User Interface Model for Scientific Publications

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The dissemination of scientific knowledge has evolved over the centuries from handwritten to digital documents available for consultation online. Even if it primarily relies on digital media, academic publishing still generally adheres to its historical paper-based style - where static content is presented in the ready-to-print letter format. This paper addresses the work in progress on creating a scientific publication model in hypermedia focused on the User Experience design. In this way, it reflects new ways of presenting scientific content as more interactive and engaging, using multimedia features, such as video, audio, 3D animated images or interactive infographics.

Electronic publishing. Human-computer Interaction. Multimedia.

1. INTRODUCTION

The Internet has changed the way we publish and distribute scholarly works. While printed books and journals were the primary publication medium during past centuries, today's scientific results are increasingly disseminated via the Internet. Currently, however, the scientific publications today on the Web still resemble the traditional print production process: they are typically static documents organized linearly into chapters and sections, and primarily include texts and static images.

A static image can better communicate an idea than written text. Scientists have long recognized this idea, and have been including charts, drawings and photographs in their research articles even before the availability of desktop computers and document editing software.

Similarly, one could argue that a video or animation can, in some cases, be more effective at expressing a concept than a static image [1]. This is mainly the case in research areas such as Human - Computer Interaction (HCI) and Computer Graphics, which deal with multimedia and interactive systems.

Surprisingly, scientific publications do not yet make full use of the potential of interactive multimedia systems and the concepts of the User Experience (UX). Scientific documents are usually stored in isolated databases and are rarely linked to other resources on the Web. Because of their document-centric nature, they often ignore the integration of

data sets required for reproducing the described experiments, and other supplemental materials.

The need to process huge amounts of data analysis and communicate its results to the scientific community presents a major challenge for researchers. While Web-based tools have been proposed to address this problem, most of them lack important features to show the scientific work visually such as interactive infographics, 3D animated images, video, etc.

Therefore, scientific publications with embedded videos or animations are rarely published. Instead, venues may allow authors to submit a separate video, which accompanies their article. This is somewhat primitive, equivalent to submitting a deck of figures that accompany a paper, instead of embedding the figures directly into the article itself.

Specifically, this work in progress describes a survey that is about how the use of interactive multimedia features can provide an increased understanding of the article through an interactive reading experience. The focus must be on the precautions necessary to ensure an aesthetically pleasing experience and efficient learning.

In this work in progress, it first provides a discussion of the current state of scientific publications and the result obtained from the analysis of different types of scientific platforms that use some interactive multimedia features. Additionally, it describes the workflow that will be developed for creating a scientific publication model in hypermedia focused on the UX Design.

2. SCIENTIFIC PUBLICATION BACKGROUND

History reveals that over the centuries, technology has always transformed cultural practices where it is inserted [2]. The revolution in reading practices was founded on a breakthrough in society and the need for radically new learning. At the beginning of the Christian era, readers had to turn from a scroll (a roll of parchment paper) and were faced with a new object, the codex, which allowed them to have a new experience and reading method – that of paged reading [3].

Today, new experiences of reading occur in the digital environment. In the same way, academic publishing has undergone changes over the decades as the writing, submission and dissemination processes evolved from a fully physical form to one increasingly reliant on electronic media [4].

The Journal of Image Guided Surgery (1995) was the first peer-reviewed journal to offer an electronic version of its articles when bandwidth allowed quick download of files, later followed by many other journals [5]. With digitization, the object itself, scientific journals, its modifications, new possibilities, such as color figures became commonplace - which improved the visualization of scientific publications. However, in spite of such a shift—and contrary to early predictions [6]—articles have kept their print-based nature.

In a slow way, scientific communication is adapting and blending the cultural practices of reading the printed page for digital academic publishing [3]. Meadows [3] argues that the readers would not be disconnected from the creation of new graphic designs for electronic text in relation to the print medium. As recorded historically, most expect that digital publications are initially similar to those in print, but with time, the readers can adapt and modify their reading practices.

Constrained by the paper medium, the use of footnotes leads the reader to be aware of other literature related to the field of study, also showing a tendency for non-linearity [7]. With the use of the technologies in the reading process, scientific content can be more dynamic. Allowing greater flexibility and range of applications compared to the traditional system - there is the presence of particular characteristics of the digital medium, such as hypertext, multimedia, and interactivity, which transforms the reader's relationship [8].

The use of hypermedia in scientific publications can provide variation in the intensity of their use, based on the linear model for the integration with interactive multimedia and tools for data analysis

using a more visual layout and directed to nonlinear reading [9]. Besides that, there are a number of proposals and theories concerning hypermedia and learning. One important claim is that it offers more control over the environment for the user. Another claim from psychology includes the notion that hypermedia more closely models the structure of the brain, in comparison with printed text [8].

In this way, the digital medium auxiliary material in the form of video figures developed in scientific branches such as Computer Graphics and HCI which deal with interactive systems. Similar to paper submissions, multimedia material was initially mailed on VHS or disks. As digital video file formats matured, such videos could be submitted using electronic web-based systems [10]. Even so, with rare exceptions, such as JoVE¹ (Figure 1) which (exclusively) publishes contributions in video, the vast majority of publications detach the multimedia content from the actual articles, even though embedding rich media in PDF files has been available since as long as ten years ago [1].

Figure 1: The Journal of Visual Experiments

Though no model has yet imposed itself, diverse scientific communities are making efforts to create interactive academic publications. The Optical Society of America and the National Library of Medicine at NIH that jointly developed “interactive science publishing” (ISP). 2D/3D data figures can be viewed and analyzed interactively by the reader using this software².

3. APPROACHES AND METHODS

This work in progress shows the study questions, which are the range of affordances in interactive multimedia features that open new possibilities for knowledge-making, and how they improve the reading experience and access to the content (more dynamic and user-friendly) in scientific publications.

In this respect, an analysis was made of how interactive multimedia resources are implemented in the publications of the Elsevier, Plos One and Pub Pub platforms, which brought collaborations to the development of the study. Understanding the

¹ Available in: <http://www.jove.com/>

² Other examples of publications will be mentioned in the Results and Future Directions section.

fundamental nature of interactive multimedia features in relation to publications requires an exploratory approach. Analyzing the extent to which interactive multimedia features is reflected in scientific publishing also demands a user-centered design approach.

With the development of research processes and integration of new technologies in communication, the UX will guide the development phases of the proposed model. The ISO standard lists three factors that influence the User Experience: the system, the user and the context of use [11], on which the proposed model in this thesis focuses.

The field of UX represents an expansion and extension of the field of usability, to include the holistic perspective of how a person feels about using a system [12]. Therefore, in this research, a number of methods, including usability tests questionnaires, discussion, and evaluation of interfaces, for constructing and implementing a hypermedia model for scientific publications, measures the UX of an interactive product. User-centered approaches are commonly accepted to be the best way to create more effective learning tools and take advantage of the increasingly utilized HCI [13].

The model should be directed to the user profiles of the scientific publications in hypermedia. The UX starts from the premise that the user must be considered at each stage of the project. Consequently, even if the interface in scientific publications are designed for a wide profile of users and many varied features, it should offer alternatives to the most inexperienced of them, so that they can comprehend information, although, it must be done with supporting tools (i.e., tutorial instruction) [14]. Moreover, application stages of the case study and evaluation - evolving usability testing with the user - will be held for the purpose of improvement and refinement of the model.

4. RESULTS AND FUTURE DIRECTIONS

The literature review of recent studies showed that technologies available incorporate enrichments as a powerful tool for the development of new models. It offers content through video, audio, animation, and other resources, creating new interactive expectations in the reader. Thus, the interactive multimedia features in the scientific publications cause changes in communication in a new context, which have a significant effect on the acquisition of knowledge.

Publishers are aware of the need to innovate and improve the way scientific information is communicated and used. They also recognize that in an age of online publishing with a rapid expansion of supplemental materials, including those that are interactive [2]. Consequently, what researchers and

scientific readers expect is greater multimedia visuality and faster access to information

In the first phase, this study conducted an analysis of three different scientific platforms types currently available (open source, closed source and collaborative platforms) to understand and measure how they are using interactive multimedia resources in their publications. The platforms are, Elsevier (Figure 2), a closed source that provides web-based solutions for science. The project called "The Article of the Future" [15], corresponds to an initiative that aimed to redesign the traditional linear format of the academic paper to make it more dynamic. The platform allows interactive visualizations and multimedia resources.

Plos One, for being an open source that presents an interactive layout and media resources associated with publications. Pub Pub for being a collaborative platform proposal that provides tools for the users to create their own multimedia publication online. The Pub Pub platform (Figure 3) has been designed and developed by Travis Rich and Thariq Shhipar at the MIT Media Lab in Andrew Lippman's Viral Communications group. Furthermore, the scientific publications analyzed incorporate presentation improvements, such as the use of multimedia features and some interactive content.

Figure 2: Example of Elsevier layout

Figure 3: Example of Pub Pub layout

Nonetheless, as analyzed on Elsevier, the multimedia content is processed separately. The publication in the platform has three-pane-based content exploration. The layout has a navigation bar

on the left pane, main content (text and image only) area on the middle pane, and a right pane sidebar which provides access to supplementary information (cited, metrics, related content, and multimedia).

Besides, all platforms are customizable – the user can personalize the content, but Elsevier and Pub Pub only hide images and elements. Pub Pub for being a collaborative platform allows users to create the content and edit it, as well as other readers and collaborators. While these improvements are expected to influence the acquisition of the knowledge embodied in the publication, they do not have the necessary interactivity to become a dynamic publication.

Therefore, interactivity is operationally defined as a purposeful action by the user, which causes a directional change or a meaningful response by the system with regard to the content. In essence, the dynamic action and interactivity would require the user to actively intervene in the process, while the presentation improvements allow the user to engage the material more efficiently.

Consequently, the UX Design leads the construction of a prototype that will be specified and developed, implementing a hypermedia model for scientific publications. The methodology used to design the proposed model gives attention to the optimization of learning and efficient use of interactive multimedia resources embedded in the paper, including usability tests and an evaluation of the proposed model and interface.

The focus is on the reading experience and access to the content as well as performance. This shapes the readability of communicative discourse with the concepts of the new era of interactivity and nonlinearity. The prototype will be designed based on achieving the integration of static and dynamic content. As an example (Figure 4), the use of text and interactive graphics, in which the graphic adjust to the textual navigation, as well as, video or related content.

In this fashion, animated video and interactive visual representations of numerical data can communicate complex information in a clear, expressive, and illuminating manner, revealing patterns and relationships that would otherwise remain hidden in lists of numbers. An example is clicking on a label illuminates that slice, connecting written and visual representation. Data visualization is a relevant tool for researchers, they use graphs and charts to rapidly compare data sets.

The presentation of the information will be conceived for a rich experience through visuals and interaction, including appropriate functionality for researchers, adaptable to the user's skills, and the context of use. Nearly every instance of information design relying on typography to label visual elements, as well as, employed for scientific model.

Figure 4: *Integration of interactive multimedia content*

All of these multimedia interactive features will resort to gestures and tangible interactions for devices that go beyond simply clicking a mouse button or swiping to turn the page. These affordances draw users into the content through their interactive features, making the process of reading such publications more collaborative, personal and active.

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