Seminars in Medical Writing and Education. 2023; 2:27
doi: 10.56294/mw202327

REVIEW

Interactive formats: considerations for scientific publications

Formatos interactivos: consideraciones para las publicaciones científicas

Jhossmar Cristians Auza-Santiváñez[1,2], José Alejandro Carías Díaz[3], Oscar Angel Vedia Cruz[4], Sara Milca Robles-Nina[5], Carlos Sánchez Escalante[6], Blas Apaza Huanca[7]

[1]Ministerio de Salud y Deportes. La Paz, Bolivia.
[2]Universidad Mayor de San Andrés. Bolivia.
[3]Universidad Nacional Autónoma de Honduras, Departamento de Cirugía. Honduras.
[4]Hospital clínico San Carlos. Madrid, España.
[5]Hospital General 450. Durango, México.
[6]ICU Departament, King Salman Hospital Riyadh. Saudi Arabia.
[7]Ministerio de Salud y Deportes. La Paz, Bolivia.

Cite as: Auza-Santiváñez JC, Díaz JAC, Cruz OAV, Robles-Nina SM, Escalante CS, Huanca BA. Interactive formats: considerations for scientific publications. Seminars in Medical Writing and Education 2023;2:27. https://doi.org/10.56294/mw202327.

Submitted: 12-07-2023 **Revised:** 31-08-2023 **Accepted:** 06-11-2023 **Published:** 07-11-2023

Editor: Dr. José Alejandro Rodríguez-Pérez

ABSTRACT

Introduction: in the digital age, information retrieval is dominated by digital data and the demand for digital media is continually growing, consequently the dynamics are very different and e-journals can take advantage of this transition phase as an opportunity to explore ways more effective.
Methods: a bibliographic review was carried out in the main databases and other search services. The terms "interactive formats", "data visualization", "interactive graphics", "scientific publication" were used as search descriptors.
Results: an interactive publication could contain many multimedia objects: text, video, audio, bitmap images, spreadsheets, presentation graphics, or animation sequences. These objects can be in different file formats. Interactive media can be defined as the integration of various digital media content, including multimedia elements (text, graphics, audio, animation and video) into structured and engaging computerized digital content, facilitating dynamic interaction for specific purposes. An interactive approach is interesting and desirable, because users will get dynamic reactions. They have been revealed and demonstrated that the use of 3D technology for academic publications is useful and necessary. However, widespread application is yet to come. The new academic contexts can serve as a starting point for many scientific journals to redefine their position and open new fields of dissemination and financing.
Conclusions: scientific journals must take advantage of the new virtual scenarios to reorganize their communication processes and face new formats of scientific dissemination.

Keywords: Interactive Formats; Data Visualization; Scientific Publication.

RESUMEN

Introducción: En la era digital, la recuperación de información está dominada por los datos digitales y la demanda de medios digitales crece continuamente, en consecuencia, la dinámica es muy diferente y las revistas electrónicas pueden aprovechar esta fase de transición como una oportunidad para explorar formas más efectivas.
Métodos: Se realizó una revisión bibliográfica en las principales bases de datos y otros servicios de búsqueda. Se emplearon los términos "formatos interactivos", "visualización de datos", "gráficos interactivos", "publicación científica" como descriptores de búsqueda.
Resultados: Una publicación interactiva podría contener muchos objetos multimedia: texto, vídeo, audio,

imágenes en mapas de bits, hojas de cálculo, gráficos de presentación o secuencias de animación. Estos objetos pueden estar en diferentes formatos de archivo. Los medios interactivos se pueden definir como la integración de diversos contenidos de medios digitales, incluidos elementos multimedia (texto, gráficos, audio, animación y vídeo) en un contenido digital informatizado estructurado y atractivo, que facilita una interacción dinámica para fines específicos. Un enfoque interactivo es interesante y deseable, porque los usuarios obtendrán reacciones dinámicas. Se han revelado y demostrado que la utilización de la tecnología 3D para publicaciones académicas es útil y necesaria. Sin embargo, la aplicación generalizada aún está por llegar. Los nuevos contextos académicos pueden servir de punto de partida para que muchas revistas científicas redefinan su posición y abran nuevos campos de divulgación y financiación.
Conclusiones: Las revistas científicas, deben aprovechar los nuevos escenarios virtuales para reorganizar sus procesos de comunicación, afrontar nuevos formatos de divulgación científica.

Palabras clave: Formatos Interactivos; Visualización De Datos; Publicación Científica.

INTRODUCTION

Traditional academic publications have contributed to scientific culture by producing static representations in the form of published documents to disseminate innovative concepts. This publication model is linear and unidirectional, creating a separation between research and findings, and between research producers and the peer community. This model is largely anonymous and provides limited opportunities for receiving feedback from the broader community, either before or after publication. It operates within an environment where delays in communication between producers and consumers are accepted, even if delays span years.[1]

However, nowadays, sciences are published online. Indeed, some journals have entirely moved away from physical print, using technology for rapid production and dissemination.[1] The presentation of supplementary online material, like extensive data tables, has become a common practice—a prime example of the advantages resulting from the adoption of electronic journals.[2]

Considering the fast pace of current scientific innovation, mere dissemination is no longer an adequate model to ensure that science progresses based on the results of others. Instead, what is needed are integrated approaches that offer chances for collaboration, negotiation, and knowledge construction within the community during the initial phases of publication. Additionally, mechanisms must be established to publish a wider array of intellectual products for communal sharing and reuse. In recent years, this academic publication approach has been explored within the context of an electronic journal.[1]

Interactive media can be defined as the integration of various digital media contents, incorporating multimedia elements like text, graphics, audio, animation, and video. These are embedded within a structured and captivating digital content, enabling dynamic interaction for specific purposes. An interactive approach is both captivating and desirable, given that users experience dynamic or unpredictable reactions to their actions.[3]

In the digital era, information retrieval is governed by digital data, and the demand for digital media is continuously growing. As a result, the dynamics are markedly different, giving electronic journals a chance to explore more efficient avenues of academic discourse and quality control during this transition.[1,3]

In this regard, the consumption of scientific content requires a dual effort: first, from the audience to comprehend the most complex processes of science, and second, from communicators and content creators. They hold the responsibility of understanding the audience's science consumption habits and should create an audiovisual product that meets these expectations.[4]

There's a need to encourage a reconsideration of scientific communication formats, enriching the conventional written article by incorporating alternative audiovisual formats. These new formats should promote interactivity, ubiquity, portability, and seamless integration into modern academic structures.[5]

Finally, this review was conducted to explore the diverse interactive formats applicable to scientific publication.

METHODS

Information search was conducted across databases including Redalyc, Elsevier Science Direct, PubMed/Medline, SciELO, ClinicalKeys, and the Google Scholar search engine. Advanced search strategies were used to retrieve information by structuring search formulas using terms such as "interactive formats," "data visualization," "interactive graphics," and "scientific publishing," and their equivalents in Spanish. From the obtained documents, those offering theoretical and empirical information on the research topic were chosen, written in either Spanish or English.

DEVELOPMENT

Traditional scientific data visualizations and explorations face limitations due to interactions controlled by keyboard, mouse, and multi-touch devices, restricting the operational space within a two-dimensional framework. Because of the constraints of traditional devices, both the mouse and multi-touch devices exhibit inadequate performance when it comes to depth-direction movements and hybrid interactions in three dimensions.[6,7]

Given the primarily electronic publishing landscape, why there aren't well-established alternatives to the traditional printable 2D diagrams? Certainly, the challenge of sharing and publishing multidimensional datasets has been identified previously. Apart from films and animations, several alternative solutions have been deliberated in recent years, encompassing interactive PDF documents, augmented reality, 3D printing, and interactive HTML documents.[2]

An "interactive publication" has the potential to include numerous multimedia objects, such as text, video, audio, bitmap images, spreadsheets, presentation graphics, or animation sequences. These elements can exist in various file formats, such as text in Microsoft® Word or PDF, spreadsheets in Microsoft® Excel, video in Adobe® Flash Video or Quicktime®, Adobe® Flash animations, clinical images following DICOM2 standard, 3D representations of 2D image sequences, and so forth.[7,8]

In other words, the document becomes a research tool. By creating such documents and providing tools for their use, it becomes easier to disseminate them to a broader audience. This facilitates better examination of improvements in learning and understanding compared to conventional static publications.[8]

Narrative approaches in visualizations and data exploration for scientific data can aid users, especially non-experts, in achieving a deeper comprehension of the information.[6] The focus should be on how supplementing academic documents with associated secondary resources (like survey data, video clips, demonstrations, comments) that could support academic interpretation. This support could aid in evaluating the uniqueness of ideas, results quality, and method appropriateness.[1,9]

However, most of these propositions suffer from two main deficiencies.[2]

Firstly, these techniques are largely associated with specific software, some of which are not open-source. Depending on specific software restricts the user's freedom of choice and frequently hampers the ability to experiment with these new techniques. Software is also subject to rapid changes and evolution, causing specific tools to unexpectedly become obsolete at a fast pace.[2]

Secondly, the level of endorsement by major scientific journals varies for these different methods. Currently, none of these techniques have the unanimous active support and promotion of all journals. Therefore, the different visualization techniques mentioned earlier are frequently viewed as experimental. Certainly, the reliance on specific software to implement these different solutions also contributes to this perception.[2]

Apart from design examples, an evident domain where electronic journals can enhance scientific value is by granting access to audio or video data. Excerpts from transcripts, which can be challenging for readers to understand when removed from the source, now gain clarity when viewed alongside the original conversation or the embedded video clip within the text.[1]

Articles may incorporate embedded examples within the text using web browser add-ons or downloadable content for readers to run on their devices. Guided tours, carried out via screen recordings along with optional author commentary, present an alternative and more effective method of communicating the work compared to static screenshots. As a significant part of research in this field involves the use of websites, it's easy for authors to provide direct links to an active site or a specially prepared version (for instance, with a guided tour) for readers to experience firsthand what they've been reading about.[1,7,9]

Some authors have suggested the following attributes as essential for an interactive publication:[8]

- The document should resemble or offer a paginated view similar to that of a traditional article. This involves providing access to a diverse array of fonts, weights, styles, paragraphs, multi-column formatting, among other features.
- Enabling the traditional use of the keyboard and mouse for page transitions and navigating within the page.
- The most commonly used image formats should be natively compatible.
- Being able to activate audio, video, and other objects should be possible.
- The document should natively support interactivity with tabular data, images, and other multimedia content. Authors should be able to define the necessary metadata to manage interactivity with multimedia data.
- Data in specialized and proprietary formats should be viewable using appropriate supporting application software.
- The document model should allow for reader-controlled sequential transmission in multimedia-rich documents with heavy data usage, ensuring convenient access.
- The document model should support both embedding and linking of multimedia and other

interactive data, such as dynamic tables or active images.

- It is crucial that the document remains self-contained, implying that multimedia components should be present within the document itself rather than solely existing in remote databases.

A number of the desired features are present in current published file formats, standards, or recommendations. For instance, it's feasible to integrate multimedia components within the suite of products offered by Microsoft® Office or Adobe® Acrobat.[8]

Visualization has become pivotal in the current management and dissemination of information, to the extent that it's almost impossible to find an article, book, or written material lacking of some form of graphical representation to illustrate its findings. The primary reason for using visualization lies in the assertion that humans' most advanced sense is vision, making it the simplest way to communicate information, especially when it is intricate or extensive.[9,10,11]

Studies on journal groups have revealed a limited use of multimedia resources in publications, considering the multiple advantages provided by the digital medium. Most of them use photography and images, but very few use videos, animations, and audio.[12]

3D graphics

The computing power accessible to scientists nowadays typically facilitates the management of multidimensional datasets as they progress through all phases of analysis, simulation, and data reduction. However, during the stage of results publication, multidimensional datasets undergo systematic division, compression, and/or projection. Because scientific journals were traditionally printed on paper, it was necessary for scientific diagrams—used to illustrate complex dataset contents—to be printable. This requirement often led to the compression of multidimensional datasets into a two-dimensional format.[2,9]

In recent years, the usefulness and necessity of using 3D technology for academic publications have been revealed and proven. However, broad implementation is still pending. One possible explanation might be the hard process that has been necessary until now to produce appropriate data and pertinent electronic documents.[13]

Three-dimensional data is progressively accelerating across various scientific fields. The portable document format serves as a highly appropriate medium for visualizing and publishing such data.[13]

In many scientific fields, the availability (and thus, the significance) of 3D data has increased in recent years. Consequently, these data often serve as the cornerstone of scientific publications. To prevent information loss, the visualization of such data should be in 3D whenever possible. However, nearly all existing visualization methods (such as paper prints or computer screens) only offer a 2D interface. The most common solution to this limitation is projecting 3D data onto the available 2D plane, resulting in what is known as "2.5D visualization". This projection poses two primary problems: restricted depth perception and overlapping objects. A simple yet efficient solution to these challenges involves interaction: by adjusting the projection angle in a 2,5D visualization (that is, changing the viewpoint), it enhances depth perception while improving the visibility of previously obscured objects.[11,13]

Despite the availability of numerous tools and libraries that facilitate the creation of 3D model files and final PDF documents, the entire process remains challenging. There are various issues at hand: certain tools require programming expertise, and some lack support for key features essential to 3D scientific data, such as polylines and point clouds. Additional conflicts arise from compatibility issues with the operating system platform and royalty-free use.[13]

However, the main issue remains the creation of the final PDF files. Defining the content and, specifically, the layout of a document can be a complex task typically handled by highly specialized word processing software.[13]

It's worth mentioning that many previously published 3D models are quite large, sometimes reaching nearly 100 megabytes. In most cases, this size could be substantially reduced (certainly it should be) since excessively high polygon mesh density is typically unnecessary for illustrative purposes.[13]

Embedded videos and video articles

New academic contexts may offer a starting point for numerous scientific journals to redefine their position and explore fresh avenues for dissemination and financial support.[5,7]

Video is the preferred dissemination format due to its dynamic, engaging, and visual nature. The video article would represent one of the most potential formats for dissemination, and no communication journal currently includes it in its pages or web platforms.[5]

The emerging audiovisual formats can be displayed on multiple devices and align with the principles of ubiquity and portability. In order to accomplish this, the platforms and websites providing journal content need restructuring to evolve into digital platforms for scientific knowledge and dissemination, going beyond mere repositories for edited articles.[5]

https://doi.org/10.56294/mw202327

The concept of a video article involves authors presenting and explaining their written work through video format. A video "pill" lasting between five and fifteen minutes, freely accessible through a "Creative Commons" license, even within journals adopting a "pay-per-view" format.[5]

The video article serves as a supplement to the written content, encompassing all technical information, specifically focusing on the research methodology. It is important to strike a balance between engaging presentation and scientific rigor in each conveyed idea, aiming to be beneficial to a broad audience interested in the subject matter. A superficial approach would add minimal value, and an overly detailed development could make it harder to follow.[5]

An advantage of this new platform would be the opportunity to display video articles on both scientific and general social networks, enhancing the dissemination of scientific activity. This would represent a qualitatively significant step forward for scientific journals. The video article would primarily leverage social networks as a dissemination format alongside the written format.[5,9]

CONCLUSIONS

Interactive digital content involves active participation from consumers, transforming the individual into an integral part of a dynamic and two-way experience. This makes it more engaging and exciting. This type of resource transforms the experience into an active one rather than a passive one. While they demand a bit more effort to be created, users gain greater value from these resources. Their implementation in scientific publications is essential and imminent given the presence and advancement of various new information technologies. Scientific journals must use the new virtual environments to restructure their communication processes and embrace novel formats for scientific dissemination.

REFERENCES

1. Buckingham Shum S, Sumner T. JIME: an interactive journal for interactive media Learned. Learn Publ. 2001;14:273–85. https://doi.org/10.1087/095315101753141374

2. Vogt FPA, Owen CI, Verdes-montenegro L, Borthakur S. Advanced data visualization in astrophysics: the X3D pathway. Astrophys J. 2016;818(2):115 (10pp). http://dx.doi.org/10.3847/0004-637X/818/2/115

3. Prasetya DD, Wibawa AP, Hirashima T. An interactive digital book for engineering education students An interactive digital book for engineering education students. World Trans Eng Technol Educ. 2018;16(1):54–9. https://www.researchgate.net/publication/323905909%0AAn

4. Muñoz A, Jiménez J. El formato documental: la clave de la divulgación científica audiovisual. Vis Rev. 2021;8(2):227–38. https://doi.org/10.37467/gka-revvisual.v8.3000

5. Vázquez-Cano E. El videoartículo: nuevo formato de divulgación en revistas científicas y su integración en MOOCs. Rev Científica Educomunicación. 2013;XXI(41):83–91. http://dx.doi.org/10.3916/C41-2013-08

6. Liu R, Wang H, Zhang C, Chen X, Wang L, Ji G, et al. Narrative scientific data visualization in an immersive environment. Bioinformatics. 2021;37(14):2033–41. https://academic.oup.com/bioinformatics/article/37/14/2033/6128509

7. Ackerman M. The Educational Value of Truly Interactive Scientific Publishing. New Forms Expr. 2015;18(2). https://doi.org/10.3998/3336451.0018.201

8. Thoma GR, Ford G, Antani S, Demner-fushman D, Chung M, Simpson M. Interactive publication: The document as a research tool. Web Semant Sci Serv Agents World Wide Web. 2010;8:145–50. https://doi.org/10.1016/j.websem.2010.04.001

9. Srivastava D. An Introduction to Data Visualization Tools and Techniques in Various Domains. Int J Comput Trends Technol. 2023;71(4):125–30. https://doi.org/10.14445/22312803/IJCTT-V71I4P116

10. Colaboradores de Wikipedia. Visualización científica. Wikipedia, la enciclopedia libre. 2022. https://es.wikipedia.org/w/index.php?title=Visualización_científica&oldid=148161916

11. Kaushik R. 5 formas en que la visualización de datos ha ayudado a nuestros clientes. Cynoteck. 2022. https://cynoteck.com/es/blog-post/how-data-visualization-has-helped-our-clients-make-more-money/

12. González-Peña M, Espino-Hernández M. Principales elementos de contenido y forma para elaborar un proyecto de revista científica electrónica estudiantil. Rev Cuba Inf en Ciencias la Salud. 2014;25(2).

13. Newe A. Enriching scientific publications with interactive 3D PDF : an integrated toolbox for creating ready-to-publish figures. PeerJ Comput Sci. 2016;2:e64. https://doi.org/10.7717/peerj-cs.64

FINANCING

No external financing.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORSHIP CONTRIBUTION

Conceptualization: Jhossmar Cristians Auza-Santiváñez, José Alejandro Carías Díaz, Oscar Angel Vedia Cruz, Sara Milca Robles-Nina, Carlos Sánchez Escalante, Blas Apaza Huanca.

Research: Jhossmar Cristians Auza-Santiváñez, José Alejandro Carías Díaz, Oscar Angel Vedia Cruz, Sara Milca Robles-Nina, Carlos Sánchez Escalante, Blas Apaza Huanca.

Methodology: Jhossmar Cristians Auza-Santiváñez, José Alejandro Carías Díaz, Oscar Angel Vedia Cruz, Sara Milca Robles-Nina, Carlos Sánchez Escalante, Blas Apaza Huanca.

Writing - original draft: Jhossmar Cristians Auza-Santiváñez, José Alejandro Carías Díaz, Oscar Angel Vedia Cruz, Sara Milca Robles-Nina, Carlos Sánchez Escalante, Blas Apaza Huanca.

Writing - proofreading and editing: Jhossmar Cristians Auza-Santiváñez, José Alejandro Carías Díaz, Oscar Angel Vedia Cruz, Sara Milca Robles-Nina, Carlos Sánchez Escalante, Blas Apaza Huanca.