ChatGPT: The advancement of knowledge and incorpertation for its users

Louis Othen  
S21002027  
North Wales Management School  
Wrexham Glyndŵr University  
Wales, UK  
s21002027@mail.glyndwr.ac.uk

*Abstract*—200-300 word to be place here, to surmise the document in a punchy way, intro the paper, what’s it’s about, the research to conduct, the questions to ask, how data is collected, how it is processed, what key results and opinions form, what this means and what it can be going forward.

Keywords—ChatGPT, Knowledge Acquisition, user perception, something, something else

# Introduction

This template, modified in MS Word 2007 and saved as a “Word 97-2003 Document” for the PC, provides authors with most of the formatting specifications needed for preparing electronic versions of their papers. All standard paper components have been specified for three reasons: (1) ease of use when formatting individual papers, (2) automatic compliance to electronic requirements that facilitate the concurrent or later production of electronic products, and (3) conformity of style throughout a conference proceedings. Margins, column widths, line spacing, and type styles are built-in; examples of the type styles are provided throughout this document and are identified in italic type, within parentheses, following the example. Some components, such as multi-levelled equations, graphics, and tables are not prescribed, although the various table text styles are provided. The formatter will need to create these components, incorporating the applicable criteria that follow.

# Related Work

## Background and Aims

ChatGPT – is a large language Model (LLM) Artificial Intelligence (AI) tool created by Open AI which answers requests via Natural Language Processing (NLP) tasks [1], applicable in various practices. However, does ChatGPT allow for further education or knowledge enhancement for its users? Therefore, this chapter aims to examine currently available research and literature – or lack thereof - on whether users get to enhance knowledge further in that area from their perspective, and if so, is ChatGPT then incorporated into their day-to-day activities. The proceeding sections intend to highlight the literature reviewed and break out into separate themes uncovered.

## ChatGPT evaluation and applications

The evaluation of ChatGPT and the applications it can use or used with, shows as the most dominating theme found in currently available research. The studies in the next paragraphs of this section represents the potential of ChatGPT adoption, but without external validation from users.

A study seen from Surameery and Shakor [4], examines ChatGPT use in solving programming bugs, understanding if the tool aids in debugging assistance, explanation, and corrections for software development procedures. Additionally, a comparison examined between ChatGPT against Integrated Development Environments (IDE’s) to trial effectiveness between practices; concluding that whilst IDE’s help with multiple features and capabilities but more complex to interpret, ChatGPT however allows for a more approachable, explainable, and intuitive way in handling programming bugs. This study extends further from works by Sobania et al [5] and Bang et al [6]. The study – in silo – provides partial context about how ChatGPT is useable and against other tools but provide no specific examples on what bugs examined and if solvable. Additionally, no research found on software developers using ChatGPT to solve any programming problems nor a perception of how this has helped them.

With Sobania et al [5], an evaluation performed back in January 2023 against ChatGPT on responses regarding if a piece of code has a bug and how it should be fixed; concluding a mostly positive but mixed results on performance – particularly where verification is needed, but better responses compared with other tools once context is applied on either side of the query. This study extends research from Surameery and Shakor [4], showing detailed examples of prompts used and responses from ChatGPT stating “would yield ChatGPT to be a viable tool that would help software developers in their daily tasks”. This excerpt from the research was not the focus and more a buildable foundation, where the research helps at least partially address gaps the above research presents.

Additionally, Bang et al [6] evaluates ChatGPT against a series of public datasets covering different tasks, and how it compares with other LLM’s – stating a satisfactory performance, but not without the risk of external hallucination – where a confident response provided without any justification from its training [33].

An article by Su, Lin, and Lai [29] suggests using ChatGPT to support students' argumentative writing in classrooms. The authors propose is that ChatGPT can help students formulate clear and logical claims supported by evidence to persuade others. They conducted experiments with ChatGPT using various prompts to measure its feedback performance. Additionally, they recommend that teachers instruct students to create their own outlines before seeking feedback and inspiration from ChatGPT for future learning. While this paper highlights the potential benefits of using ChatGPT in the classroom, it lacks an experimental exploration of student control and test groups to evaluate the impact on argumentative writing performance. Furthermore, the perspectives of both teachers and students regarding the use of ChatGPT in this context remain unexplored, presenting an opportunity for further investigation.

Based on studies presented above, similar themes occur by way of testing ChatGPT and its application with evaluation against different metrics, other LLM’s or other tools. More importantly, gaps seen through the literature thus far in that, whilst ChatGPT has been tested on performance and practice in silo for a particular use or topic, there appears to be little view from an array of users collected to understand whether users have adopted its practice on scenarios presented above, giving space for this research to help explore this gap.

## ChatGPT and enhancement of user knowledge and incorporation

This section of the chapter groups together research found on the potential use of ChatGPT being able to enhance a user’s knowledge. The studies found below provide a great introduction into how ChatGPT has potential of utilisation both from an introductory or general view, as well as using specific cases evaluated against the tool. However, these show foundations of work that others could extend further.

Aljanabi [7] extends the notion of using ChatGPT, enabling possibilities and future directions for users and the software itself. This paper provides a great introduction into the use of ChatGPT and opportunities it presents, such as a potential for user personalisation, and alluding to integration for different working fields, and enhancing lives in meaningful ways. However, as Aljanabi [7] frames this work as an introductory piece into the subject, no specific provable claims are made here.

Similarly, an excerpt from Liberman [8] suggests ChatGPT as a tool to explore sources of information for users, focusing on students as a primary user, assisting with understanding context of a subject. Although, Liberman does go further to say that ChatGPT may not provide accurate information in all areas for its user. Again, this source does provide a highlight on what ChatGPT is and how it can assist with context, but little information of how it provides knowledge enhancement and detail is lacking to explain further, understood upon exploring this source considering the context provided.

Whilst sources above provide more of an introduction into ChatGPT as a field to explore rather than how users perceive the use of ChatGPT, the next set of sources delve further, albeit with limited range. A study produced by Kung et al [8] explored performance of ChatGPT on the United States Medical Licensing Exam (USMLE). Although the research’s primary focus was testing ChatGPT performance against the exam, a held discussion on the results was noted on whether ChatGPT can assist knowledge enhancement for users sitting the exam by providing insight into areas that needs development. However, limitations of this research keep it focused on ChatGPT and its output from USMLE, other than alluding exploration into knowledge enhancement for medical students sitting the exam and further incorporation into day-to-day use. Therefore, a gap in the study represented by no medical student participation shown against this study to explore the improvement of scoring in the USMLE.

A separate study found from Yue et al [9] explores use of ChatGPT providing financial knowledge to non-financial users, testing queries on how it can explain financial terms and metrics such as alpha, beta, earnings to price (EP) or Illiquidity to a user based on different context and publication approaches. This study is beneficial in that ChatGPT has capacity to help individuals gain financial knowledge to assist in making informed decisions. Nevertheless, no evidence located of assessing these exercises against participants to evaluate the claims made, on whether users understood the information provided, found helpful to them, as well as adds to their day-to-day routine of expanding knowledge further.

Firat [30] conducted research exploring the utilisation of ChatGPT to enhance the learning experience for autodidactic (self-taught) open education students. The research highlights ChatGPT's potential to transform students' learning experiences by offering personalised support, real-time feedback, and convenience of flexible working, among other benefits. However, the paper acknowledges limitations and emphasis for further research in this area. At time of writing, there is no evidence in this paper available regarding student use of ChatGPT in open education with autodidactic learning. Additionally, the lack of peer review raises concerns about the reliability and validity of the claims.

To summarise above, some evidence is found to exploring the notion of ChatGPT against users for knowledge enhancement, and a good introduction into possibilities that could be held here, although there seems to be a gap in measuring user engagement of the tool, instead focusing into more of what the tool can do.

## ChatGPT with user perception

Finally, this section focuses on available research regarding use of ChatGPT from a user perspective, and any indications as to what ChatGPT use is for the present and potential future user. Unfortunately, due to novelty of this view of research exploration there are limited pieces of research at present, but an aim here is presenting what is currently available and observed.

Tlili et al [10] conducted a case study on the use of ChatGPT by educational users. They explored initial user interactions and experiences, analysed Twitter networks and sentiments related to ChatGPT, and conducted interviews with participants. The study found that ChatGPT has potential as a learning aid and for idea generation. Although, whilst this source provides a solid foundation, there are limitations such as a small participant group, a narrow focus on education, and qualitative rather than quantitative research, meaning that user perspectives are immeasurable.

Haque et al. [31] conducted research on 12th December 2022, analysing sentiments of early adopters of ChatGPT using Twitter data. They employed Latent Dirichlet Allocation (LDA), an unsupervised topic modelling technique to understand user perceptions by grouping topics based on user sentiment [32]. The results indicate predominantly positive sentiments across all topics, with some negative and neutral seen as well. The study concludes that early adopters generally responded positively to ChatGPT, but also considered its implications for certain professions, due to its ability performing some required tasks. While this research provides valuable insights into early adopters' perceptions, it has limitations such as the potential changes in ChatGPT since the study and the lack of peer review, which affects the reliability and validity of the claims. Nevertheless, this research offers a useful indicator for the present-day user perception of ChatGPT.

To close off what is discovered in the above, two pieces of research is found concerning the measurement of user perception on ChatGPT. A great foundation is formed based on these where data is collected to understand how people have engaged with the tool. However, limited research is uncovered in this area and provides justification of this paper to explore further in terms of gathering current insight.

## Conclusion

This chapter evaluates existing research on individuals who have used ChatGPT to assess its impact on knowledge acquisition, both generally and within specific domains. It also examines the integration of ChatGPT into their daily activities. The findings suggest that ChatGPT is still relatively new since its release by OpenAI in November 2022 [2]. While there has been progress in this area, notable research gaps exist in understanding participant adaptation and interactions, with a focus found instead on isolated studies solely focused on the research topic. Furthermore, the scarcity of peer-reviewed resources due to the novelty of this research field.

# Research Methodology

The goal of this chapter is to explain how the research was performed, research questions and hypotheses used, dataset construction, pre-processing steps, and analysis performed; all to establish whether ChatGPT – if used – has enhanced a user’s knowledge; and if so, has ChatGPT then since been incorporated into a user’s routine for knowledge acquisition.

## Research Hypotheses

The following information below represents a set of two alternative research hypotheses (**RH**) explored as part of the study, where the first hypothesis has impact on the second hypothesis.

* **RH1**. “The utilization of ChatGPT increases the likelihood of enhancing a user's knowledge on a specific topic.”
* **RH2. “**Users who perceive ChatGPT as enhancing their knowledge are more likely to incorporate ChatGPT into their routine for knowledge acquisition compared to those who do not perceive ChatGPT as enhancing their knowledge.”

Based on these hypotheses proposed, there were research questions in addition to re-confirm or extend the response further.

## Research Questions

As well as the hypotheses explored, additional research questions (**RQ**) were applied to provide further context in this area.

* **RQ1.** Is ChatGPT being used by the participants?
* **RQ2.** If ChatGPT is being used by the participant, did the use of it enhance a user’s knowledge?
* **RQ3.** If ChatGPT did enhance a user's knowledge, has ChatGPT been adopted by the user for routine knowledge acquisition?

## Research Design

This dissertation uses a quantitative study for its speed and ability to address specific questions, allowing for future repeatability and measurement of attitude changes [10-11]. The quantitative method offers objectivity, generalisability to a broader context – enabling a foundation to build further research upon, and the ability to measure the potential cause and effect between users' knowledge enhancement of ChatGPT and its incorporation into daily use. Statistical inferences are also be used to test the hypotheses set [11-12]. Qualitative research, although valuable for building themes, providing context, and gaining insights from participants, could be a good candidate for future studies once this preceding research is complete. Due to time and resource constraints, a mixed method approach is not feasible, making the quantitative study the preferred approach.

### Quantitative Research Method

Quantitative research will utilise a survey study methodology to collect information via a questionnaire, asking specific, mainly closed-ended questions and analysing the results [14]. The purpose of the survey is to gather participant feedback on ChatGPT's usage, knowledge enhancement, and adoption. Conducted online, it aimed to access a large participant group to help ensure an optimal response rate compared to physical submissions [14]. The survey is cross-sectional as the research is novel, to establish responses from one point in time [15] over a period of approximately one month, that could be potentially compared against for future research.

## Preparation

Before research began, the survey was created ready for distribution, aimed to be done within the research project timeline. A copy of the survey used can be found in Appendix A.

## Population and Participants

The sample size used in this research consists of all ?? individual responses who interacted with the survey providing input regarding the topic of ChatGPT. However, some user characteristics were collected to allow for analysis and aid future research.

The respondents who participated in this study consisted of individuals who completed a survey titled “ChatGPT: The advancement of knowledge and incorporation for its users”. The survey was distributed to the public - by way of social media platforms as well as a post on the Wrexham Glyndwr University’s Canvas discussion board – to access a link to the Google Forms questionnaire that was created.

The survey was made available to all potential respondents, and their participation was entirely voluntary. By including all respondents who participated, this study aimed to capture a comprehensive understanding of user perspectives regarding ChatGPT. Furthermore, this approach allowed for a broader range of insights to be uncovered, enhanced generalisability of findings from a diverse range of individuals, and reduced potential for sampling bias.

## Data Collection

As this research utilised an online survey, an online questionnaire instrument was deployed. This instrument was created via a software tool known as Google Forms. With this method, a link was distributed via social media posts or direct communication on multiple platforms such as LinkedIn, Discord, and Facebook. Additionally, A link was also provided on the Wrexham Glyndwr University’s Canvas discussion board. The steps followed in the data collection process were the following:

1. A link shared with individuals across multiple social platforms to access the Google Forms survey created. Additionally, a link to the created questionnaire was distributed via email or direct communication via social media where requested.
2. The participants answered questions and made their submission.
3. At the end of the time allotted to receive responses, data was exported from Google Forms into a downloaded CSV (Comma Separated Values) file.
4. From there, the csv file was imported into a python jupyter notebook script producing the relevant statistics and analysis.

### Data Collection Suitability

The decision to collect the required data from the created survey – as described in the section above – was to allow for the speed and quality of responses that were received. Moreover, given the constraints of time and resource available for this research, this was the most optimal method to collect data, as well as allowed for ease and approachability for the participant.

## Data Analysis and Results

### Management and Storage

As described in the previous section, data was collected via a Google Forms questionnaire, then exported into a CSV (Comma-Separated Values) file, which then is imported for analysis and statistical generation.

### Software and tools used for data analysis

The CSV file was imported into Python, a user-friendly and interpretable high-level programming language [16]. Python supports data analysis through libraries like pandas for data analysis and manipulation [21], SciPy for statistical tests [22], matplotlib for standard data visualisation [23], and seaborn for statistical visualisation [24], all facilitating statistical analysis and data visualization for the collected data. The justification of using python, compared with other data analysis methods such as MATLAB, R or SPSS for example were due to a factors that contributed to the decision of using python. Mainly, its versatility, ease of use and readability. Python is framed as a general-purpose programming language, with extensive libraries being able to cover various research domains, and beyond, as well as being able to integrate into other programming languages, frameworks, and practices better, allowing for potential future development, regardless of avenue that is taken; where languages such as MATLAB, R, or SPSS remain more domain specific [34].

### Data Analysis Steps

The following list of tasks were executed to present findings and derive insight from the data collection:

#### Pre-processing

Most participant data collected will consist primarily of categorical responses, including yes or no choices and some characteristic information selected from multiple choice selection (e.g., occupational background, highest level of education). Consequently, data conversion also transformed categorical values into numerical representations, utilising transformative logic.

**(MORE STUFF NEEDED HERE, ONCE CODE IS DONE)**

#### Descriptive Analysis

Initial analysis summarised data points using tables and graphs. Examples included total participant count, percentages of population with specific characteristics. Additionally, analysis addressed the main research questions:

1. How many participants found ChatGPT enhanced their knowledge? What percentage of the population reported knowledge enhancement, and the percentage where it did not.
2. Among participants who reported knowledge enhancement, how many now use ChatGPT for knowledge acquisition? This analysis will provide percentages for both the subset and the entire sample.

The analysis also explored the limited participant characteristics for potential insights.

**(MORE STUFF NEEDED HERE, ONCE CODE IS DONE)**

#### Pearsons Correlation Coefficient

Pearson correlation assesses the strength and direction of a linear relationship between two variables, indicating their closeness [19-20]. This study examines the association between ChatGPT users who have experienced knowledge enhancement and the integration of ChatGPT into their daily knowledge acquisition routine. The `dataframe.corr('pearson')` function in pandas [21] will be employed to generate a correlation table. A positive correlation was anticipated, signifying that users who enhance their knowledge with ChatGPT are inclined to incorporate it into their regular knowledge-seeking practices. Table 1 shows the variables used for the Pearson correlation coefficient analysis, which related to the RQ variable referred to.

Table 1 variables to be used for Pearson's Correlation Coefficient Analysis.

|  |  |  |
| --- | --- | --- |
| Question in survey | Variable defined in python after pre-processing steps | RQ related to variable |
| When you used ChatGPT - based on the prompt you entered - did the response help enhance your knowledge in that area? | rq2\_question | RQ2 |
| If ChatGPT did enhance your knowledge, have you used it more into your day-to-day routine since? | rq3\_question | RQ3 |

#### Hypothesis Testing

To assess the statistical significance of the survey results and investigate the two hypotheses, an employment of the binomial test in python was used using the scipy.stats library package. The null hypothesis, in both cases, will assume that only 50% of the participants reported an improvement in their knowledge and the inclusion of ChatGPT as a tool for regular knowledge acquisition. Should more than half of the responses demonstrate this trend, the null hypothesis will be rejected, and the alternative hypothesis, which aligns with the research theories, would be accepted [35,36].

### Results from analysis

The results are displayed in both tabular, graphical – in terms of data visualisations and textual formats for the reader dependent on the context of what is being shown.

## Ethical Considerations

As research involved the perception of participants’ view in form of a quantitative survey study, there remained potential items that were considered. Participants' rights had been prioritised throughout the study, and all procedures will adhere to ethical guidelines outlined by The Institute of Electrical and Electronics Engineers (IEEE) [25] within their code of ethics [26].

Participants were provided with a clear explanation of the study's purpose, the benefits this research aims to bring, and procedures involved. Informed consent was obtained from each participant before participation ensuring they can withdraw from the questionnaire at any time, confirming they can make informed decisions. The consent was documented through the online survey platform, with participants required to indicate their voluntary participation by selecting the option “I agree to these terms and wish to participate”, before the survey began.

Participants' confidentialities were maintained. Data collected is stored and anonymised. Only the researcher the dissertation supervisor will have access to the data, which will be used solely for research purposes. No personal identifying information was expected in the survey results but was separated from survey responses during analysis.

The study poses minimal risks to participants. However, measures were taken to mitigate potential risks, such as providing clear instructions on the survey process to avoid any confusion. No conflicts of interest that could compromise the objectivity or integrity of the research were detected.

### Action to obtain ethical approval

To get ethical approval for this research project, a proposal was sent to the dissertation supervisor, due to the ethical consideration outlined. Whilst this study involves the use of humans to get their views on the use of ChatGPT, there is minimal to no harm or misconduct expected towards participants who engage with the survey. A signed copy of the ethical approval of research projects in online programmes form can be found in Appendix B.

## Limitations

Particularly as this piece of research delved into a novel area concerning ChatGPT, limitations were uncovered and need to be addressed to provide as much transparency as possible. Due to limited time and resources, only one survey will be conducted with a limited series of mostly closed questions to gather prompt and enriching feedback. Additionally, the analysis will be limited to the collected data without comparison to other datasets, due to the lack of research in this area. Furthermore, it is important to note that bias may be introduced in this study as participants interested in the topic may be the only ones who choose to participate.

# Intial findings and Data collection

Clearly identify the data relating to research hypothesis and questions a useful way to present your data, only tables here, use graphs for analysis and discussion

## Something here

## Somethiung else here

## Figures and Tables

## Something else here

# Data analysis

The chapter looks at was done with data found from findings the results of research study and only based on data collected.

# Results and discussion

Interpret what the results mean and discuss the implications why are results important, and what limitations in what the results are saying.

# Conclusion

djfbnsdkjgbfskgjbsdkgjsdgb

## Future work

Sdsdsdsdsd

## Recommendations

jgkgfjgjkgkj

# References

1. E. Gregersen, “ChatGPT | Definition & Facts | Britannica,” www.britannica.com, May 10, 2023. https://www.britannica.com/technology/ChatGPT (accessed May 13, 2023).
2. OpenAI, “Introducing ChatGPT,” OpenAI, Nov. 30, 2022. https://openai.com/blog/chatgpt (accessed May 16, 2023).
3. M. Rahman, H. J. R. Terano, N. Rahman, A. Salamzadeh, and S. Rahaman, “ChatGPT and Academic Research: A Review and Recommendations Based on Practical Examples,” Journal of Education, Management and Development Studies, vol. 3, no. 1, pp. 1–12, Mar. 2023, doi: <https://doi.org/10.52631/jemds.v3i1.175>.
4. N. M. S. Surameery and M. Y. Shakor, “Use Chat GPT to Solve Programming Bugs,” International Journal of Information technology and Computer Engineering, vol. 3, no. 31, pp. 17–22, Jan. 2023, doi: <https://doi.org/10.55529/ijitc.31.17.22>.
5. D. Sobania, C. Hanna, M. Briesch, and J. Petke, “An Analysis of the Automatic Bug Fixing Performance of ChatGPT,” Jan. 2023. Accessed: May 24, 2023. [Online]. Available: <https://arxiv.org/pdf/2301.08653.pdf>
6. [6]Y. Bang et al., “A Multitask, Multilingual, Multimodal Evaluation of ChatGPT on Reasoning, Hallucination, and Interactivity,” arXiv:2302.04023 [cs], vol. 1, Feb. 2023, Accessed: May 24, 2023. [Online]. Available: <https://arxiv.org/abs/2302.04023>
7. M. Aljanabi and ChatGPT, “ChatGPT: Future Directions and Open possibilities,” Mesopotamian Journal of Cyber Security, vol. 2023, pp. 16–17, Jan. 2023, doi: <https://doi.org/10.58496/mjcs/2023/003>.
8. M. Lieberman, “What Is ChatGPT and How Is It Used in Education?,” Education Week, Jan. 04, 2023. Accessed: May 13, 2023. [Online]. Available: <https://www.edweek.org/technology/what-is-chatgpt-and-how-is-it-used-in-education/2023/01>
9. T. Yue, D. Au, C. C. Au, and K. Y. Iu, “Democratizing Financial Knowledge with ChatGPT by OpenAI: Unleashing the Power of Technology,” papers.ssrn.com, Feb. 02, 2023. https://ssrn.com/abstract=4346152 (accessed May 13, 2023).
10. A. Tlili et al., “What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education,” Smart Learning Environments, vol. 10, no. 1, Feb. 2023, doi: <https://doi.org/10.1186/s40561-023-00237-x>.
11. T. H. Kung et al., “Performance of ChatGPT on USMLE: Potential for AI-Assisted Medical Education Using Large Language Models,” medRxiv, vol. 2, Dec. 2022, doi: <https://doi.org/10.1101/2022.12.19.22283643>.
12. Formplus, “15 Reasons to Choose Quantitative over Qualitative Research,” Formpl.us, Jul. 10, 2019. https://www.formpl.us/blog/quantitative-qualitative-research (accessed May 19, 2023).
13. T. Williams, “Why Is Quantitative Research Important?,” GCU, Jun. 14, 2021. https://www.gcu.edu/blog/doctoral-journey/why-quantitative-research-important#:~:text=The%20purpose%20of%20quantitative%20research (accessed May 19, 2023).
14. S. McLeod, “What’s the Difference between Qualitative and Quantitative research?,” Simply Psychology, Apr. 06, 2023. https://www.simplypsychology.org/qualitative-quantitative.html (accessed May 19, 2023).
15. K. Hammarberg, M. Kirkman, and S. De Lacey, “Qualitative Research Methods: When to Use Them and How to Judge Them,” Human Reproduction, vol. 31, no. 3, pp. 498–501, Jan. 2016, doi: <https://doi.org/10.1093/humrep/dev334>.
16. S. McCombes, “Doing Survey Research | A Step-by-Step Guide & Examples,” Scribbr, May 06, 2022. https://www.scribbr.co.uk/research-methods/surveys/ (accessed May 19, 2023).
17. J. W. Creswell and J. D. Creswell, Research Design: Qualitative, Quantitative & Mixed Methods Approaches, 5th ed. Los Angeles: Sage, 2018, p. 149.
18. Python Software Foundation, “Welcome to Python.org,” Python.org, Nov. 18, 2019. https://www.python.org (accessed May 19, 2023).
19. A. Gefferth, “One Hot Encoding scikit vs pandas,” Medium, Mar. 13, 2023. https://towardsdatascience.com/one-hot-encoding-scikit-vs-pandas-2133775567b8 (accessed May 20, 2023).
20. N. Abraham et al., Coding all-in-one. Hoboken, Nj: John Wiley & Sons, Inc, 2017, p. 354.
21. D. J. Rumsey, Statistics for dummies. Hoboken, Nj: John Wiley & Sons, 2016, pp. 297–300.
22. D. Spiegelhalter, STATISTICS : the art of learning from data. Pelican, 2019, p. 58.
23. W. Mckinney, “Data Structures for Statistical Computing in Python,” 2010. Accessed: May 20, 2023. [Online]. Available: <https://conference.scipy.org/proceedings/scipy2010/pdfs/mckinney.pdf>
24. scipy, “SciPy documentation — SciPy v1.8.1 Manual,” docs.scipy.org, Feb. 19, 2023. https://docs.scipy.org/doc/scipy/ (accessed May 20, 2023).
25. J. D. Hunter, “Matplotlib: A 2D Graphics Environment,” Computing in Science & Engineering, vol. 9, no. 3, pp. 90–95, 2007, doi: <https://doi.org/10.1109/mcse.2007.55>.
26. M. Waskom, “seaborn: statistical data visualization,” Journal of Open Source Software, vol. 6, no. 60, p. 3021, Apr. 2021, doi: <https://doi.org/10.21105/joss.03021>.
27. IEEE, “History of IEEE,” @IEEEorg, 2019. https://www.ieee.org/about/ieee-history.html (accessed May 21, 2023).
28. IEEE, “IEEE Code of Ethics,” ieee.org, 2020. https://www.ieee.org/about/corporate/governance/p7-8.html (accessed May 21, 2023).
29. Y. Su, Y. Lin, and C. Lai, “Collaborating with ChatGPT in argumentative writing classrooms,” ELSEVEIR, vol. 57, no. 100752, pp. 100752–100752, Jul. 2023, doi: <https://doi.org/10.1016/j.asw.2023.100752>.
30. M. FIRAT, “How Chat GPT Can Transform Autodidactic Experiences and Open Education?,” Jan. 2023, doi: <https://doi.org/10.31219/osf.io/9ge8m>.
31. M. U. Haque, I. Dharmadasa, Zarrin Tasnim Sworna, R. N. Rajapakse, and H. Ahmad, “‘I think this is the most disruptive technology’: Exploring Sentiments of ChatGPT Early Adopters using Twitter Data,” arXiv (Cornell University), vol. 1, Dec. 2022, doi: <https://doi.org/10.48550/arxiv.2212.05856>.
32. D. Blei, B. Edu, A. Ng, M. Jordan, and J. Edu, “Latent Dirichlet Allocation,” Journal of Machine Learning Research, vol. 3, pp. 993–1022, Jan. 2003, Accessed: Jul. 09, 2023. [Online]. Available: <https://www.jmlr.org/papers/volume3/blei03a/blei03a.pdf?ref=https://githubhelp.com>
33. Z. Ji et al., “Survey of Hallucination in Natural Language Generation,” ACM Computing Surveys, vol. 55, no. 12, Nov. 2022, doi: <https://doi.org/10.1145/3571730>.
34. T. Colliau, G. Rogers, Z. Hughes, and Ceyhun Ozgur, “MatLab vs. Python vs. R,” ValpoScholar, 2017. https://scholar.valpo.edu/cba\_fac\_pub/51 (accessed Jul. 09, 2023).
35. M. J. Moroney, Facts from Figures, Second. Penguin Books Ltd, 1953, pp. 216–237.
36. D. Spiegelhalter, STATISTICS : the art of learning from data. Penguin Books, 2019, pp. 256–267.

# Appendices