Image quality in electronic journals: A case study of Elsevier geology titles

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Abstract

This study's purpose was to establish the image quality of photographs and figures in online journals verses the print format of five Elsevier titles. The images were evaluated on a point scale, taking three issues out of each journal every five years from 1970 to 2000. The study discovered that there is a significant loss of content in the online photographs from 1970 to 1995. The data found in this study provide important discussion points when considering the purchase of electronic journal backfiles.

1. Introduction

There is a growing trend for academic scholars to collect much of their information from online resources. Published studies have shown the increase in electronic journal usage by faculty and students, such as at Washington State [1], and the University of Illinois, Urbana-Champaign, which had 4 million PDF downloads in one year [2]. One of the ways to access information online is by downloading PDF files created from scanned printed pages. Due to the potential size of PDF files, the software provides a choice to scan at different resolutions. Lower quality scans (i.e., 8-bit) make smaller files that are faster to produce, and easier for scholars to download, but also produce lower quality figures and photographic pictures than both the print version and digitally born graphics. If the articles were all text-based the publishers could scan at a lower resolution. However, many science articles contain photographic images, illustrations and graphs that do not reproduce as clearly in an 8-bit resolution scan. Images such as thin sections and detailed pictures of land formations are very important to geologists. Biologists need to study images of organisms; chemists must study chemical structures and reactions; and astronomy students must be able to study images of the sky. Each of the sciences has some need for good image quality to fully represent information in their respective disciplines.

The issue of image quality would not be as crucial if there was not a trend for libraries to focus on developing their electronic journal collection, while holding fewer print journals. The rise in use and demand for electronic access to current and back issues of journals in academia has been significant. This has led some libraries to change both their role and their physical space for the new needs of their patrons. In 2005, the Chemistry Library at the University of Illinois, Urbana-Champaign, found that the role of the library had shifted from resource center to a place for students to study and do group projects [3]. Their solution is to move the library into a smaller space with a more study-friendly, totally wired environment rather than hosting stacks of print materials. To save physical space, librarians can choose electronic subscriptions to replace the print version. A problem arises, however, if the electronic version of the journal is not of the same quality as the print version.

2. Purpose

This paper is intended to help librarians become aware of the significant image quality problem in electronic journals that can affect the scholarship of their patrons. Evaluation is a very important part of decision making for librarians, and good decisions must be based on good data. The following data provide an example of how one institution's departmental library evaluated the images in its electronic journal collection.

3. Background

The Geology Library at the University of Illinois, Urbana-Champaign (UIUC), had the opportunity to make space in its already full stacks in early 2005 due to the construction of a new remote storage facility. The geology librarian selected low usage items and serials that have full access online to be moved during the first stage of the transfer to the storage facility.

After completing this initial transfer, the librarian was approached by patrons concerned about the low quality of photographic images found in the online form of the geology journals. Patrons were being forced to recall print journals from remote storage in order to get needed information from images. Therefore, the geology librarian took note of the patrons' concerns and pursued the issue.

The geology librarian discussed concerns regarding the image quality of PDFs with representatives from Elsevier during a meeting at UIUC on March 10, 2005. The representatives stated that Elsevier was “committed to improving quality” [4] and they suggested that the librarian send them the citation of any pages that needed to be rescanned. This meeting prompted two brief surveys, followed by a more in-depth survey, conducted by the geology library graduate student from May 2005 through the fall semester. The initial survey consisted of a brief review of a few randomly issues selected from each of the 35 currently subscribed Elsevier journals (Table 1) to determine if there were some figures or photographs that were of lower quality than the print counterpart. The preliminary study focused on electronic journal backfiles, dating from the journal's inception up until 1995. After reviewing just a few of the journals, a trend emerged suggesting that the image quality of photographic images in the PDFs was not acceptable for scholarly research. Of the 35 current subscriptions briefly surveyed, 29 titles showed some problems. Seven journals showed either good quality photographic scans or only minor problems with figure scans. Not every sample issue contained photographic pictures to evaluate.

Table 1.

The 35 electronic Elsevier journals currently subscribed to by the UIUC Geology Library

Journal title	**Electronic subscription details**
Applied Geochemistry	1986–current
Catena	1976–current
Chemical Geology	1967–current
Continental Shelf Research	1982–current
Earth and Planetary Science Letters	1966–current
Earth-Science Reviews	1966–current
Engineering Geology	1965–current
Estuarine, Coastal and Shelf Science	1982–current
Geobios	1995–current

Journal title	Electronic subscription details
Geochimica et Cosmochimica Acta	1950–current
Geomorphology	1987–current
Global and Planetary Change	1989–current
International Journal of Coal Geology	1980–current
Journal of African Earth Sciences	1983–current
Journal of Asian Earth Sciences	1997–current
Journal of Contaminant Hydrology	1986–current
Journal of Geochemical Exploration	1972–current
Journal of Geodynamics	1984–current
Journal of Hydrology	1963–current
Journal of Sea Research	1996–current
Journal of South American Earth Sciences	1988–current
Journal of Structural Geology	1979–current
Journal of Volcanology and Geothermal Research	1976–current
Marine Chemistry	1972–current
Marine Micropaleontology	1976–current
Organic Geochemistry	1977–current
Palaeogeography, Palaeoclimatology, Palaeoecology	1965–current
Physics of the Earth and Planetary Interiors	1967–current
Precambrian Research	1974–current
Quaternary International	1989–current
Quaternary Research	1995–current
Quaternary Science Reviews	1982–current
Review of Palaeobotany and Palynology	1967–current
Sedimentary Geology	1967–current
Tectonophysics	1964–current

The second preliminary survey consisted of reviewing every issue of the 35 journal backfiles and noting the first page of each issue that contained image quality problems [5]. This second study found 31 of the 35 journal titles have significantly low quality images throughout the entirety of the journal.

Five of these 35 journals were chosen for closer investigation: *Chemical Geology*, *Earth and Planetary Science Letters*, *Earth-Science Reviews*, *Engineering Geology*, and *Geochimica et Cosmochimica Acta*. The findings summarized in this paper show the quality of figures and photographic pictures in these five journals and seek to establish whether academic scholarship can be negatively affected through accessing only the electronic journals, due to quality issues of images.

Please note that all examples and references in this paper were current as of the December 2005. Changes may, and hopefully will, occur to the online scanned versions of the journals.

4. Methodology

In order to gain a wide variety of data, a list of 35 current geology electronic journal subscriptions, purchased by the geology library, was compiled. For the purpose of comparing the print image with the online equivalent, the list was reduced to those journals that have been in production since at least 1970 and had a print version available. Eleven of the 35 journals fit this description. Five journals were then selected from these eleven to become the core group of the case study. The preliminary two surveys focused on the backfiles of the electronic journals. This more in-depth survey sampled three issues from each journal, starting with 1970, and continuing every five years until the year 2000. The author included 1995 and 2000 to allow for some comparison between the backfiles and the regular subscription dates. Therefore, 35 issues were reviewed from each individual journal with 175 issues reviewed in total. Every online figure and photograph was compared to the print equivalent to determine if the PDF scan altered the images in any way. The figures and the photographs were coded individually in an Excel worksheet, each with a separate point scale to determine the image quality. The quality of the scanned text, or other problems such as pages that appeared upside down, were not noted in this study.

A four-point quality scale was created to evaluate the electronic version of the photographs, compared to the print version. A sample image, shows the different quality levels which are based on examples found in the electronic journals [6]. Quality 1 (Fig. 1) is the best quality and indicates that the author did not see any difference between the online and print photograph. Quality 2 (Fig. 2) indicates that there is a slight difference, but that the online version of the photograph did not seem to be missing highly significant information that the scholars may need. Indications of a Quality 2 picture may include grey areas appearing lighter or darker than the print version. Quality 3 (Fig. 3) shows a more significant loss of information in the picture. Parts of the picture may be completely black or hard to see, but the overall concept of the image is still recognizable. Quality 3 pictures indicate that a scholar will need to check the print version of the image if the lost information is of importance for full understanding of the content. Quality 4 (Fig. 4) contains a large amount of information that is lost to the point of little to no recognition of image content. The most dramatic loss of information is a completely black box.

 (42K)

Fig. 1. Quality 1.

 (43K)

Fig. 2. Quality 2.

 (37K)

Fig. 3. Quality 3.

 (28K)

Fig. 4. Quality 4.

The electronic versions of the figures were divided into a three-point scale based on the notion that if any information is lost, the scholar will not be able to read the figure properly. A sample image shows the different quality levels, which are based on examples found in the electronic journals [7]. Quality 1 (Fig. 5) is the best quality and indicates that there is no difference between the online and print image. Quality 2 (Fig. 6) indicates that the online version of the figure may have some minor changes such as faded lines or darker grayed areas, but that the integral part of the figure content remains intact. Quality 3 (Fig. 7) suggests that a key part or a significant part of the online figure is affected.

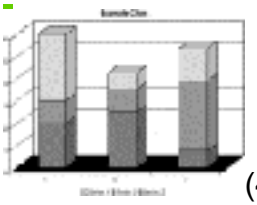 (44K)

Fig. 5. Quality 1.

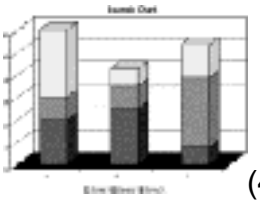
(43K)

Fig. 6. Quality 2.

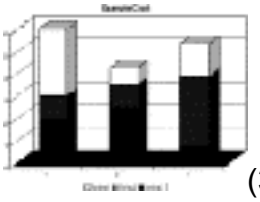
(37K)

Fig. 7. Quality 3.

An Excel spreadsheet was created to record the findings from each reviewed electronic journal issue. The types of data recorded include the year of the issue, the volume and issue number, the total pages in the issue, the page number of each figure and photograph, the position number of the figure or photograph on the PDF page, and the quality rating point the image received. Each page that contained an image was compared to the print version to decide the quality point. If a photograph or figure presented had multiple parts associated with it, a decision had to be made whether to record them separately or as a whole. In general, if it was difficult to decide whether to enter them as a whole or individually, the image was entered as a whole.

After collecting the raw data, the content was summarized in a spreadsheet that contained all five electronic journals. This cumulative spreadsheet listed the journal title, year of the issue, volume and issue

number, total pages in the issue, total pages with photographic pictures, total number of photographs found, total number of photographs by Qualities 1–4, total number of pages with figures, total number of figures found, and total number of figures by Qualities 1–3.

5. Results

A total of 175 issues with 16,685 pages were reviewed for images in the five journals. About 5% (801 pages) of the total pages contained photographic pictures, while 32% (5,362) of the total pages contained figures. The statistical breakdown of image quality can be found in Table 2 and Table 3.

Table 2.

Quality summary statistics for figures

Quality rating	Percentage of the total 10,203 figures found on 5,362 pages
1	83
2	11
3	6

Table 3.

Quality summary statistics for pictures

Quality rating	Percentage of the total 1,708 photographs found on 801 pages
1	16
2	5
3	11
4	68

To determine if the quality of the images affects scholarship, the author divided the quality points into two categories: quality acceptable for online scholarship without the aid of the print version (Qualities 1 and 2), and quality which is poor and requires consulting a print source for full understanding of the content (Qualities 3 and 4). The overall acceptable quality trend of the five journals from 1970 to 1995 indicates that an average of 93.71% of the figures are of acceptable quality while an average of 3.60% photographs are of acceptable quality. As of the year 2000, all the electronic images are of acceptable quality (Table 4).

Table 4.

Percentage of Qualities 1 and 2 photographs and figures, by year

Year	1970	1975	1980	1985	1990	1995	2000
Photographs	2.30	5.70	0	2.25	.51	10.84	100
Figures	96.50	95.72	95.59	93.70	94.59	86.17	100

The quality of the images remains constant, only fluctuating about ± 10% between 1970 and 1990. In 1995, the photographic images improve slightly while the figures quality decreases slightly, and in the year 2000 all the images are of good quality. The decrease in figure quality between 1990 and 1995 could be attributed to an increased use of grey tones and patterns. The author did note that most of the figures receiving quality points 1 and 2 were black and white with very few grey tones. When grey tones and patterns were present, the image quality of the figures decreased. The reason for the small increase in photographic images from 1990 to 1995 is not known by this study. Perhaps it is related to the sample size. However, by the year 2000, all five journals have acceptable image quality in both the electronic and print formats.

Over 16,500 pages were reviewed in this study. About 3.8% (500 pages) contain low quality photographs and 1.2% (165 pages) contains low quality figures. Within the approximately 500 pages containing photographs, there were about 1,350 poor quality images. Of the approximately 165 pages of figures there were about 615 poor quality

images. This suggests that if the publisher were to rescan the PDF pages with the low quality images, only about 5% (665 pages) of the journals are problematic. However, if the publisher wishes to rescan the entire issue or each article to make reinserting problem pages easier, then the majority of all journals need to be rescanned. The Excel worksheet of the pages containing images suggests that the low quality images are dispersed throughout each journal issue, with occasionally higher concentrations found in specific journal issues or articles.

6. Summary

This usage study determined that the importance of the quality of figures and photographs in the online environment is directly related to the institution's dependence on and usage of electronic journal access compared to a reliance on print. This study found that the overall image quality of five Elsevier electronic geology journals varied over time. Prior to the year 2000, the photographic pictures were very poor, indicating that scholars would need to review print materials to understand the full content of the image. On the other hand, the figures were generally found to be of good quality. The discrepancy between the two types of images was found to be due to grey tones. Most of the figures are black and white with few patterns and grey tones. Poor figure quality tended to be due to problems distinguishing one grey area from another. As of the year 2000, all image quality improved.

The other finding was that about 5% of the total pages contain poor quality images. Of the approximately 665 pages, there were nearly 2,000 problematic figures and pictures. Therefore, even if 95% of the text is readable, if a researcher needs a specific figure or picture, then that 5% becomes very significant.

A study was conducted in 2003 at the University of Tennessee, the University of Pittsburgh and Drexel University to establish the electronic journal usage patterns of faculty members [8]. This study found that over two-thirds of the articles read by faculty members were published within one year of the present date. Around 20% of the articles that were published from 2 to 5 years ago were read, while only 15% published over 5 years ago were accessed.

The importance of this usage study in regards to this photograph and figure quality study has to do with establishing the cost/use ratio verses

quality. If a small portion of a university's online usage is found in backfiles, and if backfiles are generally of lower image quality, then perhaps the university should reconsider purchasing backfiles until image resolution improves. It may prove to be more cost effective to maintain and develop the known quality of a print collection, if electronic backfiles are both of inferior quality and of lower usage.

There are many other items to consider when purchasing or maintaining electronic journal backfiles, such as the institutional space to hold the print equivalent, the theory that if items are made available online that journal usage increases, and the preference of the patron to use electronic journals versus print journals. Based on all of these concerns, there is a need for librarians to lobby publishers to improve the image quality of the electronic journal backfiles in order to best serve their patrons.

Future studies need to be conducted on both the image quality of backfiles from other publishing houses and the usage of backfiles verses the print equivalent. Such studies will help librarians decide if their library should invest in backfiles, supply them with data to approach the publishers, and to encourage the publishers to improve their production. If publishers are willing to work with librarians to better electronic journal image quality, a study may need to be conducted to estimate the amount of work to replace poor image quality pages with higher quality scans.

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