in technical communication are to design ethically [1–11], to carefully consider graph type and graph components when designing a visual [12–13], to create accessible [14], interactive designs [15–17], and to design aesthetically [18–21]. The literature recommends using tools such as Gantt charts, GIMP, Privacy Rating, and WAVE to create data visualizations [22, 15, 23, 14].

II. METHODS

To research approaches to data visualization in technical communication, I conducted a systematic literature review, identifying significant findings and trends from 23 peer-reviewed articles to determine predominant techniques and tools for visualizing data in technical communication documents.

Data Collection

To collect the data set, I examined articles published between 2018–2023 in order to discover modern patterns while remaining practically feasible within the time constraints of the project. These articles were selected from four major technical communication journals: IEEE, Transactions of Professional Communication (IEEE), the Journal of Business and Technical Communication (JBTC), Technical Communication (TC), and Technical Communication Quarterly (TCQ) using the keyword *data visualization.* These journals were chosen because, as pointed out by other researchers such as Boettger and Lam [24], Smith [25], and Melonçon and St.Amant [26], IEEE, JBTC, TC, and TCQ are representative of technical writing as a field due to their longevity and credibility. Although technical communication research is published in other well-recognized journals, the time parameters of this study confined the review to four journals. In total, this systematic literature review discusses 23 articles; 5 from IEEE, 9 from JBTC, 4 from TC, and 5 from TCQ.

Journal	Total results	After filters	After analysis
IEEE	27	12	5
JBTC	75	27	9
TC	120	7	4
TCQ	116	38	5
Sum	**338**	**84**	**23**

Table 1. Total number of articles in each journal at each stage of the article selection process. *Note:* IEEE = *IEEE, Transactions of Professional Communication,* JBTC = *Journal of Business and Technical Communication,* TC = *Technical Communication, and* TCQ = *Technical Communication Quarterly.*

Inclusion criteria:

- The document must be a peer-reviewed research paper
- The article must be from IEEE, Transactions of Professional Communication, the Journal of Business and Technical Communication, Technical Communication, or Technical Communication Quarterly
- The article must be published between 2018–2023
- The article must be discoverable via the keyword “data visualization”

Exclusion criteria:

- The document is an editorial article, book review, book, or poster
- The article is not available in English
- The article does not discuss approaches to data visualization

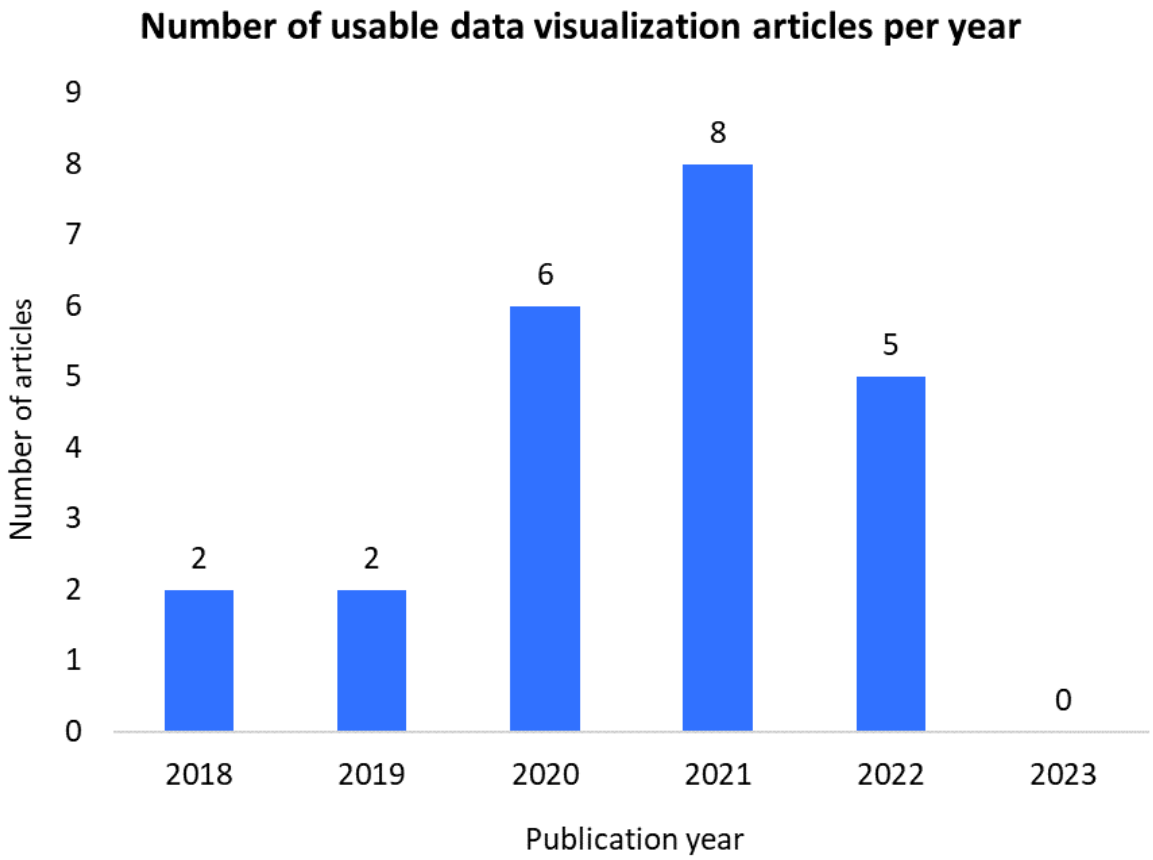

Figure 1. Number of articles used in this literature review by publication year.

Categories of Data Visualizations

The approaches to data visualization described by the articles studied in this review fall in at least one of two categories: techniques and tools. The category of techniques refers to the processes, or techniques, that can be used to create data visualizations and includes sources 1–21. Techniques can be sorted into five categories: 1) ethical

design, which can be further subcategorized into subject misrepresentation [1–6], realism [7], and contextual data [8–11], 2) individual data visualization components [12–13], 3) accessibility [14], 4) interactivity [15–17], and 5) aesthetic design [18–21]. The category of tools refers to programs, databases, or other devices that can be used to create data visualizations, and includes sources 14, 15, 22, and 23. For the purpose of this paper, articles that are categorized as "tools" are not also categorized as "techniques" when the suggested technique is to use the described tool.

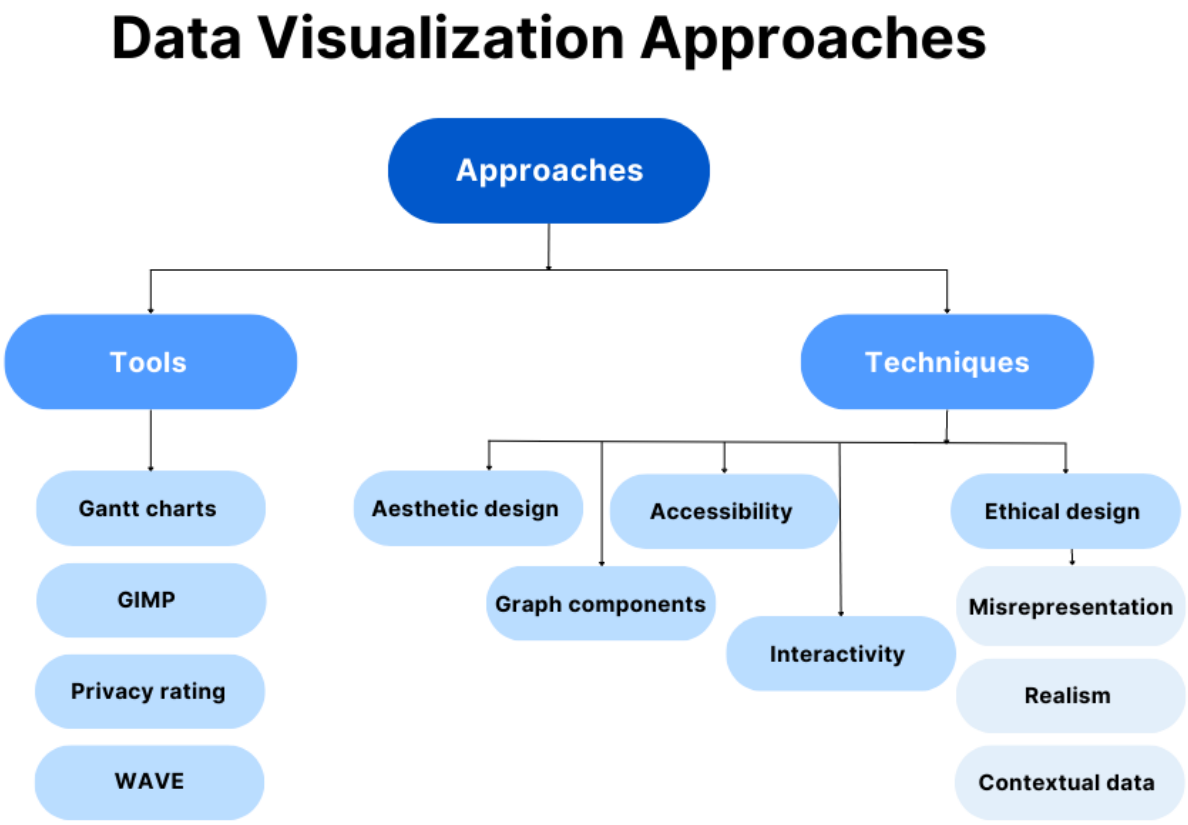

Figure 2. Data visualization approaches listed category and subcategory.

III. RESULTS

Principal findings of this systematic literature review indicate that ethical design, graph component selection, accessible design, interactive design, and aesthetic design are the best approaches to use when designing data visualizations for technical communication documents. Tools that can be used for effective data visualization include Gantt charts, GIMP, Privacy Rating, and WAVE. The results are described in depth on the following pages.

Techniques

The techniques recommended by technical communication researchers in this review can be classified into five subcategories: 1) ethical design, which can be further subcategorized into subject misrepresentation [1–6], realism [7], and contextual data [8–11], 2) individual data visualization components [12, 13], 3) accessibility [14], 4) interactivity [15–17], and 5) aesthetic design [18–21].

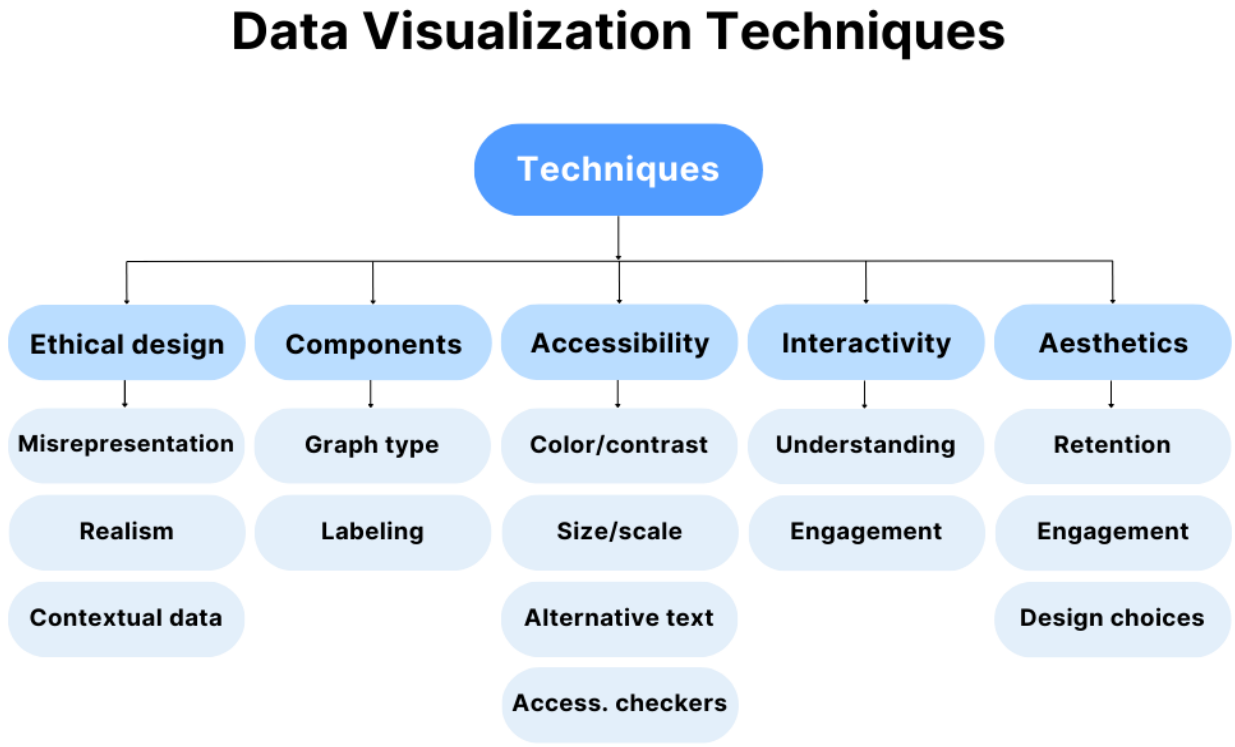

Figure 3. Data visualization techniques and key points.

Ethical Design: Subject Misrepresentation in Data Visualizations

In order to design data visualizations ethically, technical communicators must authentically represent the subject in order to avoid misinformation by misrepresentation. One example of this is Welhausen's research, which questioned why individuals addicted to crack are considered criminals while individuals addicted to opioids are considered patients, finding that the graphics used to visualize the crack and opioid epidemics influenced the perceived threat of the drugs [1]. Scripto-visual rhetoric, such as genre and topic choice, was used to "reinforce the dominant media narratives that positioned crack addiction as a crime but opioid addiction as a public health issue" [1]. Welhausen found that by using bar graphs to emphasize the increasing crime associated with the crack epidemic and line graphs to emphasize the increasing mortality of the opioid epidemic, public opinion was influenced to view crack as criminal and opioids as tragic [1]. Welhausen argues for the need for a heuristic framework to avoid promoting inequalities in data visualizations and proposes the following questions: What identity markers are represented in the dataset, and which are included in the specific variables that will be visualized? What relationships will be shown, and how do those relationships position the subject matter? How can scripto-visual rhetorical choices empower or hurt certain groups? [1]. The choices technical communicators make about what data to visualize and how to visualize it have strong influence on the perception of the subject and must be decided ethically.

Similarly, Li found that ineffective data visualization can create misconceptions of the subject matter by studying the ways in which Chinese immigrants were alienated and racialized in 19th

and 20th century data visualizations [2]. Data visualization can be used to create or support an us/them mentality via strategies such as the selection, classification, and grouping of data, graph type, and color choices [2]. Warping data to tell a specific story is unethical and compromises the data.

Because there are always multiple statistically-supported stories available from the same set of data, "storytelling with data" as a concept coined by Knaflic doesn't fully address the idea that technical communicators need to understand storytelling as malleable and select the story that they choose to tell with significance, according to Danner [3]. In addition, data stories can change based on factors such as the gathering and visualizing of data, the contextualizing and deploying of that data for persuasive purposes, and the technical and organizational demands that impact how and what story can be told [3].

COVID-19 proved to be a potent source for misrepresentation in data visualizations. Using the example of COVID-19, Amidon et al argue that visual risk literacy supports the public's understanding of information and that certain steps must be taken to support visual risk literacy when designing visuals for the general public, such as creating multiple visual metaphors rather than a singular representation, revealing socioeconomic disparities in local contexts, and "confronting the misuse and misrepresentation of visuals by policymakers" and others [4]. Doan argues that the media shared misleading data visualizations relating to COVID-19 by displaying inadequate data, manipulating scales and visual distance, and omitting contextual labels [5]. By placing a pie chart depicting individuals with the flu and next to a pie chart depicting COVID-19 deaths, these deaths are trivialized–a more accurate representation would be either visuals representing COVID-19 and flu infections or COVID-19 and flu deaths [5]. Techniques such as starting the y-axis of a graph at a value other than zero, which Doan discovered FOX 31 did on their "New Cases Per Day" 2020 COVID-19 line graph, which began the y-axis at a value of 30 and represented 33 new cases, warp the visual presentation and perception of data, trivializing the seriousness and infectiousness of the disease [5]. To create ethical visualizations, consider the implications of proximity, avoid minimizing nonfatal instances of disease, create clear and standard axes, and explain visuals via titles, labels, sources, and explanations [5]. Verhulsdonck and Shah discovered that actionable metrics in COVID-19 data dashboards were used to inspire actions in stakeholders by modeling potential outcomes via future projection [6]. Their findings were threefold: 1) "lean data dashboards can help technical communicators consider new dynamic dimensions of 'live' dashboards in order to emphasize data traceability and accessibility (and hence auditability) for stakeholders, 2) actionable metrics can introduce technical communicators to lean principles in their practices, and 3) the use of open and dynamic data dashboards with different stakeholders, such as in the case of COVID-19, raises questions of ethics and transparency" [6].

For example, compare Figures 4 and 5 on the following page. Figure 4 authentically depicts the number of usable articles at each stage of the selection process for this literature review: 338 total results narrows to 84 articles after filters are applied which narrows to 23 articles after analysis. However, Figure 5 begins the y-axis at 23, which erases the "After analysis" bar from the chart entirely–unethically and incorrectly communicating that this literature review includes 0 articles–an interpretation which is further supported by the lack of data labels in Figure 5.

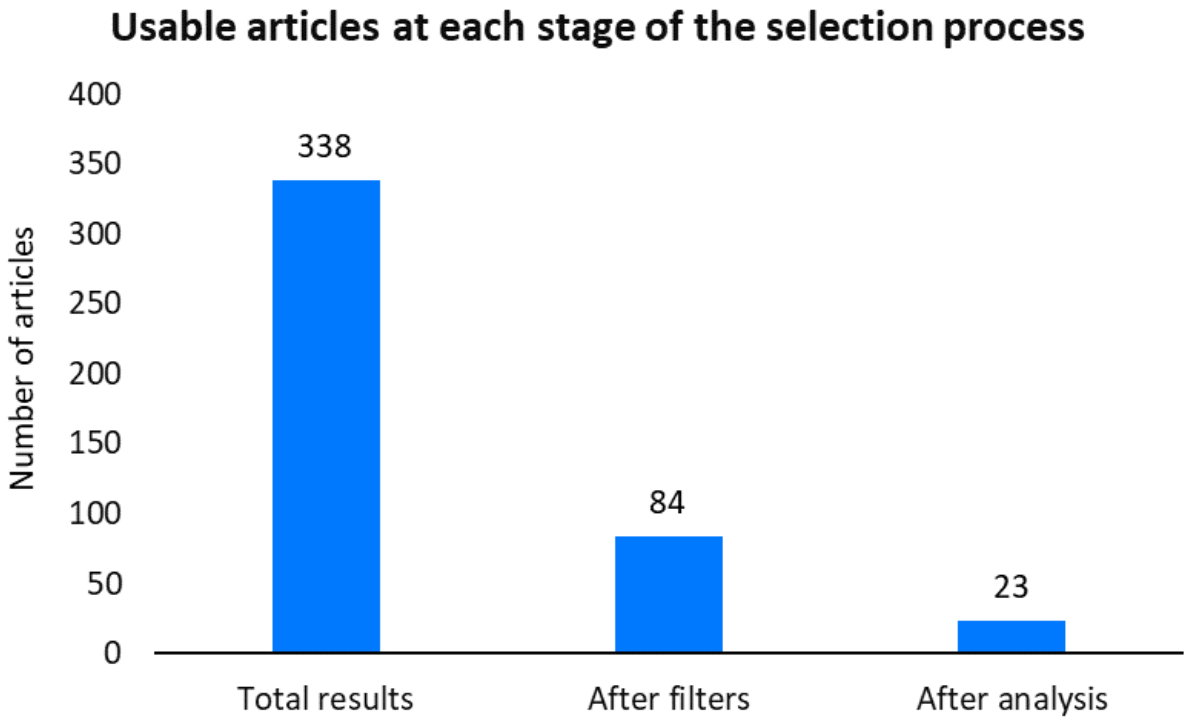

Figure 4. Usable articles at each stage of the article selection process.

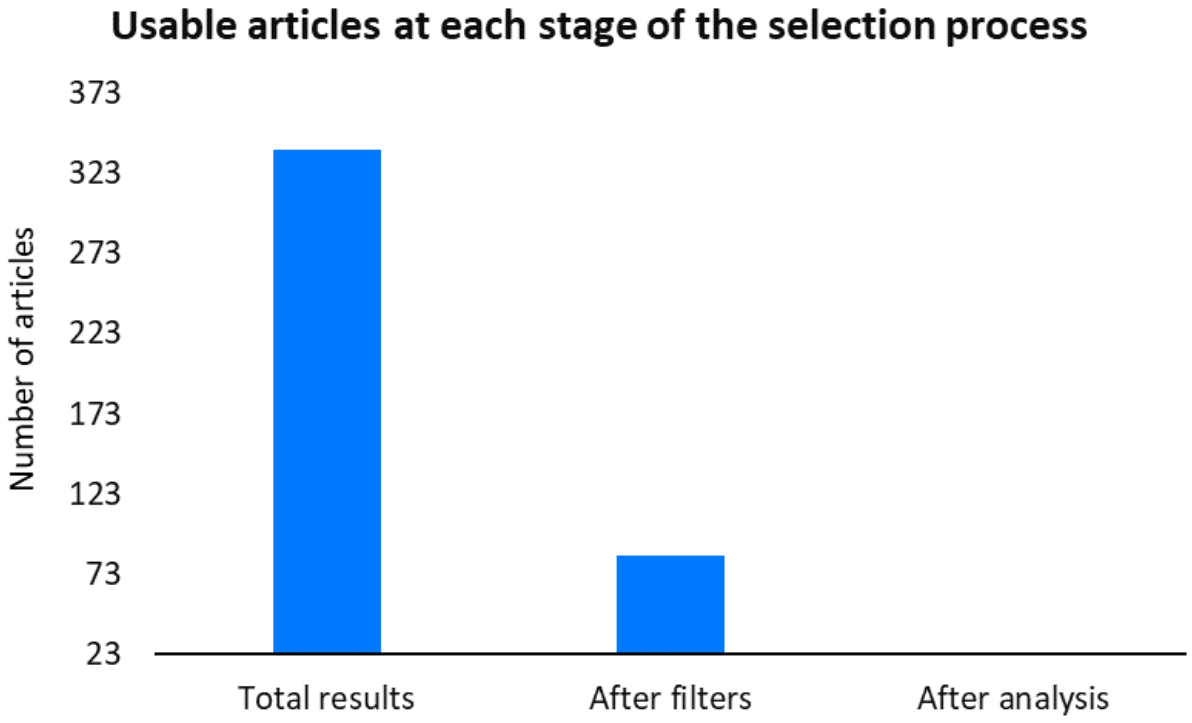

Figure 5. Unethical visualization of usable articles at each stage of the article selection process.

Ethical Design: Realism in Data Visualizations

Another ethical consideration in data visualization is the use of realism. A study by Richards and Jacobson suggests that while realism in data visualization can increase understanding, it can also have negative mental and psychological effects on the audience, especially on individuals who have personally experienced the subject that the data represents; in the case of their research, flooding [7]. Although Richards and Jacobson do not present concrete findings, they suggest that the negative effects of realism include individuals distrusting the data, making negative interpretations of the data due to negative experiences and a lack of understanding, and having a negative overall reaction by individuals who have experienced the subject that the data visualization is about [7].

Ethical Design: Context in Data Visualizations

Context is an essential ethical component to data visualization. Yet another reason COVID-19 was so misunderstood and misrepresented was due to misleading data visualization, created by a lack of contextual understanding and information [8]. For example, some early-pandemic COVID-19 charts required a verbal explanation for complete understanding despite often being presented without one; the charts should have been comprehensible by viewing alone [8]. Lindgren argues that professional communicators should incorporate more contextual information (continuing the COVID-19 example, contextual information could include explaining the difference between cases and confirmed cases) in data visualizations to avoid misleading charts [8]. Similarly, Atherton found that COVID-19 disproportionately impacted Black people, but race data in the "missing/ unspecified" category skewed the perception, creating disconnects between reported datasets and data visualizations [9]. Atherton suggests that technical communicators create accurate and ethical data visualizations by balancing simplicity with context, considering what questions can and cannot be answered within the visual [9]. Being aware of the context surrounding an issue such as COVID-19 is necessary to understand the data visualizations surrounding it [9]. Another example of the importance of context in understanding COVID-19 is that of how data visualizations portrayed health information in rural communities, researched by Carlson et al [10]. These data visualizations can draw attention to health concerns but can also make some of the most vulnerable community members invisible in the data [10]. Technical communicators should “call attention to the underrepresented concerns of rural communities and support rural community members who are multiply marginalized and thus especially vulnerable in times of crisis” by contextualizing data visualizations regarding public health [10].

In addition to presenting some amount of context surrounding specific data visualizations to users, technical communicators must understand the context around data visualizations generally in order to avoid unknowingly perpetuating stereotypes or other negative assumptions [11]. For example, Olman suggests that infographics are historically racist and were used to oppress and marginalize groups, such as justifying redlining [11]. W.E.B. Du Bois began to decolonize infographics; modern technical communicators can continue that decolonization via topological analysis, which suggests that infographics should be understood within a colonial context, regardless of the intentions of the creators, that a balance between synoptic and analytic views must be struck when redesigning infographics, and that collaboration with oppressed communities is highly encouraged [11]. Infographics are necessarily generalized, but must not be generalized in such a way to deliberately support an oppressive or discriminatory group [11].

Individual Data Visualization Components

The individual components to data visualizations– such as graph type, shape, titles, and axes–play a significant role in understanding the visual.

Different graph types present the same data in different ways, impacting audience understanding and perception [1, 2]. Accurately and clearly labeling axes, titles, and other graph components is crucial to creating an understandable design [5]. Previous coursework or other forms of familiarity positively impact data visualization understanding [12]. Lauer and O'Brien found that across four graph types (bar, line, bubble, and pie), misleading titles were a consistent but minor influence on graph understandability and that the easiest graph to read overall was the bar graph, followed by pie, then line, and, in "a distant fourth place," the bubble graph [12]. A larger influence was "eye candy" effects such as beveling and beginning the y axis at anything other than 0, both of which negatively impact user understanding [12]. Lauer and O'Brien analyzed deceptive and non-deceptive titles on deceptive and non-deceptive graphs to determine how people were influenced [12].

Similarly, Meng researched visual signaling in data visualizations, finding that visual signaling significantly positively affects task accuracy and that visual signaling directs user attention [13]. Although his research focuses primarily on screenshots, it is heavily applicable to data visualization; tiles, labels, and other individual components of data visualizations guide the user's eyes and can influence understanding [13]. Task accuracy was significantly improved with visual signaling; participants looked more often and longer at the visually-signaled items [13].

Compare Figure 1 on page 3 with Figure 6, below. While both graphs theoretically provide the same information, Figure 6 includes a vague title and legend; it is difficult to understand what the graph is attempting to communicate without prior information. Visually, Figure 6 signals to the audience to look at the pie chart first due its comparatively large size and vibrant color to the rest of the visualization; in Figure 1, the title and line graph are signaled (one with bold text and one with color), providing the audience with not only data but also context. Figure 1 also provides clarity regarding what the data is about–that is, the year in which articles used in this literature review were published–and includes clear labels of all graph components to improve audience comprehension.

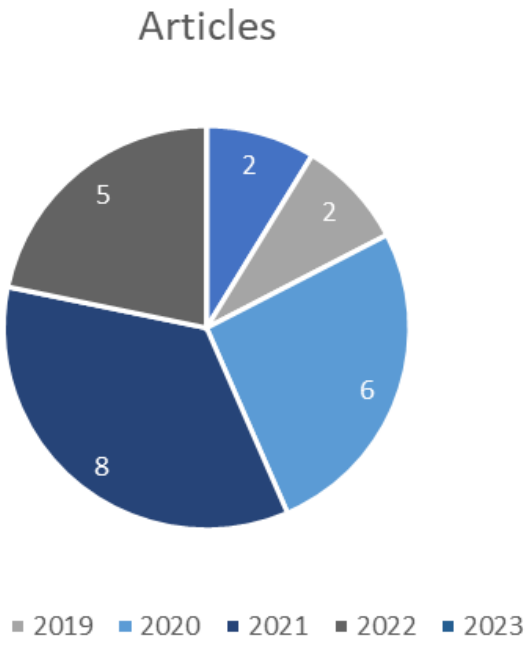

Figure 6. Poorly formatted visual of the number of articles used in this review by publication year.

Accessibility

The importance of accessibility in data visualization cannot be understated; information without effective communication is useless. Accessibility in data visualization can include "visual acuity, color/contrast difficulties, color blindness, and size/scale issues" [14]. Because data visualizations are both textual and graphical, it can be difficult to meet accessibility criteria. To create accessible data visualizations, Strantz suggests a three-part approach: first, to design the visual by using whitespace, creating contrast, maintaining size/scale, and clearly labeling data visualizations; second, create the visual by following accessibility web standards for color, contrast, resize text, alt text, and more; third, to test the visual for accessibility using tools like WAVE or screen readers [14].

Interactivity

Researchers Meister et al developed a 3D AR thunderstorm life cycle visualization in order to determine if an interactive data visualization would impact users' knowledge of thunderstorms [15]. They found that user knowledge was increased after using the visualization due to the visual's animation and interactivity, which suggests that interactive data visualizations promote audience engagement and learning [15]. Meister et al acknowledge that 3D visualizations are significantly more time-consuming and challenging to create than 2D visualizations [15].

Richards also found that interactive data visualization boosts efficacy and efficiency in audience understanding [16]. Interactive risk visualizations are symbolic and increase audience understanding of the subject matter [16]. Effective interactive risk visualizations should include persuasion, localization, design choices, and representation [16].

In addition, Passera discovered that the use of any data visualization is more interactive and engaging than exclusively prose; audience understanding is increased by incorporating diagrams into text [17]. Government documents specifically are often challenging to interact with, but by including diagrams such as flowcharts, swimlanes, and timelines, they can be more effectively communicative [17].

Aesthetic Design

Another approach to data visualizations is to enhance the aesthetic design of the visual. As Hardesty and Hollinger discovered, visual literacy, or "an awareness of the rhetorical situation connected to visuals, how to communicate with visuals, and how to represent visuals;" that is, the ability of technical communicators to understand and use aesthetics to their advantage, is key [18]. Effective and memorable data visualizations utilize beauty and aesthetic appeal and beautiful data visualizations are more memorable, meaningful, and usable [18]. Drawings, storyboards, and other design elements such as typography, color theory, alignment, image placement, and proximity make data visualizations aesthetically-pleasing [18]. Technical communication students should be supported in their search for beauty and creativity in data [18].

Kostelnik argues that aesthetic appeal in data visualization has other benefits as well, including "engaging audience interest, enhancing clarity and persuasiveness, arousing emotion, and strengthening credibility by meeting audience expectations for effective design" [19]. Kostelnik suggests implementing the four following techniques in the design process: 1) parallelism, which can be found in graphical components like bullets or borders as well as many other places, 2) balance, such as the distribution of elements across a page, 3) color, which enhances usability and persuasion because "pure, bright hues (not flattened with grayscale) evoke beauty, as do colors that are blended harmoniously," and 4) fine descriptive details, such as delicate lines or realistic drawings, which enhance the visual [19]. Kostelnik also discovered that users found "smooth and subtly curving forms (like circles) attractive" and that individuals enjoy

looking at aesthetically-pleasing charts more and retain more information from aesthetically-pleasing visualizations [19]. However, beautifying techniques must not be used at the expense of the data or understandability of the data [19]. Kostelnik discusses "information aesthetics," a term he uses to refer to the general field of designing information or data in an aesthetically-pleasing way, and writes that beautifying data heightens its effectiveness and impact [19].

Data that is poorly designed, with a too-small focus on aesthetics, and data that is compromised by a too-large emphasis on aesthetics are both ineffective forms of communication [18–20]. Kungl et al. suggest that technical writing and the fine arts need to combine together to create effective artifacts and data visualizations [20]. Black and white visuals evoke timelessness while color can be engaging to an audience; illustrations are a great way to conceptualize difficult subject matter for an audience or user [20].

W.E.B. Du Bois is an early leader of effectively using aesthetics to convey a message in addition to data and text in infographics; his artistic designs made his infographics stand out [21]. As Winkle writes, "it might be wise to actually defy convention, to include the unfamiliar, to ignore the data-ink ratio, and perhaps even strive for an artistic, decorous quality if it helps the work get seen and increases the possibility of interocularity for the intended message" [21]. Effective data visualizations deliver a message quickly and clearly; good data and good data research are needed for persuasive data visualization [21]. Creativity and artistry benefit data visualizations and help prevent visualizations from depriving their subjects of their humanity [21].

For example, compare Table 1 on page 2 with Table 2, below. Although both tables include the same information in the same cells, Table 1 applies aesthetic design techniques to the design, including color, placement, and whitespace, unlike Table 2. Table 1 is more visually engaging and memorable than Table 2, making it the more effective visual.

Journal	Total results	After filters	After analysis
IEEE	27	12	5
JBTC	75	27	9
TC	120	7	4
TCQ	116	38	5
Sum	338	84	23

Table 2. Unformatted visual of the total number of articles in each journal at each stage of the article selection process. *Note:* IEEE = *IEEE, Transactions of Professional Communication,* JBTC = *Journal of Business and Technical Communication,* TC = *Technical Communication, and* TCQ = *Technical Communication Quarterly.*

Tools

The unique tools technical communicators can use to improve and create data visualizations that were discussed in this literature review included Gantt charts, GIMP, Privacy Rating, and WAVE, described briefly in the table below. Although this is not nearly a comprehensive list of the tools technical communicators use to create data visualizations, these tools were all that were discussed within the search parameters of this systematic literature review.

Data Visualization Tools

Tool	Use	Source
Gantt charts	Gantt charts are used for project management and tracking and analyzing data. Gantt charts suggest "managerial values of certainty and simplicity" and cannot always accurately portray data or context.	22
GIMP	GNU Image Manipulation Program (GIMP) is an open source image editor created by The GIMP Team. It is free and used to create or edit data visualizations.	15
Privacy Rating	Privacy Rating is “a tool for mapping and visualizing the privacy of online services” designed by Barth et al. It had a significant positive effect on user trust and users reported that they would support the standardization of the tool.	23
WAVE	WAVE is AIM’s suite of web accessibility evaluation tools, used to “check data visualizations for accessibility before making the material public."	14

Figure 7. Data visualization tools, uses, and source.

IV. DISCUSSION

Effective visualization increases understanding. Approaches to data visualization in technical communication include ethical design (which itself includes considerations around subject representation, realism, and contextual data), the correct selection of individual graph components, accessible design, interactive design, and aesthetic design. Suggested tools include GIMP, WAVE, Gantt charts, and Privacy Rating. A brief summary of each article, its research focus, and its journal source is found on the following page.

Source	Journal	Research focus	One-sentence summary
1	IEEE	Ethical design: Misrepresentation	Public impact of data visualizations on the crack and opioid epidemics.
2	TCQ	Ethical design: Misrepresentation	Use of data visualizations to alienate and racialize Chinese immigrants.
3	TCQ	Ethical design: Misrepresentation	Ethical concerns around choosing which story to tell with given data.
4	JBTC	Ethical design: Misrepresentation	Public impact of visual risk literacy on data comprehension.
5	JBTC	Ethical design: Misrepresentation	Data manipulation tactics used in COVID-19 data visualizations.
6	JBTC	Ethical design: Misrepresentation	Actionable metrics used in COVID-19 data dashboards.
7	TCQ	Ethical design: Realism	Ethical concerns regarding realism in data visualizations.
8	JBTC	Ethical design: Contextual data	Misrepresentation of COVID-19 in data visualizations.
9	JBTC	Ethical design: Contextual data	Misleading data visualizations regarding COVID-19.
10	JBTC	Ethical design: Contextual data	Context in data visualizations aid user comprehension.
11	JBTC	Ethical design: Contextual data	Historical racism regarding infographics.
12	IEEE	Data visualization components	Impact of individual data visualization components on user comprehension.
13	TC	Data visualization components	Visual signaling positively impacts task accuracy.
14	IEEE	Accessibility	Best accessibility practices in data visualizations.
15	IEEE	Interactivity	Animation and interactivity increase the understandability of data visuals.
16	JBTC	Interactivity	Interactivity makes data more

			effective and efficient to users.
17	JBTC	Interactivity	User comprehension is increased with the use of diagrams.
18	TC	Aesthetic design	Aesthetically-pleasing content increases content efficacy.
19	TC	Aesthetic design	Aesthetic conventions should be used in the technical design process.
20	TC	Aesthetic design	Effective artifacts rely on technical writing and the fine arts together.
21	TCQ	Aesthetic design	Creativity and artistry in data increase the efficacy and persuasiveness of it.
22	TCQ	Tools	Gantt charts suggest certainty and simplicity rather than contextual data.
23	IEEE	Tools	Privacy Rating increased user trust in online services.

Table 3. One-sentence article summary including source number, journal, and research focus. *Note:* IEEE = *IEEE, Transactions of Professional Communication,* JBTC = *Journal of Business and Technical Communication,* TC = *Technical Communication, and* TCQ = *Technical Communication Quarterly.*

Trends

The most prevalent trend in modern data visualization in technical communication research is a push to design ethically [1–11]. Subject representation and contextual data were identified as often overlooked or intentionally disregarded ethical considerations, although the use of realism as an ethical factor was also discussed. Misrepresenting the subject(s) of the data visualizations is incredibly harmful, both to the subject(s) and to the user, who is disadvantaged by an inaccurate understanding of the data [1–7]. A lack of context makes data easy to misinterpret or misunderstand [8–11].

In addition, aesthetic design has become an increasingly popular approach to modern data visualization practices. More than making data visualizations look pretty, aesthetic design provides benefits to user retention, engagement, usability, and persuasion [18–21]. Creating aesthetically-pleasing designs is therefore not only a matter of looks but also a matter of substance.

Finally, another trend discovered from this literature review was the use of COVID-19 as an example, which occurred in 6 of 23 sources, or slightly more often than in 1 out of every 4 sources [4–6, 8–10]. Although there are many possible and even likely theories for this regularity, such as the worldwide impact of COVID-19 and its fundamental changes and challenges to pre-pandemic life and research, I would argue that COVID-19 is a popular example in the field of data visualization because COVID-19 was grossly misrepresented in early visuals due to the politicization of the disease. The only other repeated data visualization example in the literature was that of W.E.B. Du Bois' infographics, which were praised by both Olman and Winkle [11, 21].

Further Research

Future researchers should consider using other respected journals of technical communication research such as the Journal of Technical Writing and Communication (JTWC) in addition to IEEE, JBTC, TC, and TCQ. In addition, this literature review discussed only 4 tools for data visualizations; this is likely because this paper reviews technical communication research rather than technical communication professional practice. Future researchers should seek to describe a wider variety of data visualization tools.

Best Practices for Technical Communicators

Based on this systematic literature review, the following approaches are recommended for technical communicators designing data visualizations:

1. Outline ethical parameters for the dataset and intended data visualization. Avoid misrepresentation of the subject, disturbing realism, or a lack of context in the data.
2. Select the graph type and components that best fits the data. Ensure all labels, axes, and other graph components are clear, accurate, and non-deceitful.
3. Make the data visualization accessible by meeting accessibility parameters for color, contrast, size and scale, and more. Include alternative text that describes the visual, and use WAVE or other tools to test the accessibility of the document.
4. Make the data visualization as interactive as is practically feasible for the design to improve audience engagement and understanding.
5. Make the data visualization aesthetically-pleasing by using color and color theory, placement and proximity principles, and rounded shapes. Do not compromise the understandability of the data for aesthetics, but rather use aesthetics to communicate the data more effectively.

V. REFERENCES

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