2024 International Conference on Trends in Quantum Computing and Emerging Business Technologies
CHRIST (Deemed to be University), Pune Lavasa Campus, India. Mar 22-23, 2024

2024 International Conference on Trends in Quantum Computing and Emerging Business Technologies (TQCEBT) | 979-8-3503-8427-7/24/$31.00 ©2024 IEEE | DOI: 10.1109/TQCEBT59414.2024.10545256

Data Visualization in Transforming Raw Data into Compelling Visual Narratives

Prithu Sarkar[1]
[1]*Assistant Professor, Amity School of Communication, Amity University*
Kolkata
psarkar@kol.amity.edu

Yadavalli Devi Priya[2]
[2]*Assistant Professor, Computer Science and Engineering, Vignan's Institute of Information Technology, Duvvada,*
Vishakapatanam, Andhra Pradesh
yadavallidevipriya@gmail.com

Pravina B. Patel[3]
[3]*Assistant Professor, Department of Computer Science, Ganpat University,*
Mehsana, Gujarat, India
pbp07@ganpatuniversity.ac.in

Dr. Prasanta Chatterjee Biswas[4]
[4]*Professor, CDOE, Parul University*
Vadodara

Sreenivasulu Arigela[5]
[5]*Assistance Professor Mohan Babu University,*
Tirupati, Andhra Pradesh
sreenu1184@gmail.com

Sravanthi Sallaram[6]
[6]*Assistant Professor, Department of Computer Science and Engineering*
St.Martin's Engineering College

***Abstract* - One of the main ways to evaluate information is through visual learning, which traditionally combines textual reading with visual aids like graphical representations. However, separating the visual method of learning to distinguish between text and visuals has been suggested in light of advancements in learning styles. The ability to swiftly create complex visual information and inexpensively distribute it digitally is another way that technology has improved visual presentation. The purpose of this research paper is to conduct a detailed investigation of the Virtualization of data, storytelling, and Data Visualization's Narrative, understand how Instruments and methods are used in visualization, and select the appropriate tool for presenting visual data stories and upcoming projects. To address this purpose, this research has reviewed a wide range of different journals and articles to gather information about data visualization, storytelling, and data narratives. Based on the analysis, this research paper finds an all-encompassing perspective on the visual data narrative process, incorporating the phases of discovering insights (data exploration), developing these insights into a tale (creating a story), and sharing this story with others (telling a story). Through the pursuit of these novel research directions, visualizations can facilitate more potent data storytelling.**

Keywords: Data Visualization, Storytelling, Visual Narratives, Data Analysis, Data Transformation

I. INTRODUCTION

Two common uses of visual content that are regularly connected to entertainment or data representation are image/video exchange programs and information visualizations. These visual-oriented methods help improve interactions and information visualization efforts. Records are a helpful tool for knowledge, but to make it intelligible to humans, evaluation, simplification, and the right visualization strategies are needed.Everyone may convert important data into enjoyable material for wide audiences by mixing entertainment with graphic representation. This might extend the useful area of visualizing data and increase its mass popularity. After analyses of information and discovery, visualization moves on to the present. The demonstration of facts is the main topic of this research, with an emphasis on how to better communicate the knowledge and lessons acquired from statistical analysis. It emphasizes producing multimedia materials using ideas from data mining and presenting results in the form of visual narratives.This research proposes an example of developing visual-based narrative capabilities on a web-based interactive medium for broad people, building on prior research in storytelling visualization and simple visualization. To achieve greater recall and attractiveness, the programming approach depends on data block organization, computing innovations, techniques from meaningful video games and pleasure using computers, and research on mental factors[1].To sum up, this research looks at more fascinating methods to communicate information with viewers and to present information in a collaborative, interesting, and enlightening visual format as a practical means of telling data narratives.

A. Objectives

1. To know about the Virtualization of data, storytelling, and Data Visualization's Narrative.
2. To understand how Instruments and methods are used in visualization.
3. Selecting the appropriate tool for presenting visual data stories and upcoming projects.

B. Research Questions

1. What is data visualization, data visualization narrative, and storytelling?
2. How data visualization can be used to transform raw data into narratives?

II. LITERATURE REVIEW

A. Virtualization of data

Displaying content visually is one way to define visualizing data, but there's more to this important concept than meets the eye. In a worldwide meeting, SAS highlighted how visualization of data facilitates making decisions by offering accurate and confirmed statistical parameters that are useful in the comprehension of difficult ideas or in identifying patterns and outcome prediction. The significance of Visualization of data may be expressed from multiple viewpoints. According to Aparicio & Costa, data visualisation raises data to a degree of experience, suggesting a conceptual simplification of the word. Since people understand data primarily via the visual senses, presenting content in an easy-to-understand way facilitates sending messages. However, Gratzclaims that the primary objective of visualization of data is the finding of new perspectives.

When it comes to visualization of data, mixing both of these techniques and selecting the right platform for displaying information look to be essential for getting its message across. Achieving readily available and meaningful presentations for vast volumes of information has become vital. Every day, companies produce information. Consequently, there is now an enormous increase in the quantity of material accessible on the Internet. Users find it challenging to visualize, study, and make use of this massive amount of content[2]. For academic research, data visualization is essential. Big amounts of information can now be processed by machines. The architecture, growth, and use of digitally producedvisual information visualizations are the focus of this topic. It offers efficient representing data for information coming from various places. Managers may now see statistics in a visual format, which facilitates their understanding of the results. It aids in the detection of patterns, data understanding, and viewpoint formulation. Visualizing data and visualization for science are other terms used to describe visualizing data. Visualizations have traditionally been used by humans to extend messages or knowledge. It is possible to graphically represent things that can't be eaten, smelt, or experienced.

B. *Storytelling*

Studying the parts, characteristics, and core of tales is an essential step in the study of significant narrative. One important component of narrative is mimicry, which is characterized as artistic mimicry, in which the tale turns into the object being told. Artists use relative viewpoints to mimic truth to generate feelings. An attentive public that engages with the tale's narrative structure and understands it as a sense of emotion is a further vital part of storytelling. Experiences may be thought of as a psychological modelling procedure that makes what is provided into information[3]. A stranger might narrate a tale and add conclusions and clarification, or they can provide feedback about how things are represented or circulation (mimicry). Diegesis is the term used to describe this part of telling a story.A tale is an account of an incident or chain of events that aims to capture the attention of the viewer. A tale's purpose is to mentally engage the viewer in the progression of the narrative. Narratives develop based on a certain order or pattern of activities occurring in the moment and place. This characteristic may be summarized as an events-driven narrative that develops the storyline.

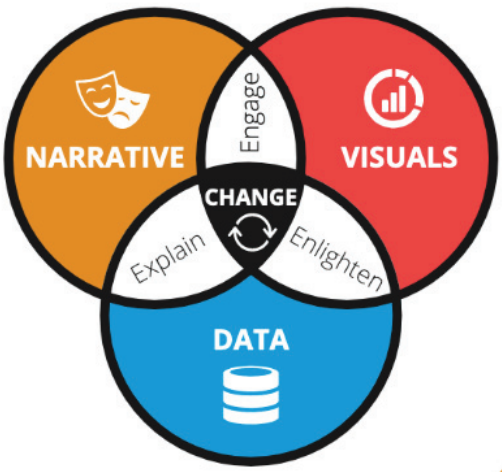

Fig. 1. Storytelling

A narrative is created as a tale that combines non-diegetic content with given and signified situations that are shown to the viewers as a structure. While non-diegetic content, like movie titles, fails to match the causality, moment, and space connection of the moving images, related happenings are pictured or understood by viewers.The subject of telling a story is covered in great detail in a variety of creative works such as books, video games, and films. The additional readings listed below are great starting points for learning about the conceptual aspects of storytelling: a great blog, works like the narrative cubic outlined in, or other very pertinent works in the narrative area[4].4 variables create the key aspects of storytelling: conversation, medium-sized, viewpoint, and narrative. Elements like drawing or display, sentiment or mental processes, and the encoding or decoding procedure are all included in perspectives. The basic method that people use to understand their surroundings is via narratives, which is a belief which includes narrative structure (conversation) and narrative content (tales). Bordwell's concept highlights the explanation part of storytelling by highlighting that a tale is a combination of both represented human-perceptible things and human-inferred occurrences.

C. *Data Visualization's Narrative*

There is now a lot of attention to display difficult data in an easier attractive style that is relevant to various audience groups. Engaging a target audience via the presentation of visuals and diagrams as individual data is no longer the most efficient method. The present tendency is to use data to create a tale, that presents a fresh range of potential and difficulties for discussion when thinking about the craft of storytelling. Mackinlayemphasize the value of integrating a bit of emotion into tale presentation. This is having a greater effect than just presenting data and information as it has engaging components. Additionally, they point out that tales provide a clarification for why data describes a situation. The result is logical to express an idea in this situation by combining tales and statistics. In addition, Mackinlay provides a framework for effective tales that reach above the standard framework that everybody was taught in schools. Segel & Heer provide two distinct ways to narrative: author-oriented and reader-oriented, in addition to providing an extensive framework [21].

Although the next version has a greater ever-changing, promotes information discovery, and encourages several conclusions, the primary one is unchanging, maintains an ordered framework, and expresses just one idea.These methods provide many visualisation patterns that are separated into three categories: drilling down stories, dynamic slideshows, and martini glass structures[5]. A martini glass design firstly provides the results at the outset and afterwards invites debate as it goes along. Subsequently, the dynamic presentation enables investigation throughout the entire visualizing data procedure. Lastly, the drilling-down narrative gives a general summary of the subject while allowing a detailed examination of a particular data point. Picking a strategy for using data visualization to present a narrative is still crucial to getting the message across and having a positive impact on the audience.

D. *Instruments and methods are used in visualization*

Several tools are used in the data visualization narrating method to guide individuals in developing exciting stories and presenting data with greater levels of engagement. The

artwork by Hans Rosling is a prime example of Gapminder's most successful design, which lets viewers connect graphics with their stories, play/pause at any moment, go forward or backward to study specific periods and zoom in to draw out broad patterns within times. Further study is currently being performed to make graphical tales that writers with no or very little knowledge of computing can generate. For a greater level of knowledge, Hillman pays attention to straightforward, "slideshow-style" demonstrations; Satyanarayan et al. created Ellipses, a framework which mixes a graphical user experience for narrative production with a language tailored to the domain (DSL) for narratives. A different device that lets people evaluate information and move progressively across its visualizations in several interactive graphs is Tableau Storytelling Rewards, which enables users to create tales using facts.Highly effective strategies may be used to influence a series of steps. To close the distance between exploring data and story delivery, Gratzl et al. establish the concept of authenticity facts and suggest the CLUE approach. The origin chart, which includes every activity taken throughout the investigation, particularly the pathways taken that resulted in discoveries and the researcher's meeting with obstacles, forms the foundation of the CLUE architecture. The CLUE toolkit architecture may be used by currently available visualization techniques to copy the first research and initiate fresh discoveries [22].

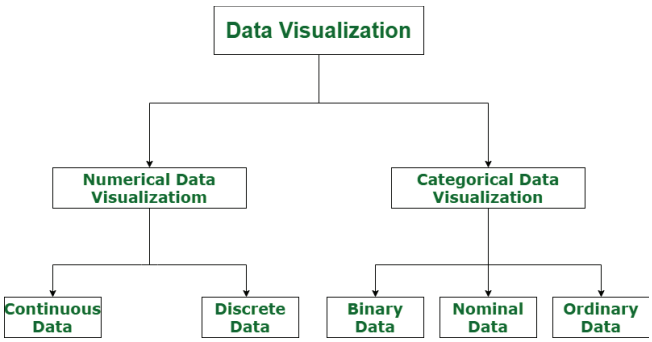

Fig. 2. Data Visualization Techniques

E. Selecting the appropriate tool for presenting visual data stories

Many additional factors are involved in visual information narrative and have a direct impact on the whole process. Presenting patterns should be based on various target groups and situations because the techniques and tools advance in their peak of development. Every situation has different factors like what and how much data will be displayed, the methods applied, the purpose of the presentation, and the expected level of engagement.In the first situation, results are presented to a large group of individuals who aren't always familiar with the content prior. This situation may have a limited impact (slideshows), self-running (videoclips), or need input from consumers[6]. In this case, a straight-line slide-show display format is perfect .Offering frequently to a group that has some previous experience is situation two. It calls for finding an equilibrium between attention and participation from the audience. These situations are suited for the gap minder project displays.In situation three, peers or superiors need to be informed of important details on a topic that everybody has an understanding of. In these situations, the more powerful CLUE concept makes it logical [23].The way a visual narrative is presented also depends on details including the media, location, information, and targeted audience. Fixed photographs and videos are hard to produce, modify, and publish promptly, as they don't talk as effectively about the outcomes of research as other kinds of visual data tales.

F. Upcoming projects

The scientific computation narrative has a bright future ahead of itself. Virtual and augmented reality might be used to give content greater depth and establish a stronger connection with the viewer. This may help individuals connect to information and improve the engagement of the narrative techniques that are already available. Modelling is usually the first step in the computational scientific pipelines and is observed by simulations and visualisation. A single-solving issues ecosystem might be created to facilitate study in this area. This would enable visualisation researchers to present their findings to a broader audience without messing with the distinct creation platforms of the other parts. In the field of scientific computation, tales may now go across the globe, just as in actual life[7].

III. METHODOLOGY

The present research on the use of data visualization to turn unprocessed data into engaging visual stories is an exploratory study that could act as a foundation for further concepts and frameworks. The study is primarily theoretical because there aren't many cases accessible. In order to create the new framework, this study took pertinent theories from different disciplines, critically evaluated them, synthesized them thoroughly, and applied them to the area of narrative visualizations. In simpler terms, the objective of this research work was to develop a paradigm that would both reflect and build upon current practices and theories. The writers first identified the material for additional study to answer the research questions. The researchers did this by locating significant books and articles that were published in highly referenced scientific publications. Following the initial selection process, manual database searches were conducted using keywords that aligned with the study's internal logic. These themes included the perception of visuals, visual interaction, and visual transformation. By visiting websites, aggregators, and blogs dedicated to visualization, empirical materials were acquired. Through this study, the researchers looked at how visual data storytelling is currently used and how it may be expanded by organizations. We'll use the strategic perspective on data visualization. According to Zhang *et al.* [8], the primary feature of the visual strategic approach is its emphasis on the intentional application of visuals within an organization to further its objectives and further its mission. Regarding the ontological and epistemological stances, it is important to note that researcher traditions and perspectives differ greatly because of the intricacy of the data visualization phenomena and the significance of visually engaging narratives in contemporary culture.

IV. ANALYSIS

This issue of defining storytelling within the visualization domain has been the subject of numerous research studies. Park *et al.* [9] define "narrative visualization," as highlighting visual narratives that contain a "narrative" or a sequence of events that are causally connected. Additionally, they demonstrate how discussing narrative in the light of visualization is inextricably linked to discussing visual

narratives; however, further clarification is still required, particularly given the lack of knowledge regarding the distinctions and similarities with conventional storytelling techniques and methods. They develop the story visualization design space to gain a deeper comprehension of "visual data stories." Lotfi *et al.* [10] define "narrative visualization" as a genre that combines interpersonal, symbolic, and convincing strategies for delivering an intended "story" with interaction tools for exploration control over insights acquired. The authors try to better explain the visualization approaches involved in conveying an intended message, however, they do not provide a clear definition of what a "visual data story" is. Even while these two methods are excellent starting points for comprehending visualization-related communication mechanisms in general, it is still unclear exactly what constitutes a visual data story.

It is suggested that visual data narratives can be conceptualized as follows when talking about the process of turning data into graphically communicated stories

- A visual data narrative consists of a collection of story parts, or certain facts supported by data such as the evolution of energy consumption over time.
- The majority of the narrative elements are illustrated to bolster one or more desired meanings. To underline and accentuate this message and to prevent ambiguity, the visualization incorporates annotations (labels, points, text, etc.) or narration (particularly for synchronous storytelling) [11].
- To support the author's high-level communication purpose, which can range from informing or amusing the viewer with a factual illustration to persuading or convincing them with thoughts that provoke thinking, story parts are given in a coherent order or relationship between them.

A. Visual Data Storytelling Process

In the past, a broader visual narrative process has not been extensively examined in research articles. The article by Aparicio *et al.* [12] stands out as an exception, as its objective is to present a comprehensive summary of the current status of storytelling research. They contend that analysis visualization tools are rarely useful for presenting information and give a quick overview of a workable model for creating tales based on journalistic practices.

In order to create a more comprehensive understanding of the visual storytelling process and identify unexplored research opportunities, this study provides a much more thorough overview of the method of storytelling in visualization concerning the roles, activities, and objects involved. Drawing on many models found in the data journalism literature, the graphic (Figure 3) proposes the visual data storytelling process (VDSP) as a workable paradigm. The VDSP enumerates the primary responsibilities and tasks performed by visualization storytellers in transforming unprocessed data into a visually engaging narrative, as well as the kinds of artifacts that emerge from these endeavors [13]. The narrative process does not have to start on the left and proceed to the right; it might include several loops and several instances of each component. For illustration reasons, the process is arranged linearly in the picture. To keep things simple, there are three primary elements: data exploration, narrative creation, and narrative delivery [14].

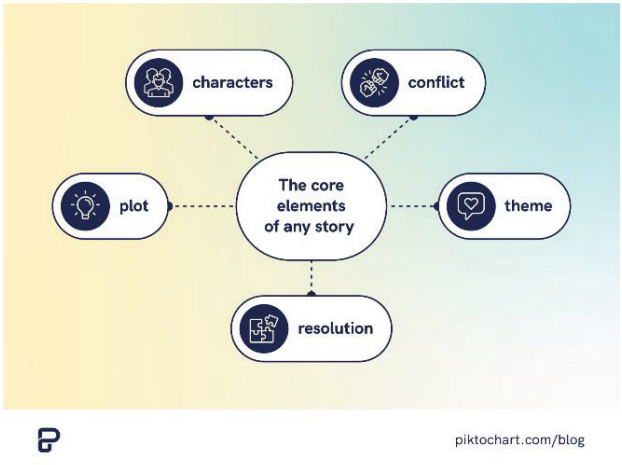

Fig. 3. Visual Storytelling Process

B. Data Exploration

Data exploration is a collection of activities that are focused on data exploration and analysis. The foundation of the visual story content is data, which is the raw material. Extracted relevant data fragments are gathered via exploratory analysis. These could be as basic as stages from the evaluation process or documented data facts [15]. They could be more intricate, such as insights from derived data, intriguing groups or patterns within the information, and/or specifics and variants of the method. These could consist of the initial rapid externalizations of the data, like Excel charts or hand drawings created while the data was being analyzed. This compilation of extracts may or may not be connected to any particular visual representation at this stage of the process [16]. A compilation of the selected data extracts is the end product of data exploration when creating a visual data story.

C. Narrative Creation

The data snippets collected in the first phase must be put together into an engaging, insightful, and captivating plot to become a story. A story's chronology is crucial; a given collection of passages can either make an impression or not. The process of creating the storyline or narrative is an important aspect of creating a story [17]. The tasks include putting everything in order, making sense of connections, producing flow, crafting a message, and coming up with a denouement. These frequently combined tasks might be completed in a stepwise manner, concurrently, or by going through several iterations.

D. Narrative Delivery

The broad technique of bringing the abstract narrative to life and narrating the story is called storytelling. Developing a presentation (i.e., developing story content utilizing the selected media), telling the tale utilizing the narrative material, and then addressing audience response are the components that make up this process [18].

Making data into a graphically shared story involves several various jobs. The data analyst explores and analyzes the data that serves as the story's basis. A scriptwriter uses the given samples to construct the story [19]. The tale is ultimately delivered by the presenter, who has prepared the

TABLE I. FOUR COMMON SETTINGS FOR STORYTELLING

Example scenario	Time	Place	Audience participation level
Live presentations	Synchronous	Co-located	Low
Dynamic discussions	Synchronous	Co-located	High
Recorded videos/ static infographics	Asynchronous	Distributed	Low
Guided tours/interactive infographics	Asynchronous	Distributed	High

story material with the editor. The story is experienced by the audience, who also offers comments. Keep in mind that it is not uncommon for one individual to fulfill more than one of these responsibilities. One person, for instance, may gather the information, construct a narrative, produce the necessary materials, and then deliver it. However, it is also conceivable for different persons to assume diverse responsibilities in many professional situations [20].

V. CONCLUSION

The purpose of visual narrative is to attract viewers and inspire them to use highlighted data to create stories of their own. It gives them the confidence to make independent judgments according to certain facts and gives them the ability to turn ordinary people into storytellers. For visual narrative, a variety of methods are available, all having a distinct function. Besides generating interest and engagingly delivering data, the narrative initiates a path into motion and extends a request to those watching to continue after the idea is presented. This study looks at several approaches to data displaying that include concepts related to scientific, community, and emotional demands.

ACKNOWLEDGMENT

The author would like to express their sincere gratitude to everyone who helped with this data visualization research study by turning raw data into visually engaging storytelling. We especially appreciate the mentors' guidance and help. I am grateful to my colleagues for their wise counsel. Resources-supplying organizations and organizations are also recognized. Their combined efforts were crucial in shaping the nature of this research undertaking.

REFERENCES

[1] Dykes, B., 2019. Effective data storytelling: how to drive change with data, narrative and visuals. John Wiley & Sons. https://books.google.co.in/books?hl=en&lr=&id=rHDDDwAAQBAJ&oi=fnd&pg=PR9&dq=Data+Visualization+in+Transforming+Raw+Data+into+Compelling+Visual+Narratives&ots=M2PmQojU1Y&sig=2jJNEVTrC2rKP4R6iYzDQXZqZUY&redir_esc=y#v=onepage&q&f=false

[2] Amini, F., 2020. Data videos: turning data into engaging narratives.https://scholar.googleusercontent.com/scholar?q=cache:LaqQ4-DZzU0J:scholar.google.com/+Data+Visualization+in+Transforming+Raw+Data+into+Compelling+Visual+Narratives&hl=en&as_sdt=0,5&as_ylo=2019

[3] Wilke, C.O., 2019. Fundamentals of data visualization: a primer on making informative and compelling figures. O'Reilly Media.https://books.google.co.in/books?hl=en&lr=&id=XmmNDwAAQBAJ&oi=fnd&pg=PP1&dq=Data+Visualization+in+Transforming+Raw+Data+into+Compelling+Visual+Narratives&ots=6MG1q03Dy8&sig=hfDBV6IbylbLcl1MQoYPx-m0WcQ&redir_esc=y#v=onepage&q&f=false

[4] Benoit, G., 2019. Introduction to information visualization: Transforming data into meaningful information. Rowman & Littlefield.https://books.google.co.in/books?hl=en&lr=&id=c35_DwAAQBAJ&oi=fnd&pg=PR7&dq=Data+Visualization+in+Transforming+Raw+Data+into+Compelling+Visual+Narratives&ots=9zviYNSx9O&sig=S1Y3v7zrh8pmX09ZJgBXpZaEl2g&redir_esc=y#v=onepage&q&f=false

[5] Bremer, N. and Wu, S., 2021. Data Sketches: A journey of imagination, exploration, and beautiful data visualizations. CRC Press.https://books.google.co.in/books?hl=en&lr=&id=V9kREAAAQBAJ&oi=fnd&pg=PA138&dq=Data+Visualization+in+Transforming+Raw+Data+into+Compelling+Visual+Narratives&ots=seltMc1Mfx&sig=d7qtM7DUctvp6Dii0zqw_2ZVgxA&redir_esc=y#v=onepage&q&f=false

[6] Obie, H.O., Chua, C., Avazpour, I., Abdelrazek, M., Grundy, J. and Bednarz, T., 2020. Authoring logically sequenced visual data stories with gravity. Journal of Computer Languages, 58, p.100961.https://www.sciencedirect.com/science/article/abs/pii/S2590118420300216

[7] Chen, Q., Cao, S., Wang, J. and Cao, N., 2023. How does automation shape the process of narrative visualization: A survey of tools. IEEE Transactions on Visualization and Computer Graphics.https://ieeexplore.ieee.org/abstract/document/10081398/

[8] Zhang, Y., Reynolds, M., Lugmayr, A., Damjanov, K. and Hassan, G.M., 2022, September. A visual data storytelling framework. In Informatics (Vol. 9, No. 4, p. 73). MDPI. https://www.mdpi.com/2227-9709/9/4/73/pdf

[9] Park, D., Suhail, M., Zheng, M., Dunne, C., Ragan, E. and Elmqvist, N., 2022. StoryFacets: A design study on storytelling with visualizations for collaborative data analysis. Information Visualization, 21(1), pp.3-16. https://journals.sagepub.com/doi/pdf/10.1177/14738716211032653

[10] Lotfi, F., Beheshti, A., Farhood, H., Pooshideh, M., Jamzad, M. and Beigy, H., 2023. Storytelling with Image Data: A Systematic Review and Comparative Analysis of Methods and Tools. Algorithms, 16(3), p.135. https://www.mdpi.com/1999-4893/16/3/135

[11] Oberascher, L., Ploder, C., Spiess, J., Bernsteiner, R. and Van Kooten, W., 2023. Data Storytelling to Communicate Big Data Internally–a Guide for Practical Usage. European Journal of Management Issues, 31(1), pp.27-39. https://mi-dnu.dp.ua/index.php/MI/article/download/416/311

[12] Aparicio, J.T., Arsenio, E. and Henriques, R., 2023, October. tex2net: A Package for Storytelling Using Network Models. In Proceedings of the 41st ACM International Conference on Design of Communication (pp. 119-125). https://dl.acm.org/doi/pdf/10.1145/3615335.3623022

[13] Zdanovic, D., Lembcke, T.J. and Bogers, T., 2022, March. The influence of data storytelling on the ability to recall information. In Proceedings of the 2022 Conference on Human Information Interaction and Retrieval (pp. 67-77). https://pure.itu.dk/ws/files/98209889/3498366.3505755.pdf

[14] Sun, M., Cai, L., Cui, W., Wu, Y., Shi, Y. and Cao, N., 2022. Erato: Cooperative data story editing via fact interpolation. IEEE Transactions on Visualization and Computer Graphics, 29(1), pp.983-993. https://arxiv.org/pdf/2209.02529

[15] Chen, Q., Liu, Z., Wang, C., Lan, X., Chen, Y., Chen, S. and Cao, N., 2022. VizBelle: A Design Space of Embellishments for Data Visualization. arXiv preprint arXiv:2209.03642. https://arxiv.org/pdf/2209.03642

[16] Allen, W.L., Bandola-Gill, J. and Grek, S., 2023. Next slide please: the politics of visualization during COVID-19 press briefings. Journal of European Public Policy, pp.1-27. https://www.tandfonline.com/doi/full/10.1080/13501763.2022.2160784

[17] Lim, V.Y., Peralta, L.M.M., Rubel, L.H., Jiang, S., Kahn, J.B. and Herbel-Eisenmann, B., 2023. Keeping pace with innovations in data visualizations: A commentary for mathematics education in times of crisis. ZDM–Mathematics Education, 55(1), pp.109-118. https://link.springer.com/article/10.1007/s11858-022-01449-0

[18] Jacob, S.A., Walizer, C. and Kinzie, J., Sharing Compelling Results: Data Storytelling and Data Visualization. In Coordinating Divisional

and Departmental Student Affairs Assessment (pp. 175-194). Routledge. https://www.taylorfrancis.com/chapters/edit/10.4324/9781003460695-11/sharing-compelling-results-stacy-jacob-cassandra-walizer-jillian-kinzie

[19] Outa, F.E., Marcel, P., Peralta, V. and Vassiliadis, P., 2023. Highlighting the Importance of Intentional Aspects in Data Narrative Crafting Processes. Information Systems Frontiers, pp.1-17. https://link.springer.com/article/10.1007/s10796-023-10418-1

[20] Errey, N., Liang, J., Leong, T.W. and Zowghi, D., 2023. Evaluating narrative visualization: a survey of practitioners. International Journal of Data Science and Analytics, pp.1-16. https://link.springer.com/article/10.1007/s41060-023-00394-9

[21] Balaji, V., Acharjee, P. B., Elangovan, M., Kalnoor, G., Rastogi, R., & Patidar, V. (2023). Developing a semantic framework for categorizing IoT agriculture sensor data: A machine learning and web semantics approach. The Scientific Temper, 14(04), 1332-1338.https://scientifictemper.com/index.php/tst/article/download/867/750

[22] Rani, S., Acharjee, P.B., Kaswan, S., Athavale, V.A., Udhayamoorthi, M. and Pant, K., 2022, April. A Face Spoof Detection in Artificial Neural Networks Using Concepts of Machine Learning. In 2022 2nd International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE) (pp. 1604-1607). IEEE.https://ieeexplore.ieee.org/abstract/document/9823587/

[23] Das, A., Nath, B., Acharjee, P.B. and Dey, A., 2017. A New Kind of Dynamical Pattern Towards Distinction of Two Different Emotion States Through Speech Signals. J. Multim. Process. Technol., 8(4), pp.142-148.https://www.researchgate.net/profile/Akalpita-Das/publication/343222088_JMPT_A_New_Kind_of_Dynamical_Pattern_Towards_Distinction_of_Two_Different_Emotion_States_Through_Speech_Signals/links/5f1d7587a6fdcc9626b39a2c/JMPT-A-New-Kind-of-Dynamical-Pattern-Towards-Distinction-of-Two-Different-Emotion-States-Through-Speech-Signals.pdf?_sg%5B0%5D=started_experiment_milestone&origin=journalDetail