

## The Data Visualization Tools on the Research Capability of Marketing Students

Ana May A. Pagaling<sup>1</sup>, Sean Gabrielle S. Agbin<sup>1</sup>, Hazel M. Bantatua<sup>1</sup>, Remsen C. Calzado<sup>1</sup>,

May V. De Guzman<sup>1</sup>, Joyce A. Quiñones<sup>1</sup>

<sup>1</sup>*Eulogio “Amang” Rodriguez Institute of Science and Technology - Nagtahan, Sampaloc, Manila, Philippines*

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Email of Corresponding Author: [bantatuahazel@gmail.com](mailto:bantatuahazel@gmail.com)

### Abstract

This study examined the relationship between data visualization tools and the research capability of marketing students. It focused on how digital visualization tools support students' research performance, analytical skills, digital literacy, reporting ability, collaboration, and overall research capability. No explicit theoretical framework was stated in the manuscript. The study employed a descriptive-correlational research design to describe the extent of students' use of data visualization tools and determine their relationship with research capability without manipulating variables. The respondents were marketing students who had exposure to and experience using data visualization tools in academic and research-related activities. Data were gathered through a structured questionnaire composed of indicators on data visualization tools and research capability. Responses were rated using a Likert scale and analyzed using frequency, percentage, weighted mean, ranking, Pearson Product-Moment Correlation Coefficient, and a 0.05 level of significance. Findings showed that marketing students assessed data visualization tools positively. Software and applications received an overall weighted mean of 4.21, interpreted as Strongly Agree, while type of visualization received 4.39, also interpreted as Strongly Agree. Data analysis features received 4.60, showing that students often benefited from built-in functions, trend identification, filtering, organizing, and reporting features. Ease of use and accessibility received 3.99, while collaboration features received 3.81, both interpreted positively. In terms of research capability, students demonstrated good data analysis skills, strong reporting and presentation skills, high digital literacy and tool proficiency, and frequent use of critical thinking when working with visualized data. The results further showed that data visualization tools were effective in enhancing research capability, with the highest impact observed in research performance, level of usage, and tool features. Collaboration features showed the strongest relationship with research capability, followed by software and application and ease of use and accessibility. Type of visualization showed no significant relationship, and data analysis features had no computable correlation. The study concluded that effective utilization of data visualization tools enhances marketing students' ability to analyze, interpret, and communicate research data. It recommended continuous student use of visualization tools, faculty integration of these tools into research activities, institutional training and software access, and a seminar-workshop on data visualization tools for enhancing research capability. The study is aligned with SDG 4 – Quality Education because it supports improved research learning, digital literacy, and academic skill development. It is also connected to SDG 9 – Industry, Innovation and Infrastructure because it promotes the use of digital tools and technology-based platforms in higher education. Its sustainability impact is mainly educational, technological, and institutional, as it supports long-term improvement in research instruction, digital competence, and technology-supported academic development.

**Keywords:** Data Analysis, Data Visualization Tools, Digital Literacy, Marketing Students, Research Capability, Research Performance, Visualization Tools

### 1. Introduction

Digital transformation has changed how academic research is conducted, especially in marketing and business fields where data-driven decision-making is important. As research data becomes more complex, students need tools that can convert raw information into organized and meaningful visual outputs. Data visualization tools help marketing students understand patterns, compare consumer groups, identify trends, reduce errors in statistical presentation, and communicate research findings more effectively. Marketing education requires students to develop research capability through data analysis, interpretation, and presentation of results. However, students may experience difficulty handling large datasets and translating them into understandable insights. This creates a need to examine how data visualization tools contribute to their research capability and how these tools may improve research-related learning outcomes. Related literature in the manuscript shows that data visualization tools support students' research capability by improving accuracy, analytical confidence, interpretation, and communication of findings. Agatep and Villalobos (2020) highlight that Filipino graduate

students recognize the importance of data visualization skills but often lack structured mentoring, training, and access to analytic and visualization tools. This supports the need for proper training and tool access in marketing education.

Asamoah (2022) found that students who actively used data visualization tools improved their data interpretation skills, analytical confidence, and engagement in research activities. Similarly, Teimourzadeh et al. (2023) stated that the use of data visualization tools helped students strengthen their analytical and data interpretation abilities, particularly through features such as filtering, organizing, and identifying trends. The manuscript also highlights the importance of domain knowledge in the effective use of visualizations. Vázquez-Ingelmo et al. (2024) emphasized that students' ability to interpret and design data visualizations is strongly shaped by their domain knowledge and contextual understanding. This suggests that visualization skills are not limited to technical use alone but also depend on students' familiarity with the subject matter being analyzed.

Recent research further strengthens the relevance of the present study. Chang et al. (2024) examined the strategies and difficulties students encounter when constructing data visualizations, showing the need to understand not only tool use but also the learning challenges involved in producing accurate visual representations. Firat et al. (2022) emphasized interactive visualization literacy as an academic skill involving the ability to read, interpret, and construct visual designs. Rogers and Jeffcoat (2024) similarly reported that students may possess data visualization literacy skills but still show gaps in interpreting specific visualization types. These studies support the present investigation by showing that students' research capability is affected not only by access to visualization tools but also by their literacy, interpretation skills, and ability to construct meaningful visual outputs.

Other studies also relate visualization activities to academic performance and research readiness. Students may improve their classroom performance by applying the knowledge and skills gained from academic activities. This is supported by Matveeva et al. (2023), who reported that structured visualization activities help develop stronger data interpretation and analytical skills, especially when these activities are integrated into research tasks. Muniasamy et al. (2024) found that students who actively engaged with data visualization tools showed improved data literacy, analytical confidence, and research readiness. This is supported by Batt et al. (2020), who found that structured, hands-on data visualization activities significantly enhanced students' data interpretation skills, analytical thinking, and research preparedness. Hsu et al. (2022) further emphasized that students who actively use data visualization tools and participate in visualization-focused tasks demonstrate improved data literacy, analytical understanding, and research readiness. Overall, Batt et al. (2020), Hudiburgh and Garbinsky (2020), Asamoah (2022), and Vázquez-Ingelmo et al. (2024) support the view that tools such as Tableau and Power BI contribute to students' data literacy, analytical skills, engagement, and research capability.

Locally, the study focuses on marketing students from Eulogio "Amang" Rodriguez Institute of Science and Technology. The study responds to the academic need to strengthen research capability among students through technology-supported learning tools. In the Philippine educational context, the findings are relevant because students increasingly need digital literacy, data interpretation, and research communication skills for academic and professional preparation. Nationally, the study reflects the growing importance of technology integration in higher education, particularly in business and marketing programs. As marketing students are expected to interpret consumer data, identify market trends, and produce credible research reports, data visualization tools become useful in improving research performance and academic readiness. Globally, the study aligns with the increasing role of digital platforms, analytics, and visualization tools in education and industry. Since marketing and business decisions are becoming more data-driven, students must be trained to use digital tools responsibly, accurately, and effectively in research tasks.

At the higher education level, recent studies show that analytics and visualization technologies are becoming central to teaching, learning, and institutional decision-making. Stojanov and Daniel (2024) reviewed the application of big data and analytics in higher education and emphasized their role in supporting learning, teaching, and academic administration. Paulsen and Lindsay (2024) further showed that learning analytics dashboards are increasingly focused on supporting learning processes rather than merely presenting analytics. Taylor et al. (2024) demonstrated how visualization and machine learning techniques can be used to examine educational assessment data, while Valverde-Rebaza et al. (2024) highlighted the emerging role of advanced language models and visualization tools in data analytics learning. These studies strengthen the relevance of the present study by situating marketing students' research capability within broader developments in educational analytics, technology-supported instruction, and data-driven learning.

The conceptual basis of the study is anchored on the relationship between data visualization tools and the research capability of marketing students. The manuscript treats data visualization tools as a support mechanism for improving students' ability to analyze, interpret, summarize, evaluate, and present research data. The study's framework may be understood through major dimensions of tool use, including software and application, type of visualization, data analysis features, ease of use and accessibility, and collaboration features. These dimensions are connected to research capability indicators such as data analysis skills, research design and methodology, critical thinking, reporting and presentation skills, and digital literacy and tool proficiency. The cited literature supports this basis by showing that visualization tools improve data literacy, analytical skills, contextual interpretation, and research readiness. Agatep and Villalobos (2020), Asamoah

(2022), Teimourzadeh et al. (2023), Vázquez-Ingelmo et al. (2024), Matveeva et al. (2023), Muniasamy et al. (2024), Batt et al. (2020), and Hsu et al. (2022) collectively support the role of visualization tools in strengthening students' academic research skills.

The manuscript identifies the need to examine how data visualization tools relate to the research capability of marketing students. Although students use tools such as Tableau, Power BI, Excel, dashboards, charts, and infographics, there remains a need to determine how these tools affect research performance, analytical skills, digital literacy, collaboration, and reporting skills. The study is also justified by the challenges students face in handling large datasets and converting complex data into understandable insights. Some findings in the manuscript suggest that while students generally perform well in using visualization tools, certain areas still need improvement, such as navigating advanced features, identifying deeper trends and correlations, anticipating implications, selecting suitable applications for specific research tasks, and maximizing task assignment or progress-tracking features. Thus, the rationale of the study is to provide evidence on how data visualization tools support marketing students' research capability and to guide faculty members and institutions in improving instructional strategies, technology integration, training, and access to visualization software.

This study aligns most directly with SDG 4 – Quality Education because it focuses on improving students' research capability, digital literacy, analytical skills, and academic performance through the use of data visualization tools. By supporting technology-enhanced learning in marketing education, the study contributes to better research instruction and stronger student preparation for data-driven academic work. The study also aligns with SDG 9 – Industry, Innovation and Infrastructure because it promotes the use of digital tools, analytics platforms, and visualization technologies in higher education. The integration of tools such as Tableau, Power BI, Excel, dashboards, charts, and infographics supports innovation in teaching, research, and academic data analysis. SDG 8 – Decent Work and Economic Growth is also relevant because the study prepares marketing students for professional environments where data analysis, research reporting, and digital communication are important workplace skills. Strengthening students' research capability can improve their readiness for marketing, business, and data-oriented careers.

The study contributes to educational sustainability by promoting technology-supported research learning among marketing students. By encouraging the use of data visualization tools, the study supports long-term improvement in students' ability to analyze, interpret, and communicate research findings. The study also contributes to technological and digital sustainability by emphasizing responsible and effective use of visualization platforms in academic research. Students who develop digital literacy and tool proficiency are better prepared to work with data systems, generate accurate outputs, and evaluate digital results critically. In terms of institutional sustainability, the study provides a basis for improving curriculum design, faculty instruction, training programs, seminars, and access to visualization software. These improvements can help institutions build stronger research cultures and better prepare students for academic and professional demands. The study further supports socio-economic sustainability by helping students develop skills that are useful in business, marketing, and data-driven workplaces. Improved research capability, analytical thinking, collaboration, and presentation skills can strengthen students' future employability and professional competence.

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## **2. Material and methods**

### **2.1 Research Design**

The study employed a descriptive-correlational research design to determine the relationship between data visualization tools and the research capability of marketing students. This design was used to describe the extent of students' use of data visualization tools and to examine their relationship with research capability without manipulating any variables. This approach is consistent with Creswell and Creswell (2018), who explained that quantitative research designs are appropriate when the objective is to measure variables and examine relationships among them.

### **2.2 Locale of the Study**

The study was conducted in the context of Eulogio “Amang” Rodriguez Institute of Science and Technology, Nagtahan, Sampaloc, Manila. The manuscript identifies this institution as the affiliation of the researchers and the academic setting connected to the study.

### **2.3 Respondents of the Study**

The respondents were marketing students who served as the primary source of data. They were selected because of their exposure to and use of data visualization tools in academic work, particularly in research-related activities.

### **2.4 Sample and Sampling Procedure**

The study selected marketing students who had experience using data visualization tools for academic and research purposes. The manuscript indicates that the sampling procedure was intended to ensure that the selected respondents

represented the target population of marketing students. The statistical analysis also reports a sample size of 150 respondents.

### **2.5 Research Instrument**

A structured questionnaire served as the main data-gathering instrument. It contained indicators that measured the use of data visualization tools and their perceived impact on students' research capability. The responses were rated using a Likert scale to quantify the level of agreement or effectiveness. The instrument covered areas related to tool usage, software and application features, visualization types, data analysis features, ease of use and accessibility, collaboration features, data analysis skills, research design and methodology, critical thinking, reporting and presentation skills, digital literacy, and tool proficiency.

### **2.6 Data Gathering Procedure**

Data were gathered from marketing students through the structured questionnaire. The respondents provided ratings based on their experience and perception of data visualization tools in relation to their research tasks. The collected responses were then organized and prepared for statistical analysis to determine the level of effectiveness, utilization, and relationship between data visualization tools and research capability.

### **2.7 Data Analysis Techniques**

The gathered data were analyzed using frequency and percentage to describe the demographic profile of the respondents. Weighted mean and ranking were used to determine the level of effectiveness and utilization of data visualization tools, as well as the level of research capability among marketing students. The weighted mean was used to interpret the overall assessment of the respondents, while ranking was applied to arrange the indicators from highest to lowest. To determine the significant relationship between data visualization tools and research capability, the Pearson Product-Moment Correlation Coefficient was utilized. The significance of the relationship was tested at the 0.05 level of significance to determine whether the observed correlation was statistically significant. The results were interpreted using a verbal interpretation scale ranging from Not Effective to Very Effective. The interpretation of correlation strength was guided by Cohen (1988), whose conventional benchmarks are commonly used in evaluating effect sizes in behavioral research.

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## **3. Results and Discussion**

### **3.1 Effectiveness of Data Visualization Tools on Research Capability**

#### **3.1.1 Software and Application**

The results showed that marketing students had a highly positive assessment of software and application use in data visualization, with an overall weighted mean of 4.21 interpreted as Strongly Agree. The highest result was on the ability of automated tools to reduce errors in representing statistical research data, with a weighted mean of 5.00. This was followed by the use of professional-grade visualization applications to improve the credibility and quality of research reports. Students also agreed that they possessed technical proficiency in using advanced tools such as Tableau, Power BI, and Excel, while software features helped them organize complex datasets and identify hidden consumer trends. These findings indicate that software and applications support students' accuracy, efficiency, and research output quality. The use of advanced visualization tools helps students manage research data more effectively and prepares them for academic and professional standards in marketing research. This is supported by Agatep and Villalobos (2020), who highlighted that Filipino graduate students recognize the importance of data visualization skills but often lack structured mentoring, training, and access to analytic and visualization tools. It aligns closely with the findings of the present study that marketing students perceive software and applications as enhancing research capability, improving accuracy, and increasing report quality, emphasizing the need for proper training and tool access.

#### **3.1.2 Type of Visualization**

The results showed that the type of visualization received an overall weighted mean of 4.39, interpreted as Strongly Agree. Students strongly agreed that various charts help them compare different consumer groups more accurately, with a weighted mean of 5.00. They also strongly agreed that dashboards or trend lines help them identify market trends, while infographics help explain complex research results more clearly than plain text. Students also agreed that they could choose appropriate charts and use visuals such as heat maps or scatter plots to identify relationships between market variables. These findings suggest that charts, dashboards, infographics, and other visual formats improve students' ability to analyze, interpret, compare, and present research data. The results show that visualization strengthens analytical and communication skills needed for data-driven decision-making in marketing education. This is supported by Asamoah (2022), who found that students who actively used data visualization tools developed better data interpretation skills, analytical confidence, and engagement in research activities. This supports the present findings that data visualization helps marketing students analyze, interpret, and communicate research data more effectively.

### **3.1.3 Data Analysis Features**

The results showed that data analysis features obtained an overall weighted mean of 4.60, interpreted as Often. Students reported that built-in functions for computing totals and averages, identifying trends and patterns, and filtering and organizing data were always useful, each receiving a weighted mean of 5.00. They also often used visualization tools to analyze research data accurately and generate summarized results or reports. These findings indicate that data analysis features play a significant role in strengthening students' research and analytical skills. Functions for computation, filtering, organizing, and identifying patterns help students complete research tasks more efficiently and accurately. This is supported by Teimourzadeh et al. (2023), who stated that students who used data visualization tools developed stronger analytical and data interpretation skills. This supports the findings in Table 3 that data analysis features such as filtering, organizing, and identifying trends help students analyze research data more efficiently and accurately.

### **3.1.4 Ease of Use and Accessibility**

The results showed that ease of use and accessibility received an overall weighted mean of 3.99, interpreted as Agree. Students gave the highest rating to accessibility across different devices such as laptops, mobile phones, and tablets. They also agreed that the tools had clear instructions and interfaces, were easy to use, and could be accessed when needed for research tasks. However, navigating tool features received the lowest rating among the indicators, although it was still interpreted positively. These findings suggest that data visualization tools are generally accessible and user-friendly for marketing students. Their availability across devices supports flexible academic use, but the lower rating for navigation suggests that some students may still need further familiarization with advanced features. This is supported by Vázquez-Ingelmo et al. (2024), who emphasized that domain knowledge significantly influences how students interpret and design data visualizations. This supports the present findings by highlighting that effective use of data visualization tools in marketing education requires not only technical skills but also the ability to align visuals with marketing concepts and research questions

### **3.1.5 Collaboration Features**

The results showed that collaboration features obtained an overall weighted mean of 3.81, interpreted as Agree. Students agreed that collaboration features increase productivity when working with others, allow easy access to and editing of shared documents and files, provide notifications and updates on team activities, and support real-time communication. However, task assignment and progress tracking received the lowest rating and were interpreted as Neutral. These findings indicate that collaboration features help students complete group research tasks more efficiently and productively. The results suggest that students value tools that facilitate file sharing, communication, and timely updates, although task management features may not yet be fully utilized. The findings further imply that active engagement in collaborative academic activities contributes to the development of students' skills and enhances their overall learning experience, particularly through participation in research-related tasks and teamwork.

## **3.2 Research Capability of Marketing Students**

### **3.2.1 Data Analysis Skills**

The results showed that students demonstrated good data analysis skills, with an overall weighted mean of 3.99. The highest rating was on interpreting and summarizing data using graphical and visual presentations, followed by evaluating the reliability, accuracy, and consistency of results through graphical analysis. Students also showed competence in selecting and applying analytical techniques and drawing evidence-based conclusions from visually analyzed data. However, identifying significant trends, patterns, or correlations in visualized datasets received the lowest rating and was interpreted as Satisfactory. These findings suggest that students can use visual outputs to support basic analytical tasks, particularly interpretation, summarization, evaluation, and application of analytical techniques. However, the lower result in identifying trends and correlations indicates that deeper analytical thinking still needs development. This is supported by Matveeva et al. (2023), who reported that students who engage in structured visualization activities develop stronger data interpretation and analytical skills, especially when training is integrated into research tasks. This supports the present findings in Table 6 by reinforcing that consistent use of data visualization tools enhances students' ability to interpret, evaluate, and analyze data effectively.

### **3.2.2 Research Design and Methodology**

The results showed that research design and methodology received an overall weighted mean of 4.18, interpreted as Good. The highest rating was given to the use of an appropriate sampling strategy to ensure that selected marketing students represented the target population, with a weighted mean of 5.00. Students also rated instrument reliability and validity, research design selection, methodology justification, and consideration of biases or limitations positively, although attention to biases and limitations received the lowest rating. These findings indicate that the study's research design and methodology were generally viewed as strong and appropriate. The high rating for sampling strengthens the credibility of the findings, while the lower rating for biases and limitations suggests the need for greater transparency and rigor in future research. This is supported by Muniasamy et al. (2024), who reported that students who actively engaged with data visualization tools showed improved data literacy, analytical confidence, and research readiness, especially when

visualization activities were integrated into structured learning tasks. This supports the present findings by reinforcing that visualization training enhances students' ability to interpret, analyze, and communicate research data more effectively in marketing contexts.

### **3.2.3 Critical Thinking**

The results showed that students demonstrated a high level of critical thinking, with an overall weighted mean of 3.92 interpreted as Often. The highest rating was on comparing alternative interpretations of the same visual data, followed by justifying conclusions from complex visualizations using logical reasoning. Students also often evaluated the credibility and relevance of data sources and identified assumptions and biases in visualized datasets. However, anticipating implications or consequences of research findings from data visuals received the lowest rating. These findings suggest that students can analyze visual data from multiple perspectives and support conclusions with logical reasoning. However, the lower ratings in identifying assumptions, recognizing bias, and anticipating implications show that higher-order evaluative and predictive thinking skills still need strengthening. This is supported by Vázquez-Ingelmo et al. (2024), who emphasized that students' ability to correctly interpret and design data visualizations is strongly influenced by domain knowledge and contextual understanding. This supports the present findings by highlighting that marketing students develop better analytical and interpretative skills in data visualization when theory, context, and visualization practice are integrated in learning activities. This is further supported by Nagaraj et al. (2025), who presented inquiry-based active learning in data visualization for analytics as a way to strengthen learners' critical thinking through questioning, exploration, analysis, and presentation of data.

### **3.2.4 Reporting and Presentation Skills**

The results showed that reporting and presentation skills received an overall weighted mean of 4.21, interpreted as Strongly Agree. The highest rating was on clearly explaining data in visuals, with a weighted mean of 4.52, interpreted as Strongly Agree. Students also agreed that visual aids such as graphs, charts, and tables were used effectively, that they demonstrated confidence while presenting, and that research findings were presented clearly. The lowest rating was on the organization of the report or presentation, although it was still interpreted positively. These findings indicate that students are effective in communicating insights from visualized data. Data visualization tools help improve the clarity, confidence, and impact of research presentations, although students may still improve the organization and sequencing of presentation content. This is supported by Batt et al. (2020), who found that students who engaged in structured, hands-on data visualization activities showed significant improvement in data interpretation skills, analytical thinking, and research readiness. This supports the present findings by reinforcing that consistent integration of visualization tools in learning activities enhances students' ability to understand, analyze, and communicate research data effectively.

### **3.2.5 Digital Literacy and Tool Proficiency**

The results showed that digital literacy and tool proficiency obtained an overall weighted mean of 4.08, interpreted as High. The highest-rated item was the accurate examination of generated outputs from digital systems, with a weighted mean of 4.62 and a verbal interpretation of Very High. Students also demonstrated high proficiency in operating visualization platforms with minimal supervision, applying advanced functions within analytical software, and observing ethical use of technological resources. However, identifying appropriate applications for specific investigative tasks received the lowest rating, although it still remained within the High level. These findings indicate that students have strong digital literacy skills and are generally capable of evaluating digital outputs, using visualization tools, applying software functions, and utilizing technological resources responsibly. The comparatively lower rating in selecting suitable applications suggests that some students may still need additional guidance in matching the right digital tools to specific research tasks. Hands-on use of visualization and analytical tools may further strengthen students' digital literacy and improve their overall research capability in marketing contexts. This is supported by Rogers and Jeffcoat (2024), who emphasized data visualization literacy as an emerging literacy area and identified continuing student gaps in specific visualization types.

## **3.3 Perceived Effectiveness of Data Visualization Tools**

The results showed that data visualization tools were generally perceived as Effective, with an overall weighted mean of 4.18. The highest-rated indicator was the effect of digital visualization tools on the research performance of marketing students, with a weighted mean of 4.84 and a verbal interpretation of Very Effective. This was followed by the level of usage corresponding to research capability, the contribution of visualization tool features to research skills development, the influence of data visualization tools on research capability, and the relationship between adapted tools and research capability. These findings indicate that digital visualization tools play a meaningful and positive role in improving students' research capability, especially in research performance and practical data analysis. The results suggest that students consistently benefit from these tools, although further enhancement and training may still improve the contribution of tool features and overall research capability. This is supported by Hsu et al. (2022), who emphasized that students who actively use data visualization tools and engage in visualization-focused tasks demonstrate improved data literacy, analytical understanding, and research readiness, which directly supports the findings of the present study that visualization tools significantly enhance marketing students' research capability and performance. Valverde-Rebaza et al. (2024) also support

this point by showing the relevance of combining advanced language models and visualization tools in data analytics learning.

### 3.4 Relationship Between Data Visualization Tools and Research Capability

The results showed that collaboration features had the strongest relationship with research capability, with an  $r$ -value of 0.459, indicating a moderate positive correlation. This interpretation is consistent with Cohen's (1988) guidelines for evaluating correlation effect size. Its computed  $t$ -value of 6.283 exceeded the critical value of 1.976, showing a significant relationship and leading to the rejection of the null hypothesis. Software and application followed with an  $r$ -value of 0.362 and a  $t$ -value of 4.720, indicating a low positive but significant relationship. Ease of use and accessibility also showed a low positive and significant relationship, with an  $r$ -value of 0.335 and a  $t$ -value of 4.319. Type of visualization had an  $r$ -value of 0.032 and a  $t$ -value of 0.385, indicating a negligible and non-significant relationship, leading to failure to reject the null hypothesis. Data analysis features had no computed correlation, so no statistical interpretation or decision was established. These findings indicate that data visualization tools influence the research capability of marketing students mainly through collaboration features, software and application, and ease of use and accessibility. The results suggest that accessible, collaborative, and functional tools may improve students' research performance, while the visual format alone does not directly affect research capability. Table 12 is supported by the findings of Batt et al. (2020), Hudiburgh and Garbinsky (2020), Asamoah (2022), and Vázquez-Ingelmo et al. (2024), which showed that the use of data visualization tools such as Tableau and Power BI improves students' data literacy, analytical skills, engagement, and research capability. This supports the present findings that Collaboration Features, Software and Application, and Ease of Use and Accessibility have significant relationships with the research capability of Marketing students.

## 4. Conclusion & Recommendations

The study concludes that marketing students highly utilize data visualization tools, particularly those with strong data analysis capabilities, and demonstrate a high level of research capability, especially in reporting and presenting research findings. The findings further show that data visualization tools contribute significantly to students' ability to analyze, interpret, and communicate research data. Overall, the effective utilization of data visualization tools enhances the research capability of marketing students.

Marketing students are encouraged to continuously use data visualization tools to improve their data analysis, interpretation, and presentation skills. Faculty members may integrate visualization tools into research activities to strengthen students' research capability and digital literacy, while the institution may provide training, seminars, and access to visualization software to support students' research development. A seminar-workshop on "Data Visualization Tools for Enhancing Research Capability" is also recommended to improve marketing students' data analysis and presentation skills.

### Compliance with ethical standards

The authors declare no conflict of interest. This study complied with recognized ethical standards for human-participant research by ensuring voluntary participation with informed consent, the right to withdraw without penalty, and strict confidentiality through anonymous, secure, and aggregated data handling. Given the focus on psychological well-being, procedures were non-invasive, and safeguards were observed to minimize discomfort, with guidance to appropriate support services when needed, and required institutional permissions were secured for instrument use and access to academic records.

## REFERENCES

- Agatep, J. L. E., & Villalobos, R. N. (2020). Research capabilities among selected graduate school students in Philippines. *Science Insights Education Frontiers*, 6(2), 691–705. <https://doi.org/10.15354/sief.20.or037>
- Asamoah, D. A. (2022). Improving data visualization skills: A curriculum design. *International Journal of Education and Development Using Information and Communication Technology*, 18(1), 213–235.
- Batt, S., Grealis, T., Harmon, O., & Tomolonis, P. (2020). Learning Tableau: A data visualization tool. *The Journal of Economic Education*, 51(3–4), 317–328. <https://doi.org/10.1080/00220485.2020.1804509>
- Chang, H.-Y., Chang, Y.-J., & Tsai, M.-J. (2024). Strategies and difficulties during students' construction of data visualizations. *International Journal of STEM Education*, 11, Article 11. <https://doi.org/10.1186/s40594-024-00463-w>
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates.
- Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE.

- Firat, E. E., Joshi, A., & Laramée, R. S. (2022). Interactive visualization literacy: The state-of-the-art. *Information Visualization*, 21(3), 285–310. <https://doi.org/10.1177/14738716221081831>
- Hsu, J. L., Jones, A., Lin, J. H., & Chen, Y. R. (2022). Data visualization in introductory business statistics to strengthen students' practical skills. *Teaching Statistics*, 44(1), 21–28. <https://doi.org/10.1111/test.12291>
- Hudiburgh, L. M., & Garbinsky, D. (2020). Data visualization: Bringing data to life in an introductory statistics course. *Journal of Statistics and Data Science Education*, 28(3), 262–279. <https://doi.org/10.1080/10691898.2020.1796399>
- Matveeva, N., Dorel, L., Kosareva, I., & Sabirova, F. (2023). The influence of educational information visualization trends in higher education for students in the Russian Federation. *Frontiers in Education*, 8, Article 1190150. <https://doi.org/10.3389/feduc.2023.1190150>
- Muniasamy, M. A., Naim, A., & Kumar, A. (2024). *Data visualization tools for business applications*. IGI Global.
- Nagaraj, P., Raja, M., & Rajkumar, D. T. (2024). Development of inquiry-based active learning pedagogy approach to heightening learners' critical thinking skills in data visualization for analytics course. *Journal of Engineering Education Transformations*, 37, 295–304. <https://journaleet.in/index.php/jeet/article/view/2349>
- Paulsen, L., & Lindsay, E. (2024). Learning analytics dashboards are increasingly becoming about learning and not just analytics: A systematic review. *Education and Information Technologies*, 29, 14279–14308. <https://doi.org/10.1007/s10639-023-12401-4>
- Rogers, M., & Jeffcoat, S. (2024). Data visualization literacy skills of information science students. *Journal of Education for Library and Information Science*, 65(4), 410–425. <https://doi.org/10.3138/jelis-2023-0024>
- Stojanov, A., & Daniel, B. K. (2024). A decade of research into the application of big data and analytics in higher education: A systematic review of the literature. *Education and Information Technologies*, 29, 5807–5831. <https://doi.org/10.1007/s10639-023-12033-8>
- Taylor, L., Gupta, V., & Jung, K. (2024). Leveraging visualization and machine learning techniques in education: A case study of K–12 state assessment data. *Multimodal Technologies and Interaction*, 8(4), Article 28. <https://doi.org/10.3390/mti8040028>
- Teimourzadeh, A., Kakavand, S., & Kakavand, B. (2023). Application of Python in marketing education: A big data analytics perspective. *Marketing Education Review*, 33(1), 1–16. <https://doi.org/10.1080/10528008.2021.2021374>
- Valverde-Rebaza, J., González, A., Navarro-Hinojosa, O., & Noguez, J. (2024). Advanced large language models and visualization tools for data analytics learning. *Frontiers in Education*, 9, Article 1418006. <https://doi.org/10.3389/feduc.2024.1418006>
- Vázquez-Ingelmo, A., García-Holgado, A., Verdugo-Castro, S., Therón, R., & García-Peñalvo, F. J. (2024). Data visualization and domain knowledge: Insights through focus groups of researchers in Spain. *Computers in Human Behavior*, 155, Article 108162. <https://doi.org/10.1016/j.chb.2024.108162>