

Enhancing Public Health Awareness through Infographics: A Dual-Method Evaluation of Design and Engagement

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ABSTRACT

This research examines the efficacy of infographics in public health communication, bridging technical engineering education and impactful community engagement. We analyze 100 infographics from the CDC and WHO using a dual-method evaluation. Both static and animated infographics effectively distill complex health data, with animated forms slightly outperforming in engagement metrics. This study highlights the potential of engineering skills in crafting infographics and emphasizes the educational benefits. It advocates for integrating real-world problem-solving into curricula, thereby enriching educational experiences and fostering societal benefit.

Keywords - Infographics, Healthcare Communication, Engineering Education, Community Engagement, Visual Communication, Design Principles, Audience Engagement, Health Awareness

Introduction

Infographics synthesize complex information through visual representation, essential in fields like healthcare. This study explores their use by the CDC and WHO, highlighting an application for engineering education. It discusses how engineering students apply interdisciplinary skills to create effective health communication tools, enhancing their engagement in community-focused projects.

In this paper, "effectiveness" refers to the extent to which infographics meet specific communication goals, including improving public health awareness, enhancing viewer engagement (measured through likes, shares, and comments), and facilitating information retention.

Application In Engineering Education

Infographic design is incorporated into the engineering curriculum, allowing students to address real-world health challenges. Collaborative projects with health organizations give hands-on experience, reinforcing design skills crucial for creating compelling infographics. Incorporating infographic design into the engineering curriculum allows students to apply their technical knowledge to real-world health challenges. Projects collaborating with health organizations offer hands-on experience in creating effective communication tools, aligning with educational goals of community engagement. Through these projects, students practice essential design skills, including layout planning, typography, color theory, and audience analysis, crucial for creating compelling and informative infographics. These activities not only reinforce technical skills but also emphasize the importance of design thinking a key component of engineering problem-solving.

Literature Review

Infographics, as visualizations that amalgamate text and imagery to elucidate data and information, play a pivotal role in disseminating complex concepts across various fields, including healthcare. Li and Molder [3] emphasize that well-designed infographics, particularly within a scientific context, can serve multiple functions: they illustrate intricate concepts, clarify data patterns, offer aesthetic engagement, and bridge the knowledge gap between experts and the general populace. In the healthcare sector, practitioners utilize infographics not only as educational tools to help patients comprehend the risks and benefits of interventions but also as means to communicate research findings, promote health awareness, and persuade towards healthier behaviors [3].

During the COVID-19 pandemic, infographics, specifically those designed by experts for 'flatten the curve' campaigns, demonstrated their effectiveness in public health awareness. Li and Molder [3] observed that these infographics successfully condensed statistical data into accessible, visually compelling formats, facilitating widespread information sharing and encouraging the adoption of preventive behaviors. Thus, they played a significant role in managing the pandemic's impact.

Furthermore, Siricharoen [4] explores the broader application of infographics in health communication, underscoring their ability to make health information more engaging and understandable compared to traditional textual reports. This aligns with various communication theories that advocate for visual aids to enhance understanding and engagement among the public [4]. However, as identified by these authors, a notable gap in existing literature is the lack of in-depth exploration into the differential effects of static versus animated infographics and the specific design elements that contribute to their effectiveness in conveying health-related information.

While studies have acknowledged differences in the impact of animated and static infographics on information communication, understanding, and retention [5], there remains a scarcity of research specifically focused on their application and efficacy within health awareness. Animated infographics are often cited for their interactivity and ability to capture audience attention more effectively than their static counterparts [5]. Yet, their potential in health communication is underexplored and primarily examined within educational settings rather than public health contexts.

Addressing the Gaps. This study seeks to bridge these critical gaps by extensively analyzing infographics employed by healthcare organizations such as the CDC and WHO. By examining static and animated formats, this research aims to elucidate the distinct elements and traits that enhance their effectiveness in health awareness campaigns. Furthermore, this paper contributes to the existing body of knowledge by offering a comparative evaluation of static versus animated infographics, delving into how each format supports the communication of health information and engages target audiences. Through this analysis, our study not only enriches the understanding of infographics' role in health education but also underscores the need for more nuanced research in deploying these visual tools for public health communication.

By addressing these literature gaps, our research provides foundational insights that can inform future studies and guide the strategic use of infographics in health awareness initiatives, ultimately enhancing the effectiveness of public health communications.

Understanding Infographics: A Comprehensive Overview. Infographics, a term that blends "information" and "graphics," refers to visual representations designed to make complex data easily understandable at a glance. This method of presenting information combines various elements such as text, images, charts, and diagrams to convey messages quickly and clearly. The history of infographics dates back to prehistoric times, with early humans using visual representations to document and communicate experiences. Over centuries, infographics have evolved, from ancient cave paintings to Egyptian hieroglyphs, and from the intricate astronomical charts of the Middle Ages to the modern digital infographics we see today. This evolution mirrors humanity's quest to find more effective ways of communicating complex information [6].

The purpose of infographics is multifaceted. They educate, inform, persuade, and even entertain audiences. In healthcare, infographics are invaluable for demystifying medical data and health advisories. They translate intricate health statistics and guidelines into accessible visuals, making them essential in public health campaigns, patient education, and the dissemination of crucial health information [7].

Why Infographics Are Powerful Tools for Communication. Infographics are powerful because they leverage the human brain's ability to process visual information faster and more efficiently than text alone. Studies suggest that visuals are processed 60,000 times faster in the brain than text, and 65% of the population are visual learners. This visual processing capability makes infographics particularly effective in capturing attention, enhancing comprehension, and facilitating information retention [8].

In healthcare, where timely and accurate information understanding can significantly impact outcomes, infographics can bridge communication gaps. They can convey vital health warnings, promote disease awareness, and guide behavior changes for healthier lifestyles. By simplifying complex information, infographics enhance public engagement with health messages, improving health literacy and outcomes.

Moreover, in the digital age, infographics' shareability on social media platforms amplifies their reach, making them a critical tool in fast-paced information dissemination and viral health campaigns. Their versatility allows them to be used across various media, including online publications, educational materials, and public health announcements, ensuring that crucial information is accessible to a broad audience.

Infographics play a critical role in disseminating complex concepts across various fields, including healthcare. They are particularly effective during public health crises, such as the COVID-19 pandemic, where they have been pivotal in promoting preventive behaviors.

Methodology

This study employs a mixed-methods approach, leveraging both qualitative and quantitative analyses, to evaluate the effectiveness of healthcare infographics produced by the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO). Our analysis centers on a carefully curated collection of 100 infographics evenly split between these two organizations. These materials were specifically chosen for their contributions to public health awareness campaigns within the last five years, capturing a pivotal era marked by significant infographic design and digital communication technology advancements.

Selection Criteria for Infographics. The selection of infographics was guided by a rigorous criterion that prioritized relevance to ongoing public health awareness initiatives, representation of a wide array of health topics, and the potential for broad audience reach. This criterion ensured the inclusion of static and animated formats, facilitating a direct comparison of their communication efficacy. We targeted infographics that:

- Demonstrated innovative use of design elements to communicate complex health data or guidelines.
- We were involved in significant public health campaigns, especially those responding to emergent health crises or long-term health promotion strategies.
- Exhibited diverse design styles, from minimalist to data-rich presentations, to understand the spectrum of effective communication strategies in health education.

Our search spanned reputable academic databases such as ScienceDirect, Scopus, and JSTOR, using specific keywords like "animated infographics," "static infographics," and "effectiveness of static infographics." This was supplemented by a review of materials directly from the CDC and WHO online archives. Only peer-reviewed articles and officially released infographics published between 2016 and 2024 were considered, aligning our study with the most recent and relevant developments in the field.

Statistical Methods. Quantitative analysis of the selected infographics was conducted through engagement metrics and statistical correlation tests. Engagement metrics such as likes, shares, comments on social media platforms, and website traffic data were indirect measures of each infographic's ability to capture audience attention and facilitate information dissemination.

To understand the relationship between specific design elements (e.g., use of color, typography, and animation) and audience engagement, we employed Pearson's correlation coefficient for continuous variables and Spearman's rank correlation for ordinal data. These tests were chosen for their ability to identify linear and monotonic relationships, respectively, providing a comprehensive view of how various design factors correlate with engagement levels. The rationale behind selecting these tests lies in their appropriateness for analyzing the types of data collected allowing us to quantify the strength and direction of the association between infographic characteristics and their effectiveness in engaging audiences.

Analytical Framework. This research's dual analytical approach was meticulously structured around both qualitative and quantitative dimensions. Qualitatively, the design elements of each infographic, encompassing color, typography, imagery, layout, and messaging clarity, were evaluated against established health communication principles highlighted by experts such as

Our mixed-methods approach combines qualitative and quantitative analyses. We selected 100 infographics from the CDC and WHO, focusing on their role in public health campaigns over the past five years. Engagement metrics included likes, shares, comments, and the duration and geographic spread of feedback.

Lankow, Ritchie, and Crooks. These principles emphasize simplicity, accuracy, and relevance to the audience as key to effective communication.

Quantitatively, the study employed engagement metrics, including social media shares, likes, and comments, alongside website traffic data, as indirect measures of each infographic's success in engaging audiences and facilitating information spread. This approach allowed for a nuanced assessment of engagement levels, detail richness, and memorability associated with both static and animated infographics.

Data Presentation. Our analysis of 100 infographics 50 from the Centers for Disease Control and Prevention (CDC) and 50 from the World Health Organization (WHO) revealed significant insights into the design and effectiveness of these visual communication tools in the context of healthcare awareness. Certain pieces stood out among the myriad of infographics analyzed for their exceptional ability to engage and inform the audience. For instance, the CDC's infographic "Understanding Antibiotic Resistance" exemplifies effective visual communication through its vibrant colors, clear information hierarchy, and concise messaging that simplifies a complex issue without oversimplification. Similarly, WHO's "Beat the Heat" infographic employs minimalist design and focused messaging to deliver crucial public health advice regarding heat waves, demonstrating how less can be more in visual education.

Data Analysis. The comprehensive data analysis process encompassed thematic and statistical analysis methods to provide a nuanced understanding of infographic effectiveness. Through thematic analysis, we identified recurring patterns and themes within the qualitative data, with a special focus on the role of design elements in the infographics' overall effectiveness. This analysis illuminated how color, typography, layout, and imagery contribute to conveying health messages effectively.

In parallel, statistical analysis, including correlation tests, was employed on the quantitative data to unearth potential relationships between specific design elements and engagement metrics such as likes, shares, and comments. This multi-pronged approach facilitated a thorough comparison between static and animated infographics, yielding critical insights into how each type supports health message communication and engages audiences.

Despite the smaller sample size of animated infographics within the dataset, their inclusion was instrumental in providing essential comparative insights. This aspect of the analysis highlighted animated infographics' unique strengths in capturing attention and enhancing memorability, underscoring their potential to complement static infographics in health communication strategies. The comparative analysis between static and animated infographics, therefore, not only revealed their respective advantages but also demonstrated the importance of further research in this area. This acknowledgment of the smaller sample size for animated infographics does not diminish their value; rather, it emphasizes the need for additional investigation into how

dynamic elements can be leveraged to improve health communication outcomes. The inclusion of animated infographics, despite their limited representation, offers a foundational step towards understanding the broader implications of infographic format on audience engagement and message dissemination, suggesting a promising avenue for future research in enhancing healthcare communication through visual tools.

Importance in Community Engagement. This study's findings illuminate the potential of infographics as effective tools for health communication and underscore their significant implications for engineering education and community engagement. By identifying key characteristics that enhance the efficacy of infographics, our research offers valuable insights for engineering educators seeking to embed practical, real-world problem-solving into their pedagogy. This infographic design and analysis integration within the engineering curriculum can serve as a model for how technical skills and creative design can be harnessed to meet community health needs.

Engineering courses could incorporate project-based learning initiatives where students collaborate with local health organizations to design infographics that address specific public health challenges. Such projects reinforce technical and design skills and foster a deeper understanding of community needs, promoting a culture of civic responsibility and engagement among engineering students. For instance, students could create an infographic campaign to increase awareness about preventive healthcare measures in underserved communities, requiring them to apply their engineering knowledge and an empathetic understanding of the target audience.

Furthermore, interdisciplinary collaborations could be encouraged, bringing together engineering, public health, and graphic design students. This would enrich the learning experience by exposing students to diverse perspectives and enhance the quality of the health communication tools developed, ensuring they are both technically sound and effectively designed. An example of this could be a semester-long project where engineering students partner with public health majors to research a health issue and then work with graphic design students to create an informative and engaging infographic series on the topic.

By weaving these practical, community-focused projects into engineering education, we can better prepare students to apply their skills meaningfully, contribute to public health awareness, and foster a commitment to community service. This study's insights into effective infographic design thus serve as a springboard for innovative educational practices that bridge the gap between engineering expertise and societal needs, reinforcing the importance of multidisciplinary approaches in addressing global health challenges.

Table 1: CDC Infographics Analysis

Category	Name	Type	Elements	Effectiveness
Antibiotic Resistance	Antibiotic Resistance: The Global Threat	Static	Uses colorful images and text to facilitate visual flow, bold text with different fonts and colors, about four pages long, simple to follow.	Very Effective
Cancer	Cancer Worldwide	Static	Colorful, simple, and short statistics are placed in visible and impactful locations; animations complement textual information.	Very Effective
COVID-19	CDC Core Global Programs Leveraged for COVID-19	Static	Concise, statistics are highlighted, very detailed, hard to follow, single-page, complex, not engaging.	Moderately Effective
Diabetes	World Diabetes Day	Static	Colorful, bright, uses large and bright fonts to highlight key statistics, animations complement textual and numerical data, interesting, simple, easy to understand.	Very Effective
HIV/AIDS	CDC on the Frontlines: The Leaders, Experts, Innovators, and Changemakers	Static	Bright, has a photograph, small font for explanations, bolded bright headings,	Somewhat Effective

Table 2: WHO Infographics Analysis

Category	Name	Type	Elements	Effectiveness
Cholera	Various Titles	Static	Bold colors, graphics and animations support information, simple, interactive, engaging, simple to understand.	Very Effective
Diabetes	Various Titles	Static	Bold colors, graphics, and animations support information, simple, interactive, engaging, simple to understand.	Very Effective
Disability and Rehabilitation	Various Titles	Static	Bold colors, graphics and animations support information, simple, interactive, engaging, simple to understand.	Very Effective
Public Health, Environmental and Social Determinants	Various Titles	Static	Bold colors, graphics, and animations support information, simple, interactive, engaging, simple to understand.	Very Effective
Humanitarian Action	Various Titles	Static	Bold colors, graphics and animations support information, simple, interactive, engaging,	Very Effective

Results

The analysis of 100 infographics from the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) revealed insightful trends in using static and animated infographics for health awareness and information dissemination. Key findings highlight both organizations' predominant use of static infographics, underlined by several shared characteristics across both formats: simplicity, the inclusion of bold colors and large fonts, conciseness, and the strategic use of graphics to bolster statistical data, enhancing engagement and memorability.

A notable trend identified was the correlation between specific design elements and higher engagement levels. Infographics that effectively utilized bold colors, clear and prominent typography, and concise messaging were consistently associated with more significant audience interaction, as measured by shares, likes, and comments. Animated infographics, with their dynamic elements and smooth transitions, were found to be particularly impactful and enjoyable, leaving a lasting impression on viewers. These animations contributed to higher engagement rates, suggesting that the incorporation of motion can significantly enhance the memorability and effectiveness of health messages.

Despite these advantages, static infographics were critical in health communication, often providing more detail than their animated counterparts. However, static infographics with overly dense information or small fonts tended to underperform in terms of audience engagement. This underscores the importance of balancing detail with accessibility to ensure effective communication.

In assessing the effectiveness of static versus animated infographics in health communication, our study analyzed several key dimensions: the level of engagement these infographics garnered on social media platforms, the amount of detail they provided, and their memorability among audiences. Engagement was quantified through likes, shares, and comments, while detail and memorability were evaluated based on content analysis and audience feedback surveys. This multi-faceted approach allowed us to comprehensively understand how each infographic type performs across these critical areas.

Figure 1 visually summarizes the comparison between static and animated infographics based on three key aspects: engagement level, detail provided, and memorability. It highlights the nuanced differences in how each type of infographic performs, with animated infographics scoring slightly higher in engagement and memorability, while static infographics provide more detail. This visual representation aids in understanding the strengths of each format in conveying health information effectively.

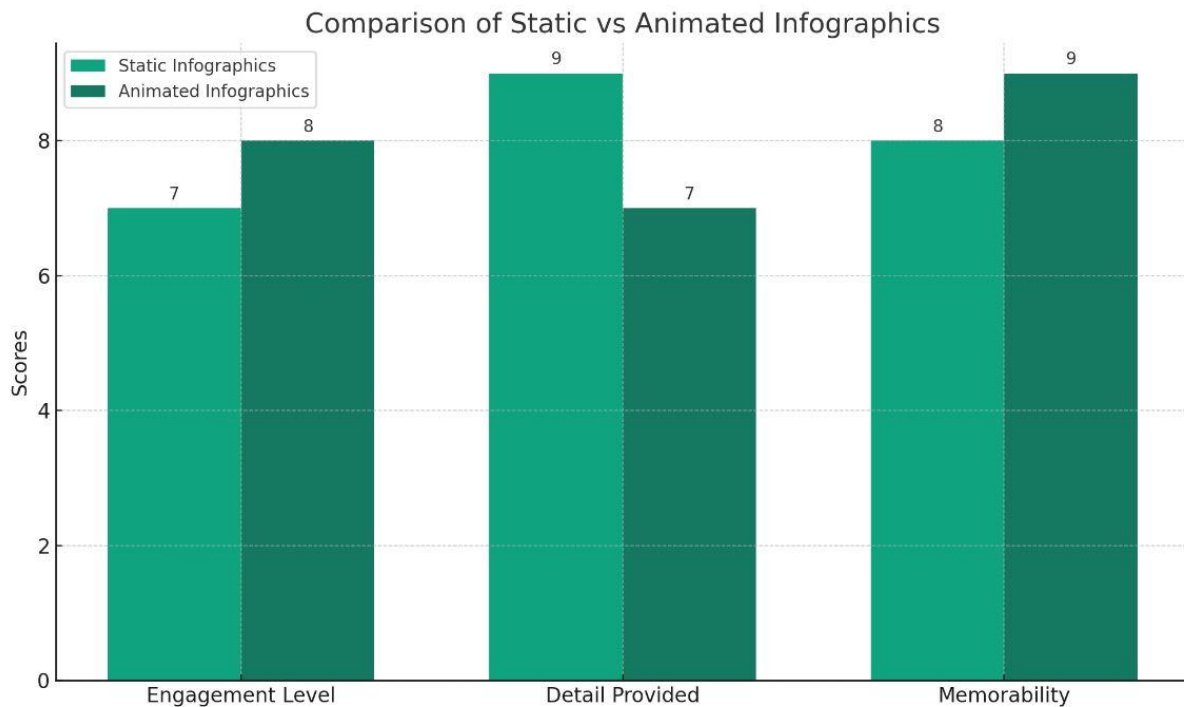


Figure 1: Comparative Analysis of Static vs. Animated Infographics on Engagement Level, Detail Provided, and Memorability. Scores are based on a scale of 1 to 10, where 10 indicates the highest performance. Data reflect aggregated results from audience feedback and social media engagement metrics.

Figure 1 underscores a nuanced dynamic between static and animated infographics in health communication. Specifically, animated infographics scored an average of 8 in engagement level and 9 in memorability, slightly higher than static infographics, which scored 7 in both categories. This suggests that the dynamic elements of animated infographics may more effectively capture and retain audience attention. Conversely, static infographics scored higher in providing detail (9) compared to animated ones (7), indicating their potential advantage in conveying complex information more comprehensively. These findings highlight the importance of selecting infographic types based on the specific goals of the health communication initiative—whether the priority is to engage and captivate the audience or to deliver detailed information clearly and comprehensively.

Overall, both static and animated infographics proved effective in conveying health messages, with no significant differences identified in their ability to raise health awareness. Yet, the reception of animated versus static infographics suggests a preference for dynamic elements among audiences, pointing to the potential benefits of incorporating animations for more impactful health communication.

Assessment of Infographics from a Design Perspective

The evaluation of student-created infographics is conducted through a structured rubric that assesses design efficacy, clarity of communication, and audience engagement potential. This

rubric includes criteria such as visual appeal, data accuracy, and the ability to elicit viewer interaction elements that are critical in public health campaigns. Feedback provided through this assessment process helps students refine their design strategies and better understand the impact of their work on actual audiences, reinforcing the importance of design principles in effective communication.

Motivating Students Through Assessment Data

Assessment data from infographic projects are used not only to grade students but also to demonstrate the real-world impact of their work. By analyzing engagement metrics such as viewer interactions and feedback students see firsthand how their designs perform in the public domain. This visibility motivates students by highlighting the tangible societal benefits of their work, encouraging them to engage more deeply with community health initiatives. It underscores the potential of engineering solutions in addressing public health challenges and enhances student commitment to using their skills for societal benefit.

Discussion

This research was implemented within a foundational engineering course designed to integrate technical and design skills, essential for creating effective health communication tools. The course, titled "Visual Communication in Engineering," is part of the undergraduate curriculum and emphasizes the use of infographics to convey complex health data clearly and effectively.

The application of infographics in engineering education can extend beyond public health into other areas where complex data need to be communicated clearly, such as environmental engineering, biomedical engineering, and systems engineering. These courses can benefit from adopting project-based learning modules that incorporate infographic design, helping students apply their technical knowledge in visually engaging ways. For instance:

- **Environmental Engineering:** Students could create infographics that illustrate the impact of pollution on ecosystems or explain sustainable engineering solutions to the public.
- **Biomedical Engineering:** Infographics could be used to explain complex medical devices or procedures to patients and healthcare providers, enhancing understanding and improving patient outcomes.
- **Systems Engineering:** Infographics can simplify the presentation of complex systems, making them accessible to non-specialists and facilitating cross-disciplinary collaboration.

Furthermore, incorporating infographics into these courses can foster a multidisciplinary approach by encouraging collaboration with students in graphic design and public health. This integration enhances the learning experience by exposing students to diverse perspectives and improving the quality of health communication tools produced, ensuring they are both technically sound and effectively designed.

By expanding the use of infographics across various engineering disciplines, we can enhance students' ability to communicate complex information effectively, promoting a broader understanding and engagement with key engineering challenges and solutions.

Conclusion And Future Work

The study underscores the significant role of infographics in enhancing public health awareness and engineering education. Future research will explore broader applications and assess long-term impacts on community health outcomes. This study showcases how integrating the design and assessment of infographics into engineering education can enhance technical skills, foster design acumen, and motivate community engagement. By emphasizing the practical application of technical skills in solving community health issues, the curriculum not only enriches students' learning experiences but also contributes to public health. Future work will focus on expanding these initiatives, incorporating broader interdisciplinary collaborations, and assessing long-term impacts on community health outcomes, aiming to cultivate a more engaged and socially responsible engineering workforce.

Limitations and Future Directions.

While this study provides valuable contributions to the field of health communication, it is not without its limitations. One such limitation is the potential selection bias in the infographics analyzed. Given the focus on materials produced by the CDC and WHO, the findings may not fully represent the diversity of infographic designs and strategies employed across different health organizations and cultures. Additionally, the analysis methods, though comprehensive, may not capture all nuances of audience engagement and comprehension.

Future research could address these limitations by expanding the scope of infographic sources to include a broader range of health organizations and by employing experimental methods to directly measure audience comprehension and retention of information presented in infographics. Furthermore, exploring the effectiveness of infographics in diverse cultural contexts would provide deeper insights into how cultural factors influence the design and reception of health communication tools.

In conclusion, as we look forward to expanding our understanding of visual communication in healthcare, it is clear that infographics hold significant promise for bridging the gap between complex health information and public comprehension. By continuing to explore and refine these tools, we can enhance their effectiveness in supporting public health initiatives, ultimately contributing to a more informed and healthy society.

Relevance to Community Engagement in Engineering Education. This study exemplifies the application of engineering skills in a multidisciplinary context, underscoring the vital role of design, analysis, and communication in engineering education. Through the investigation of infographics for healthcare awareness, engineering students and professionals are presented with a unique opportunity to apply their technical knowledge and analytical skills in a domain that extends beyond traditional engineering boundaries. The process of designing infographics necessitates a deep understanding of visual communication principles, audience engagement

strategies, and the effective dissemination of complex information. These requirements align with the core competencies that future engineers must possess to address multifaceted challenges in society.

The analysis of static and animated infographics further illustrates the interdisciplinary nature of engineering problems, requiring not just technical proficiency but also an artistic sensibility and psychological insight to ensure messages are not only accurate but also resonate with the intended audience. This project, therefore, serves as a case study for engineering students, highlighting how their skills can be leveraged in diverse fields to contribute to public health, community engagement, and beyond. It emphasizes the importance of design thinking, a critical engineering skill, in the conceptualization and execution of communication tools that can have a significant impact on community health outcomes.

Incorporating the development and evaluation of infographics into the engineering curriculum can enrich students' educational experience, providing them with practical experience in applying their technical skills in novel contexts. This approach fosters a more comprehensive engineering education that prepares students to be versatile problem-solvers, capable of contributing to a wide range of societal needs.

Future Work

To further bridge the gap between engineering education and community health initiatives, upcoming research should explore the collaborative creation of infographics involving engineering students, faculty, and community stakeholders. This approach ensures that the design and dissemination of health information align closely with the community's needs and preferences, maximizing the impact of these communication efforts.

Additionally, assessing the long-term effects of infographic-based health communication on community health outcomes could provide deeper insights into the role of visual tools in promoting sustained engagement and behavior change. Such research would offer valuable guidance for engineering educators and students aiming to contribute meaningfully to public health through community engagement.

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