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## ***Academic Articles on the Web: Reading Patterns and Formats***

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This article explores user reading activities and user preferences in the formats of Web-based academic articles by using the data from 2 online surveys. Researchers use the Web as a resource for academic articles. Despite this popular use, no generally agreed format exists on the Web. The Web environments of distributed users encourage the use of online remote evaluation. We applied an e-mail-based survey and a Web-based survey to the evaluation of some concepts for Web-based academic articles. The participants of the surveys were researchers in information technology and related areas.

Our survey results show that readers take an overview of a Web-based academic article from the screen, print it out, and then read the printed article. The results also show that the formats employed by most of the Web sites for academic articles are against readers' preferences. The simple 2-frame format among the 5 given formats was most preferred by 47% of our respondents, but the cascaded page-windows format was regarded as the worst by 65% because of its high visual complexity on the screen. An interesting result is that 26% of the respondents regarded the paperlike format as the worst, but this format is widely used for Web-based articles. In addition, the importance of interactive examples embedded in a Web-based questionnaire was revealed from the 2 consecutive surveys. Details are discussed in this article.

In the online remote surveys, the issues of Web-based academic articles were successfully addressed. The methods used in the surveys would be useful for usability tests of various concepts of other Web genres at an early design or redesign stage.

## 1. INTRODUCTION

The Web has been integrating different kinds of applications. Its driving force is the universal readership that makes documents accessible regardless of hardware platforms, file formats, and location. Besides these factors, Web genres explained later are a factor to help users to use the Web documents well.

Different genres lead users to different usage processes. Novels are read serially. Meanwhile, news sites are usually nonserially scanned, even though some news articles are read serially. People do not seem to read academic articles as they do novels, newspapers, or news articles. Different media have different capabilities to support different usage processes. For instance, multimedia presentation is possible on the Web but not on paper. Searching is much faster and more exact with computers than with paper. With those capabilities, the Web has been ever expanding its application areas. So it is natural that Web genres are not well defined as yet. Shneiderman (1997) proposed some possible ways of genre classification on the Web. These are as follows:

- Identities of providers: Individual, group, university, corporation, nonprofit organization, or government agency.
- Size: The number of Web pages or the amount of information in sites.
- Themes: Taxonomies of Web sites from many viewpoints.
- Goals of providers: Sales, advertisement, public services, discussions, or nurturing communities.
- Measures of success: The number of hits, hours of usage, or the number of users.

Academic articles such as conference and journal papers can be regarded as a Web genre. Researchers or organizations provide academic articles the size of which is usually between 1,000 and 10,000 words. The information contained in an academic article is very coherent, and the metastructure of its contents is well developed and stable (Dillon, 1991b). So the patterns of user interactions with the contained information are consistent. This seems to make users' information-gathering process robust across media. The methods to support the detailed actions of the process are dependent on the media that present the documents. Interfaces are required to support user actions for the process by utilizing the capabilities of the media engaged in the user activities. Our research touched on these issues.

We explored some basic properties of Web-based academic articles as a genre. Some of these properties are from the properties of paper-based articles, and some are from the properties of electronic documents and the Web. The properties deriving from paper include:

- The information structure is very stable (metastructure): a title, authors, an abstract, introduction, methods, results, discussion, conclusions, and references.
- The information contained is not likely to change over time because of the strict review processes. Legal documents would have this property also.

Meanwhile, other Web documents, such as various home pages and commercial pages, are expected to change the contained information.

- They are not very long, unlike a book.
- The sequence of reading does not match the sequence of information structure.
- The reading boundary is relatively limited within the article being read.

Some properties are from the Web and electronic documents, but not from paper. These include:

- By using the link mechanism, not only flat representation but also layered representation is possible.
- Multimedia presentation that covers the range from the static presentation to the dynamic presentation is possible.
- Instant presentation on demand, not just reference, is possible.
- Feedback from readers can be easily obtained.
- The contents of Web-based articles are highly machine searchable.

Major publication media for academic articles are papers. Many of them, however, are on the Web as well. Academic article readers were expected to use the two different media together, unlike newspaper readers (news Web sites are among the busiest sites). Newspaper readers are not expected to use both the media for a thread of reading activities. We concern ourselves with this issue as well as with user reading activities and formats.

There are many Web sites that contain academic articles. Some well-known sites in the human–computer interaction area were explored. These are:

- *ACM CHI97 Electronic Publications: Papers* (<http://www.acm.org/sigchi/chi97/proceedings/paper/>).
- *ACM/SIGCHI Bulletin*, Vol. 29, No. 4 (<http://www.acm.org/sigchi/bulletin/1997.4/>).
- *ACM Transactions on Computer–Human Interaction (ACM TOCHI)*, Vol. 5 (<http://www.acm.org/pubs/contents/journals/tochi/1998-5/>).
- *Alertbox* by Jakob Nielsen (<http://www.useit.com/alertbox>).
- *International Journal of Human–Computer Studies (IJHCS), A Special Issue on the Web* (<http://ijhcs.open.ac.uk>).
- *WWW6 Technical Program* (<http://www.scope.gmd.de/info/www6/technical/>).
- *WWW8 Conference Referred Papers* (<http://www8.org/fullpaper.html>).

Table 1 shows the properties of the formats from the viewpoint of format structure: information overview types, manipulation methods, and window layouts.

- Abstracts are normally included in the articles, but tables of contents (TOCs) are not.

**Table 1 : Various Formats of Academic Articles Being Used on the Web**

Web Sites	Features			
	Information Overviews	Manipulation Methods	Windows Layout	Others
CHI97	Abstract-TOC	Indexing and scrolling	Single window	
ACM SIGCHI Bulletin	TOC-Abstract	Scrolling	Single window	
ACM TOCHI	Abstract and general terms	Downloading to print	Single window	Delivery purpose
Alertbox	None	Scrolling	Single window	
IJHCS	Abstract and TOC in frames or abstract only in single window	Downloading to print (indexing and sliding) with frames or scrolling	Single window or multiple frames	Multiple versions, comments
WWW6	Abstract only	Scrolling	Single window	
WWW8 (various)	Abstract only, abstract-TOC, or TOC-abstract	Scrolling, sliding (previous-next), or indexing and scrolling	Single window	Major format is paperlike

Note. TOC = table of contents.

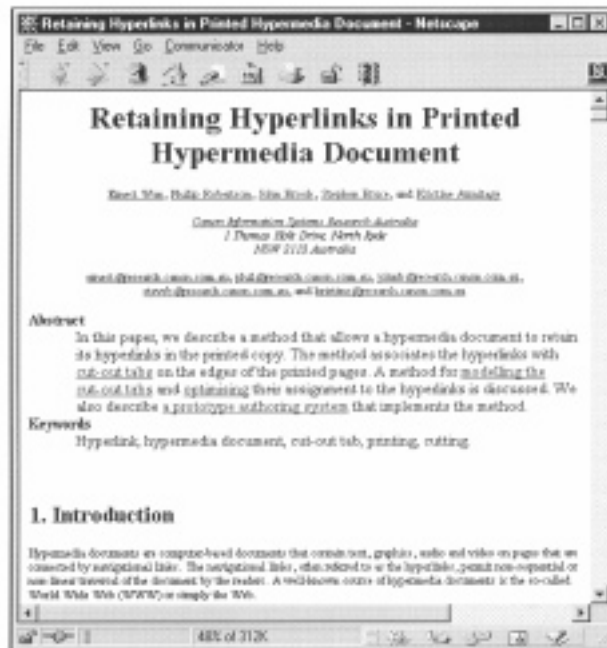
- Both of two possible sequential layouts between abstracts and TOCs are used.
- At the IJHCS site, an index frame is used.
- Scrolling is a common method of looking at their manipulation methods.
- If a TOC exists, indexing is always provided. The sliding method is normally used as a secondary method.
- The single-window layout is most popular.
- At the IJHCS site, a multiple frame and version approach is applied so that its interfaces look complex.
- At the ACM TOCHI site, the Web seems to be considered as the hybrid media of two traditional media: catalog and delivery.

Figure 1 shows a popular and widely used format that is not much different from the paper-based article in its format.

The International Standards Organization (ISO, 1998) 9241-12 defines *usability* in terms of effectiveness, efficiency, and satisfaction. The user satisfaction of a system is evaluated by real users by applying a survey with a questionnaire. If real users are geographically distributed, online surveys seem to be a unique method to measure the user satisfaction as a part of remote usability evaluation (Hartson, Castillo, Kelso, & Neale, 1996). Slaughter, Harper, and Norman (1994) showed the effectiveness of online questionnaires by reporting that online surveys were as good as paper-and-pencil surveys and motivated participants to return more comments. Some examples of Web-based questionnaires can be found in Perlman (1997).

Web documents like academic articles are supposed to be accessed by users who are geographically spread out all over the world; therefore, the online survey is considered the most effective way of surveying the user satisfaction with these documents. Online surveys are cost-effective because participants fill out a questionnaire at a location and time they choose and then electronically deliver it. For participants, online surveys are less restrictive because they can reply to the questionnaire in the environment they are used to. In the case of Web-based questionnaires to ask about Web-based applications, the benefit of online surveys can be maximized because real interactive examples can be embedded in the questionnaires. Embedding examples ensures a minimal time delay between the exposure to the documents and the measure of user satisfaction. Harper, Slaughter, and Norman (1997) described these characteristics of Web-based questionnaires.

Besides these advantages, providing users with interactive examples is possible, and logging usage history while answering questions is also possible. However, no homogeneous experimental environment is ensured because participants work in their natural environments using different browsers, different window sizes, and different interaction devices. Environmental effects can be critical for questionnaires that contain interactive examples. To minimize these effects, some sections for the homogenization of different environments need to be involved in a questionnaire; these are not likely to be involved in a paper-based questionnaire.



**FIGURE 1** A popular format used for Web-based academic articles (<http://www8.org/w8-papers/4b-links/hyperlinks/hyperlinks.html>).

Questionnaires need to be written in a proper format. No more than 25 questions is recommended (Feinberg & Johnson, 1998). Real experience should be provided to the participants. Comparison based on imagination with no experience is useless, whereas checklist-style questions about specific existing features of a system produce robust results across the user experience (Root & Draper, 1983).

To identify reading activities for Web-based academic articles and their proper formats, two different online surveys were carried out: One was e-mail based and the other was Web based. The Web-based survey was performed 2 months after the e-mail-based survey was completed.

## **2. THE FIRST SURVEY: E-MAIL-BASED SURVEY ON READING ACTIVITIES**

### **2.1. Purpose of the Survey**

This survey was conducted to see whether researchers use the Web as a resource for academic articles. If they do, what usage patterns do they apply to use the academic articles?

### **2.2. Method**

An e-mail-based questionnaire consisting of four questions was e-mailed to 130 researchers in the School of Computer Science and Engineering of the University of New South Wales in Australia: 50 academic or research staff and 80 research students. These recipients were listed on two group mailing lists in the school. Duplicates and the out-of-date listings were filtered out and received no examples.

Figure 2 shows the questions involved in the e-mail-based questionnaire.

### **2.3. Results**

We received 23 replies (an 18% reply rate). Among them, 22 respondents (96%) indicated that they find articles on the Web (Table 2).

Table 3 shows readers' selections regarding reading activities for Web-based articles. Twenty-two participants answered the second question (Q2 in Figure 2). The majority (64%) of the respondents to Q2 selected Activity 3 (choice [3] under Q2) for the first choice, and 32% selected Activity 4 for the first choice. The other activities were chosen by 0 or 1 respondents. Twenty participants replied to the third question (Q3 in Figure 2). Activities 2 and 3 both polled the highest at 30% for the second choice, followed by Activity 4 at 20%. An interesting result is that no one selected Activity 2 for the first choice, but 30% chose it for the second choice. This is discussed later.

Table 4 shows the cross-distribution between the second choice and the first choice. All six selections of Activity 2 for the second choice (43%) are from the selections of Activity 3 for the first choice, but none are from the other choices. Similarly,

**Q1:** Do you find academic articles from the Web? (Yes / No)  
 If 'Yes' for Q1,  
**Q2:** What describes your behaviour best when you have an article on the Web?

- (1) You just print it out, and then read the printed article.
- (2) You read the first few lines on the first screen, print out the article if you are interested in it, and read the printed article.
- (3) You read some concise parts such as titles & abstracts, print out the article if you are interested in it, and read the printed article.
- (4) You scan through the article, print it out if you are interested in it, and then read the printed article.
- (5) You read the article from the screen.
- (6) Others (please describe)

**Q3:** What could be your second choice in Q2?  
 If 'No' for Q1,  
**Q4:** Why?

- (1) The Web articles are NOT credible.
- (2) The Web articles are frequently updated.
- (3) Others (please describe)

**FIGURE 2** Questions involved in the e-mail-based questionnaire for the first survey.

**Table 2: Q1—Finding Articles From the Web?**

Yes		No	
<i>n</i>	%	<i>n</i>	%
22	96	1	4

**Table 3: The First Survey Result Regarding Reading Activities**

Activity	Details	1st Choice (Q2)		2nd Choice (Q3)	
		<i>n</i>	%	<i>n</i>	%
1	Print and read	1	5	1	5
2	Read from the first screen, print, and then read	0	0	6	30
3	Read concise parts, print, and then read	14	64	6	30
4	Scan through, print, and then read	7	32	4	20
5	Read from the screen	0	0	3	15
Total		22	100	20	100

all four selections of Activity 4 for the second choice are from the same source. There is no selection of Activity 5 for the second choice from the same source. Of the seven respondents who selected Activity 4 for the first choice, four selected Activity 3 for the second choice, and the other three selected Activity 5. However, none of them selected Activity 2, which was a major selection by the Activity 3 selectors in the first



**Table 4: Cross-Distribution Between the Two Activity Choices**

1st Choice	2nd Choice													
	Activity 1		Activity 2		Activity 3		Activity 4		Activity 5		No Answer		1st Choice	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Activity 1	0	0	0	0	1	100	0	0	0	0	0	0	1	5
Activity 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Activity 3	1	7	6	43	1	7	4	29	0	0	2	14	14	64
Activity 4	0	0	0	0	4	57	0	0	3	43	0	0	7	32
Activity 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2nd choice	1	5	6	27	6	27	4	18	3	14	2	9	22	100

choice. Table 4 reveals that Activity 3 is most related to Activity 2, followed by Activity 4, whereas Activity 4 is most related to Activity 3, followed by Activity 5.

**2.4. Discussion**

The Web is a resource to provide researchers with academic articles as Table 2 shows. Some sites, such as digital libraries and Web journals, are stable as a resource, but some sites, such as conference home pages, are usually temporal. To be a sound source of academic articles, the existence of articles would have to be guaranteed, and articles could not change in their information contents over time on the Web.

The most common usage pattern for Web-based academic articles is Activity 3 (the choice [3] in Q2, Figure 2); that is,

You read some concise parts of the article such as its title & abstract, print out the article if you are interested in it, and then read the printed article.

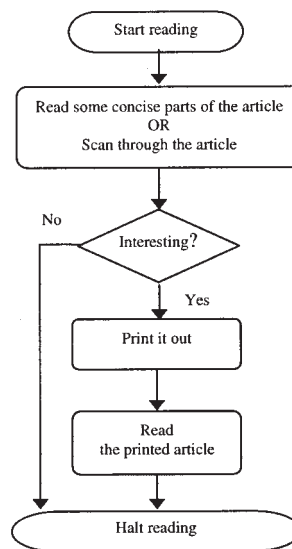
However, Activity 4 should not be ignored, because it was chosen by 32% of the respondents as their first choice. The common pattern from the first survey is similar to the usage pattern of paper-based academic journals that is reported in Dillon (1991a). This seems to be due to the fact that academic articles have a fine metastructure (Dillon, 1991b, 1996) that leads to the reading activity of Figure 3. Those who selected Activity 3 may want to view the concise parts from the first screen (Table 4). The selection of Activity 2 for the second choice by those who selected Activity 3 as first choice is somewhat related to this assumption. Activity 2 polled 0% for the first choice but 30% for the second choice. If one counts the effective number of selections of Activity 2 for the second choice as 11, after taking off the count for no answers and the reselection of Activity 3, the rate goes up to 55%. This seems to show the potential importance of the first screen. Further investigation is required to explain this result. On the other hand, the respondents who chose Activity 4 seem to consider the content overview of an article more than its interfaces (Table 4), because none of them selected Activity 2 for the second choice.

## 2.5. Survey Conclusions

The 18% reply rate for the survey is close to the rate (20%) indicated in Feinberg and Johnson (1998). Most researchers as users are likely to find academic articles on the Web. They are most likely to read some concise parts of an article from the screen, print it out, and then read the printed article. They seldom read the entire article from the screen. So which formats then do readers prefer, and which do they dislike? What will be the effects of interactive examples in a questionnaire? The second survey answers these questions.

## 3. THE SECOND SURVEY: WEB-BASED SURVEY ON READING PATTERNS AND FORMATS

In the first survey, we confirmed typical user groups and identified common reading activities for Web-based academic articles. Based on this knowledge, we have tried to identify readers' preferences regarding the formats of Web-based articles. In the first survey, no examples of Web-based articles were provided with the e-mail-based questionnaire. However, in the second survey, real interactive examples were provided to participants. The examples were embedded in the Web-based questionnaire, which consisted of checklist-style questions. Figure 5 shows a partial screen shot of the questionnaire. The second survey was performed 2 months after the first survey was completed.



**FIGURE 3** A common pattern of reading activities for Web-based academic articles.

### 3.1. Purposes of the Survey

The second survey was to explore user reading activities and user preferences in the formats of Web-based academic articles and additionally to see the effects of examples. To investigate preferences in structural details, it was worth identifying readers' preferences in overview types for the information structure of Web-based articles, window layout styles for the interface structure, and manipulation methods for the interaction structure.

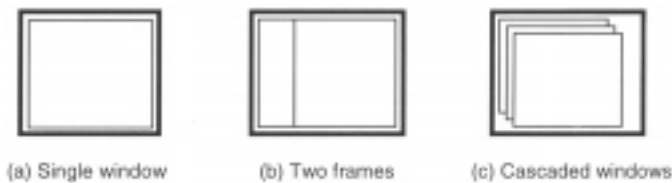
Itemizing the details based on the analysis of the Web sites in Table 1, our questions were refined as follows:

- Overview types: No TOC is used in the paper-based articles.
- Will readers prefer the existence of a TOC?
- Where is the best location for a TOC?
- Windows layout styles: Single window, frames, and cascades (Figure 4).
- Which layout do readers prefer?
- Manipulation methods: Scrolling, sliding (previous–next), and indexing by TOC.
- Which do readers prefer?
- What combination do readers prefer?
- What overall combination do readers prefer for their reading patterns?

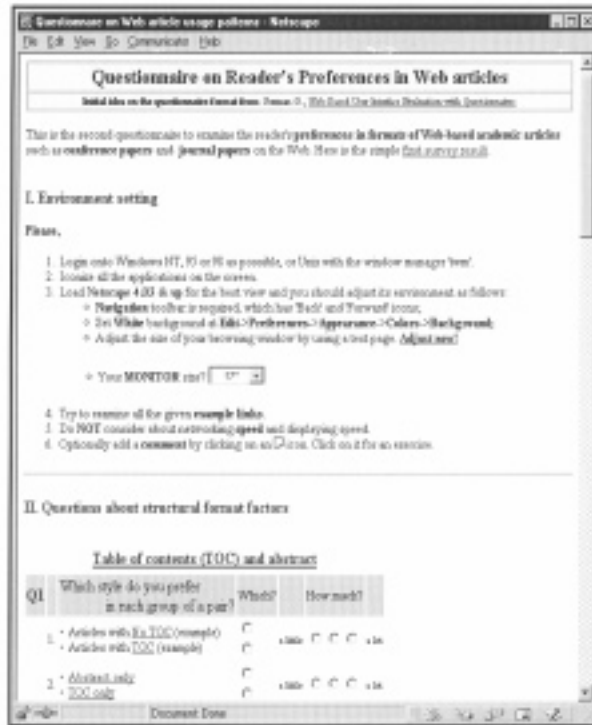
### 3.2. Method

We prepared a Web-based questionnaire containing 18 questions in three parts. The questionnaire was written in HTML and JavaScript. Figure 5 shows part of the questionnaire (i.e., Rho, 1999). The first part of the questionnaire concerns environment settings to control the visual properties and the window size of the browser in terms of the information amount. This is to avoid volume effects. To support this, a sample configuration page has been provided. Other configuration features are not limited so that readers can browse the questionnaire and examples in the environments they are used to.

The second part consists of the questions about three different features: overview types, window layouts, and manipulation methods. The questions in this part use a 3-point scale to measure the strength of preferences: 1 (*weak*), 2 (*medium*), and 3 (*strong*). The last part concerns usage patterns and overall preferences in the different presentation structures of Web-based academic articles. Each question has at least



**FIGURE 4** Window layout styles considered in the second survey.



**FIGURE 5** The Web-based questionnaire used in the second survey (<http://www.cse.unsw.edu.au/~yrho/WebPaper/Question.htm>).

one corresponding example link. The same paper (Rho & Gedeon, 1998) was used for all examples in the questionnaire. The survey was announced by e-mail. The invitation and Uniform Resource Locator (URL) of the questionnaire were sent to 150 researchers in information technology and related areas. This number includes 130 people who were targeted in the first survey and included postgraduate research students, research staff, and academic staff. Neither undergraduate nor postgraduate coursework students were included, because they were expected to seldom use the Web for academic articles. The remaining 20 researchers were sampled from other user groups: 6 research staff from a research institute in Korea and 14 research students from a university in the United States. All 150 were researchers in information technology and related areas. There were no other sampling criteria.

### 3.3. Results

We received 34 replies (a 23% reply rate). Most of the respondents used 17-in. monitors to fill out the questionnaire, as Table 5 shows.

Table 6 reveals readers' preferences in overview types contained in a Web-based article. The majority (91%) of the respondents preferred a TOC contained in a

**Table 5: Monitor Sizes**

Monitor Size (in.)	Occurrence	
	<i>n</i>	%
17	28	82
21	3	9
15	2	6
12	1	3
Total	34	100

**Table 6: Preferences in the Overview Types**

Question	Method	Which Type?			M	Which Type?			No Answer	
		<i>n</i>	%			Method	<i>n</i>	%	M	<i>n</i>
Q1-1	No TOC	3	9	1.3	TOC	31	91	2.3	0	0
Q1-2	Abstract only	27	79	2.1	TOC only	7	21	1.7	0	0
Q1-3	Abstract only	3	9	2.0	Abstract & TOC	31	91	2.5	0	0
Q1-4	TOC only	0	0	0.0	Abstract & TOC	33	97	2.6	1	3
Q1-5	Abstract first	28	82	2.5	TOC first	6	18	2.2	0	0

*Note.* TOC = table of contents

Web-based article, with a strong preference at 2.3 (Q1-1 in Table 6). Seventy-nine percent considered abstracts to be more essential than TOCs (Q1-2). Q1-3, Q1-4, and Q1-5 also clearly show readers' very strong preferences for the format containing an abstract followed by a TOC.

Table 7 shows readers' preferences in manipulation methods. The respondents preferred indexing by TOC the most, scrolling the next, and sliding the least (Q2-1, Q2-2, and Q2-3). Note that the level of readers' preference for the scrolling method is strong (2.3), even though it was chosen less often than the indexing method was (Q2-2). Q2-4 shows that 65% weakly (1.9) preferred pagination. On the other hand, 35% showed a strong preference (2.3) for no pagination. Q2-5 and Q2-6 show readers' clear preferences for the existence of both methods. Then, 79% of the readers very strongly (2.5) preferred the combination of scrolling and indexing to the combination of sliding and indexing, for which 21% showed their strong preference (2.3).

Table 8 shows the readers' preferences in window layout styles. Our respondents preferred two frames the most, a single window the next most, and cascades the least. The two-frame style was preferred by 59% of the respondents, and the single-window style by 41%. The single-window style had a slightly higher level of preference than the two-frame style: 2.6 versus 2.4 (Q3-1). The preferences for the cascade style were as weak as expected: 1.8 and 2.0 (Q3-2 and Q3-3).

Table 9 shows the reading activity patterns that our 34 respondents selected for their first and second choices. As in the first survey result, Activity 3 polled the highest at 55% for the first choice, and Activities 2 and 4 each were selected by 18%.

In the first survey, the portions were 0% for Activity 2 and 32% for Activity 4, which are very different from the second survey results. Again, these two activities polled the same amount of 29% for the second choice. This seems to mean that first screens need to be considered as a factor that affects users' reading activities.

Table 10 shows the cross-distribution between the first and second choices. Of those who selected Activity 3 for their first choice, 37% indicated Activity 2 as the second choice, and the same portion (37%) indicated Activity 4 as the second choice. Again, these two activities were selected by the same percentage of respon-

**Table 7: Preferences in the Manipulation Methods**

Question	Method	Occurrence			Method	Occurrence		
		<i>n</i>	%	<i>M</i>		<i>n</i>	%	<i>M</i>
Q2-1	Scrolling only	26	76	2.1	Sliding only	8	24	1.8
Q2-2	Scrolling only	11	32	2.3	Indexing by TOC	23	68	2.0
Q2-3	Sliding only	4	12	2.0	Indexing by TOC	30	88	2.0
Q2-4	No pagination	12	35	2.3	Pagination	22	65	1.9
Q2-5	Scrolling only	0	0	0	Scrolling and indexing	34	100	2.4
Q2-6	Sliding only	0	0	0	Sliding and indexing	34	100	2.2
Q2-7	Scrolling and indexing	27	79	2.5	Sliding and indexing	7	21	2.3

Note. TOC = table of contents.

**Table 8: Preferences in the Window Layout Styles**

Question	Method	Occurrence			Method	Occurrence		
		<i>n</i>	%	<i>M</i>		<i>n</i>	%	<i>M</i>
Q3-1	Single window	14	41	2.6	Two frames	20	59	2.4
Q3-2	Single window	25	74	2.4	Cascades	9	26	1.8
Q3-3	Two frames	29	85	2.3	Cascades	5	15	2.0

**Table 9: Reading Activities**

Activity	Details	1st Choice		2nd Choice	
		<i>n</i>	%	<i>n</i>	%
1	Print and read	2	6	2	6
2	Read from the first screen, print, and then read	6	18	10	29
3	Read concise parts, print, and then read	19	56	8	24
4	Scan through, print, and then read	6	18	10	29
5	Read from the screen	1	3	4	12
Total		34	100	34	100

dents. Table 10 reveals that Activities 2 and 4 are most related to Activity 3, whereas Activity 3 is equally related to Activities 2 and 4.

Table 11 shows that 16 respondents (47%) selected the two-frame format (Format 3) as the best, and 35% selected the paperlike-with-TOC format (Format 2) as the best. Meanwhile, 65% selected the cascades (Format 5) as the worst. It is interesting that 26% of our respondents selected the paperlike format (Format 1) as the worst. The paperlike-with-TOC format (Format 2) and the two-frame format (Format 3) were not chosen by anyone as the worst.

Table 12 shows some more details of selection patterns between the most-preferred and second-most-preferred formats. Of those who most preferred the two-frame format (Format 3), 63% selected the paperlike-with-TOC format (Format 2) for the second best, and 31% selected the slides format (Format 4) for the second best. Of those who most preferred the paperlike-with-TOC format (Format 2), 50% selected the paperlike format (Format 1) for the second best, and 33% selected the two-frame format (Format 3) for the second best.

The majority (63%) of those who selected Format 3 for the best selected Format 2 for the second best, which is 77% of overall Format 2 selections for the second best. Fifty percent of those who selected Format 2 for the best selected Format 1 for the second best, which is 86% of overall Format 1 selections for the second best. This seems

**Table 10: Cross-Distribution Between the Two Activity Choices**

		2nd Choice											
		Activity 1		Activity 2		Activity 3		Activity 4		Activity 5		1st Choice	
1st Choice		<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Activity 1		—	—	1	50	0	0	1	50	0	0	2	6
Activity 2		1	17	—	—	3	50	2	33	0	0	6	18
Activity 3		1	5	7	37	—	—	7	37	4	21	19	56
Activity 4		0	0	2	33	4	67	—	—	0	0	6	18
Activity 5		0	0	0	0	1	100	0	0	—	—	1	3
2nd choice		2	6	10	29	8	24	10	29	4	12	34	100

**Table 11: Preferences in the Overall Web Article Formats**

Format	Best		2nd		3rd		4th		Worst	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
1: Paperlike	2	6	7	21	9	26	6	18	9	26
2: Paperlike with table of contents	12	35	13	38	5	15	4	12	0	0
3: Two frames	16	47	5	15	7	21	5	15	0	0
4: Slides	2	6	8	24	10	29	12	35	1	3
5: Cascades	2	6	1	3	2	6	5	15	22	65
No answer	0	0	0	0	1	3	2	6	2	6
Total	34	100	34	100	34	100	34	100	34	100

**Table 12: Cross-Distribution Between the Best and Second Best Format Selections**

		<i>2nd Choice</i>											
		<i>Format 1</i>		<i>Format 2</i>		<i>Format 3</i>		<i>Format 4</i>		<i>Format 5</i>		<i>1st Choice</i>	
<i>1st Choice</i>		<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>
Format 1		0	0	2	100	0	0	0	0	0	0	2	6
Format 2		6	50	0	0	4	33	2	17	0	0	12	35
Format 3		1	6	10	63	0	0	5	31	0	0	16	47
Format 4		0	0	1	50	0	0	0	0	1	50	2	6
Format 5		0	0	0	0	1	50	1	50	0	0	2	6
2nd choice		7	21	13	38	5	15	8	24	1	3	34	100

to show that the two-frame format (Format 3) is an advanced format of the paperlike-with TOC format (Format 2), which seems to be an advanced format of the paperlike format (Format 1). From the structural viewpoint of formats, Format 1 is the simple translation of a paper-based format to a Web-based format of a single page. Format 2 is constructed by adding TOC links on to Format 1. Format 3 is constructed by separating the TOC links and contents into two different frames. This framed format is supposed to enhance the navigability of articles, which is not possible on paper. If this interpretation is right, the two-frame format (Format 3) will become more popular as readers experience more academic articles on the Web.

Table 13 shows the selection patterns between the selections for the best and the worst. Of those who preferred the two-frame format (Format 3), 63% thought the cascades format (Format 5) was worst, and 31% thought the paperlike format (Format 1) was worst. Of those who preferred the paperlike-with-TOC format (Format 2), 75% thought the cascades format (Format 5) was worst, which is 10% higher than the overall selections (65%) shown in Table 11. So it may be said that those who preferred Format 2 or 3 are likely to dislike Format 5. All (100%) of those who most preferred the paperlike format (Format 1) least preferred the cascades format (Format 5) and vice versa. However, the amount of data (only 2 replies) is too small to say that users who prefer one of these two formats dislike the other.

Table 14 shows the correlation between activity selections for the first choice at Q4 and the format selections for the first choice at Q5. The underscored percentages of the Activity 3 row show the format distribution. Of those who selected Activity 3 for the first choice, 47% selected Format 3 for the best, and 32% selected Format 2 for the best format. In the other view, the third column under Format 3 corresponds to activity distribution over Format 3. Activity 3 was selected by 56%, followed by Activities 4 and 2. Activity 3 matches Format 3 and vice versa. In addition, Activities 2 and 4 match Format 3 as well, with contributions of 50% and 67%, respectively.

### 3.4. Discussion

The respondents preferred the combination of an abstract followed by a TOC. In the comparison of the two overview types, the respondents preferred abstracts to TOCs.



**Table 13: Cross-Distribution Between the Best and Worst Format Selections**

	Worst													
	Format 1		Format 2		Format 3		Format 4		Format 5		N/A		Worst	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
<i>Best</i>														
Format 1	0	0	0	0	0	0	0	0	2	100	0	0	2	6
Format 2	1	8	0	0	0	0	2	17	9	75	0	0	12	35
Format 3	5	31	0	0	0	0	0	0	10	63	1	6	16	47
Format 4	1	50	0	0	0	0	0	0	0	0	1	50	2	6
Format 5	2	100	0	0	0	0	0	0	0	0	0	0	2	6
No answer	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Best	9	26	0	0	0	0	2	6	21	62	2	6	34	100

**Table 14: Correlation Between the Reading Activities and Formats for the Two First Choices**

	Q5-1st																
	Format 1			Format 2			Format 3			Format 4			Format 5			Q4-1st	
	<i>n</i>	%	%	<i>n</i>	%	%	<i>n</i>	%	%	<i>n</i>	%	%	<i>n</i>	%	%	<i>n</i>	%
Activity 1	0	0	0	2	100	17	0	0	0	0	0	0	0	0	0	2	6
Activity 2	1	17	50	1	17	8	3	50	19	0	0	0	1	17	50	6	18
Activity 3	1	5	50	6	32	50	9	47	56	2	11	100	1	5	50	19	56
Activity 4	0	0	0	2	33	17	4	67	25	0	0	0	0	0	0	6	18
Activity 5	0	0	0	1	100	8	0	0	0	0	0	0	0	0	0	1	3
Q5-1st	2	6		35			16	47		2	6		2	6		34	100

Abstracts provide informational overviews of articles. On the other hand, TOCs provide structural overviews for navigation, which are not normally found in the paper-based articles. The limited visual search capability of Web-based articles can be a reason for the difference. The more sound the document structure, the clearer the navigation overviews that TOCs deliver to readers. However, printing a TOC with the other contents is not likely to be helpful for readers to read the printed article.

The combined use of TOC-based indexing and scrolling is preferred over any of the individual uses and over the combination of indexing and sliding. Comparing each method, indexing is most preferred, scrolling is next most preferred, and sliding is least preferred. Readers seem to apply indexing for topical jumps and scrolling for short physical movement. However, from the reading viewpoint, the benefit of pagination by limiting the scrolling distance is not clear because it removes chances of taking a contextual overview of the near sections or parts. There were some comments about keyboard-based methods, such as direction keys and page-up and page-down keys, that were missed in our survey. The block movement method by page-up and page-down keys seems quite useful for those who are used to editing or programming.

For academic articles such as conference papers and journal papers, the window layout of two frames was the best configuration among the single window, the two

frames, and the cascades. With the frames, readers can efficiently use indexes in context. It seems to compensate for the screen space lost by the index frame. The single window was also very strongly preferred by those who selected it, even though fewer respondents selected it than the two frames. However, the cascade layout was not preferred by up to 85% of the respondents. This may be due to the high visual complexity on the screen. There were some such comments from some participants.

The most common reading activity for a Web-based article is that readers read some concise parts of an article, print out the article if they are interested in it, and then read the printed article. Both surveys produced a similar result. A big difference between the results from the two surveys was obtained at Activities 2 and 4. In the first survey, Activity 4 was chosen by 32%, and Activity 2 was chosen by 0%. Then, in the second survey, Activity 4 was chosen by only 18% (a 14% decrease), and Activity 2 was chosen by 18% (an 18% increase). So the portions are even. There was no significant difference in the distribution list and the question for this topic.

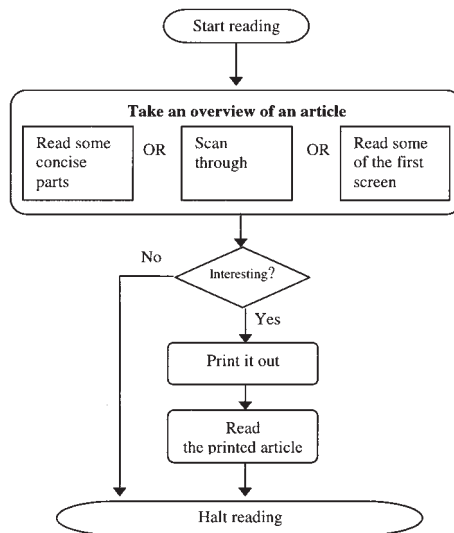
The difference seems to relate to the existence of interactive examples, which provide participants with real experience with a minimized delay between the exposure and the measure. The first questionnaire was e-mail based, with no examples to try. Meanwhile, the second questionnaire was Web based, with many examples. The participants thus had many chances to try different Web formats of the same article before answering the questions. They were likely to be aware of the importance of seeing the first screen, but not of their subsequent behavior.

Figure 6 shows the Web-based article given to participants as an example of the two-frame format in the questionnaire. This was most preferred by readers of academic articles on the Web. In the major reading activities, a common bridging action from the screen to paper is printing. So, article interfaces for readers have to be able to support two different media: the Web and paper. The majority of respondents selected the two-frame format as the best for this purpose. This is against the general idea that using frames is not good because frames waste the limited screen space when browsing (Nielsen, 1996b). The two-frame format, however, does not seem to matter with academic article readers because they are not likely to jump around between multiple articles and have no printing problems and no search problems with the frame format. The paperlike-with-TOC format can be an alternative choice. The cascade format was least preferred because of its high visual complexity on the screen, but no one selected either the two-frame format or the paperlike-with-TOC format as the worst. The answers to all the preceding questions explain why the two-frame format was selected as the best by the majority of our respondents. They preferred TOCs, the combined use of indexing and scrolling, and two frames. Activities and formats also show a correlation; Activities 2, 3, and 4 most match the two-frame format (Table 14).

The early part of the reading process, which is to take an overview of an article, occurs on the screen when reading a Web-based academic article from the screen, as Figure 7 shows. The survey results show that its early parts (taking an overview and printing) are most likely to be supported by the two-frame format, which ensures the quality of the paper-based article format when printed.



**FIGURE 6** The two-frame format example embedded in the questionnaire ([http://www.cse.unsw.edu.au/~yrho/Publications/apweb98/apweb98\\_C-tiled\\_main.htm](http://www.cse.unsw.edu.au/~yrho/Publications/apweb98/apweb98_C-tiled_main.htm)).



**FIGURE 7** A metapattern of the common reading activities from the second survey.

#### **4. GENERAL DISCUSSION AND CONCLUSIONS**

This research explored user reading activities and user preferences in the formats for Web-based academic articles by applying two online surveys. We carried out the e-mail-based survey as a preliminary survey and the Web-based survey as a main survey.

##### **4.1. Conclusions on Web-Based Academic Articles**

The results from the two surveys revealed that readers are likely to take an overview of an article from the screen, print it out if they are interested in it, and then read the printed article. The Web-based survey showed that the two-frame format (i.e., Figure 7) was most preferred to the other given formats. This format is expected to best support the common reading pattern shown in Figure 6. The two-frame format consists of one narrow frame for the TOC links and another wide frame for the paperlike article; that is, one frame for information and the other for navigation. However, users' preference in it is not clearly dominant (47%) when compared to the paperlike-with-TOC format (35%). Providing both or either of these two formats seems reasonable for the time being until users' preferences become clear.

In addition, the surveys revealed some more features regarding reading Web-based articles:

- Tables of contents are good aids for structural and navigational overviews, but abstracts are more important for readers.
- Indexing based on the TOC is a necessary part of Web-based articles, but it seems to be an overhead for paper-based articles.
- The combined use of indexing and scrolling is much better than any individual method or the combined use of indexing and sliding.
- The most common reading activity is that readers read some concise parts of an article, print it out if interested, and then read the printed article.
- Reading a Web-based article is supported by two media: the screen for taking overviews and paper for reading.
- Printing is a bridging action to connect taking overviews and reading articles, so the printed article needs to be in context with the Web-based article.
- What is on the first screen is important to readers on the Web. Displaying abstracts and TOCs on it is recommended.
- Readers do not like complex screen layouts like cascaded windows.
- The paperlike format is likely to be disliked by about a quarter of Web-based academic article readers.

##### **4.2. Lessons Learned About Online Surveys**

We employed two online survey techniques in this study. The e-mail-based survey helped with participant sampling for the Web-based survey by revealing that almost

all the respondents use the Web to find academic articles. The effects of interactive examples, which were embedded in a Web-based questionnaire, were shown. Participants more clearly understood the questions with the examples, and they were aware of the importance of the first screen when the examples were present.

E-mail systems were very useful for effective communication with the participants. We invited people by e-mail and received feedback and questions about the surveys by e-mail. The replies from the participants were delivered to us by e-mail also. There were some multiple replies from some participants. Some sent duplicates to ensure the delivery of their replies, and some sent extra messages to add more comments. These were filtered and managed. Data collection and processing was easy, as expected.

Web documents are portable, but some interactive portability still should be taken care of by producers. Browser-embedded default features are different between browsers. We experienced some problems while carrying out the Web-based survey. The "e-mail to:" method could be automatically executed with Netscape, but not with Internet Explorer. So we had to change the method to a cgi-e-mail utility. The default window size was different between the two major browsers. The child window size was dependent on the parent window in Netscape, whereas it was dependent on the initial window size in Internet Explorer. This produced problems in presenting the interactive examples in the questionnaire.

#### **4.3. Implications of This Study**

This study identified some properties of Web-based academic articles as a Web genre. The survey results show that high popularity does not mean high usability of Web documents. For example, the paperlike format being widely used is likely to be disliked by one-fourth of academic article users. The two-frame format is likely to be most preferred by users. This is against the general idea of using frames. Improper assumptions about document usage may be made by document producers. Every assumption therefore needs to be tested from real users' viewpoints regarding information, interactions, and interfaces (in short, "III"). This test should not be an evaluation of a system but a comparison of multiple concepts by real users of the genre to be tested.

News sites are among the most popular genres on the Web. Most of them use fixed size of screen space for presentation; that is, the width of Web pages is fixed regardless of browsing window size. This is against the general user experience of Web browsing that the width varies according to the size of a browsing window. The producers' assumption on this issue may affect users worldwide on a daily basis. This needs to be tested with real users on the Web. The methods we used would be applicable to this case. Web search interfaces are another good example genre to be tested as well. Some interfaces display more information than others. Some use tabs, whereas others use lists or tables. These can be tested by applying the methods we used.

Some findings in this study would also be generally useful to other Web genres, even though their application seems to be quite dependent on the document volume:

- Users want navigation abstracts as well as content abstracts prior to details, and users expect to see them on the first screen. The respondents preferred a content abstract followed by a navigation abstract (TOC) for the Web-based academic articles.
- Users are likely to have their own interaction models based on their previous experience and the purposes of access. The usage patterns were quite common for the Web-based academic articles if they needed to be sequentially placed.
- Users do not like multiple browsing windows on the screen because of the high screen complexity. The respondents least preferred the format of cascaded multiple windows.
- Users are likely to prefer indexing the most, scrolling the next most, and sliding the least. The respondents replied in this order.
- Users prefer the combined use of indexing and scrolling to any others. The respondents preferred this combination of the best two. There were no conflicts in combining the two methods.
- If a document consists of coherent multiple sections, providing structured indexes like a TOC will make it more scannable. The respondents wanted to scan through the document as well as read concise parts.
- Users are not likely to read a long Web page or a coherent document of multiple Web pages from the screen but from paper, so paper formats need to be considered. The respondents clearly required this.
- Quite a number of users may dislike the Web documents created in a paper-based format. One-fourth of the respondents least preferred the paperlike format on the Web. They wanted navigation aids like the TOC links.

#### **4.4. Future Studies**

This research focused on five types of user reading activities and five types of formats for Web-based academic articles from the viewpoints of III. Besides these activities and formats, different types need to be explored. For example, a combined layout format for multiple articles seems to be useful for users to refer to other articles or to compare one to others. Many more features need to be tested to shape more usable Web-based academic articles. These include writing styles (e.g., Morkes & Nielsen, 1997), representation styles of internal content and external document relationships, reader feedback and annotation, print formats, and time management. Nielsen's (1996a) claim on inverted pyramids of information organization, in which conclusions come first, needs to be tested from real users' viewpoints regarding III. Do we really have to write academic articles in the inverted pyramids format? Or can we provide navigation aids instead? Changing their writing styles would be very difficult for many authors.

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