Web interface consistency in e-learning

Cheul Rhee
Department of Management Science and Systems, State University of New York at Buffalo, Buffalo, New York, USA
Junghoon Moon
School of IT Business, Information and Communications University, Daejeon, Republic of Korea, and
Youngchan Choe
Department of Community Development, Seoul National University, Seoul, South Korea

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Abstract

Purpose – The purpose of this research is to examine the effects of interface consistency on the learning performance of skilled and novice computer users who are studying with web-based e-learning systems.

Design/methodology/approach – A literature review was conducted, and an experiment was set up to collect data on learning performance with respect to interface consistency and e-learning systems. Statistical methods were applied.

Findings – Skilled students made more errors than novices when using a physically inconsistent e-learning system. The learning satisfaction level of those skilled with computers was lower than that of novices using such a system. Conceptually consistent systems facilitated skilled students' learning satisfaction. Communicationally consistent systems closed the achievement gap within the novice student group. However, the effect of communicational consistency on skilled students was contradictory.

Originality/value – Implications include suggestions for designing web-based interfaces of e-learning systems and library web sites.

Keywords Worldwide web, User interfaces, E-learning

Paper type Research paper

Introduction

Computer and internet-based learning (hereafter referred to as e-learning) has been shown to have a number of potential advantages over many traditional methods of learning. It is less expensive and faster to deliver, promotes independent learning, provides good accessibility from anywhere and any time, and gives students more control over their learning processes (Cantoni *et al.*, 2004; Dewhurst and Williams, 1998; Smith and Rupp, 2004). According to the 2004 "Teachers Talk Tech" survey conducted by CDW Government, Inc., a leading provider of technology to governments and educators in the USA, 81 percent of teachers reported that information technology in education increases students' academic performance. A majority of teachers said that information technology is a valuable teaching tool for all core academic skills. Only 15 percent of them, however, indicated that the quality of available software for students' learning is "excellent," and 52 percent of them said that it is "poor" or just "okay" (Rother, 2004).

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Literature in the area of e-learning points out that the quality of educational software is significantly related to its interface quality (e.g. Buzhardt *et al.*, 2005; Cantoni *et al.*, 2004; Chu and Chan, 1998; Hinostroza and Mellar, 2001). The interface quality of educational software, moreover, has a serious impact on the learning outcome of the student (Gauss and Urbas, 2003; Jonassen and Wang, 1993). Crowther *et al.* (2004) argue that the impact of a poor interface design in education is more serious than in business. It impairs a student's overall motivation, as well as their learning performance, and has serious moral and ethical implications. In essence, interactivity between student and interface is considered the most important aspect in recent studies on how to improve quality of education through e-learning (Cantoni *et al.*, 2004; Chou, 2003; Ellis and Blashki, 2004; Gauss and Urbas, 2003).

The concept of interactivity of interface was derived from the field of information systems, and it was usually considered an influential factor in improving business web site quality (Chou, 2003). In the area of e-learning, however, interactivity plays a crucial role in knowledge acquisition and is counted as a core feature for e-students (Cantoni *et al.*, 2004; Chou, 2003). To date, there are very few studies dealing with interactivity issues in e-learning. Some of them have tried to establish guidelines or evaluation tools for interactivity of interface in e-learning, but have not provided relevant empirical verifications.

A literature review in information systems found that interactivity of interface is associated with issues of interface consistency among various aspects related to interface design (Grudin, 1992; Lin *et al.*, 1997; Ozok and Salvendy, 2003, 2004). The bottom line of interface consistency theory is that increasing the consistency levels of interface results in a significant decrease of error rates in computer and web-based tasks (Ozok and Salvendy, 2004), and Ozok and Salvendy (2003) pointed out that interface consistency is concerned with interaction between the user and the interface.

In the field of education, Gerrett *et al.* (1998) argued that maintaining interface consistency helps students to easily become familiar with interface functionality and styles of interaction. Chu and Chan (1998) stressed the importance of interface consistency for successful design of interactive interfaces for students, showing that a consistent interface in educational software behaves in a predictable fashion to students. Several studies, such as those conducted by Crowley *et al.* (2002), Gustafson (2004), and Lee *et al.* (2005) also emphasised the importance of interface consistency in e-learning; however most of them are case studies or theoretical research for education. A literature review for this research could not find any empirical studies dealing with the effect of interface consistency or inconsistency on learning processes for e-learning.

Accordingly, this study applies interface consistency theory to e-learning systems to examine the effect of interface consistency on learning so that relevant guidelines can be established to enhance interactivity of e-learning systems in the future. Furthermore, this study will deal with the issue of the "digital divide" with respect to e-learning. Government reports and academic research provide critical evidence that there is a serious gap between the digital "haves" and "have-nots", and that the gap is still growing (Drori and Jang, 2003; Jackson *et al.*, 2004; Prieger, 2003; Wilson *et al.*, 2003). We believe that e-learning has to take account of this, and we will explore the effect of interface consistency for e-learning on haves and have-nots. This attempt will make e-learning systems able to be customised for computing novices in the future, which is a way to bridge the digital gap in education equity.

Research questions

A literature review found that poor quality of an e-learning system must be related to poor interactivity of the interface. In approaching the issue of interactivity in e-learning, we found that interface consistency theory can be a key tool to improve interactivity in e-learning. Thus, this study will conduct an experiment by applying interface consistency to e-learning systems.

This study develops research questions to accomplish the goals mentioned earlier. The first main research question of this study is: what is the effect of consistency of interface on learning? Second, with regard to the effect of consistency, are there any differences between a group of students who are skilled in computer use and another group composed of novices? The findings from the two research questions will provide both researchers and practitioners, including educators and librarians, with new criteria for interface design issues in the area of e-learning.

Figure 1 represents a conceptual model of this study, and the model will be explained in detail in the next section.

Interface consistency

Background

Interface consistency has occasionally been studied in terms of computer science and management information systems. Regarding management information systems, consistency has been assumed to enhance the worker's ability to transfer skills gained in using one system to another. According to Nielsen (2001), consistency improves the worker's productivity by leading to higher throughput and fewer errors because the worker can predict what the system will do in any given situation and because the worker can rely on the "rules". This idea was conceived in the 1980 s but not frequently mentioned until GUI (Graphical User Interface) began to be widely used on computers. Since the late 1990 s it has been used to evaluate the effectiveness of information systems in workplaces, and a couple of empirical studies found that it is related to workers' job performance (e.g. Ozok and Salvendy, 2000; Ozok and Salvendy, 2003; Satzinger and Olfman, 1998).

Satzinger and Olfman (1998), who found that consistency is related to job performance (e.g. task accuracy, task time), brought up a relationship between interface consistency and human learning processes. They mentioned that consistent

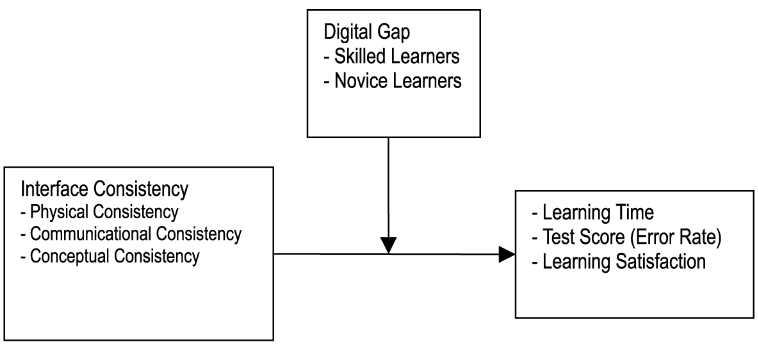


Figure 1. Conceptual model of this study

user interface probably facilitates transfer of learning, and also pointed out that very few studies have investigated the effects of interface consistency on learning. Their study provides a good rationale for research on e-learning associated with interface consistency. The effects of interface consistency on learning will be identified in this study through an experiment applying it to e-learning systems.

Three-dimensional model of interface consistency

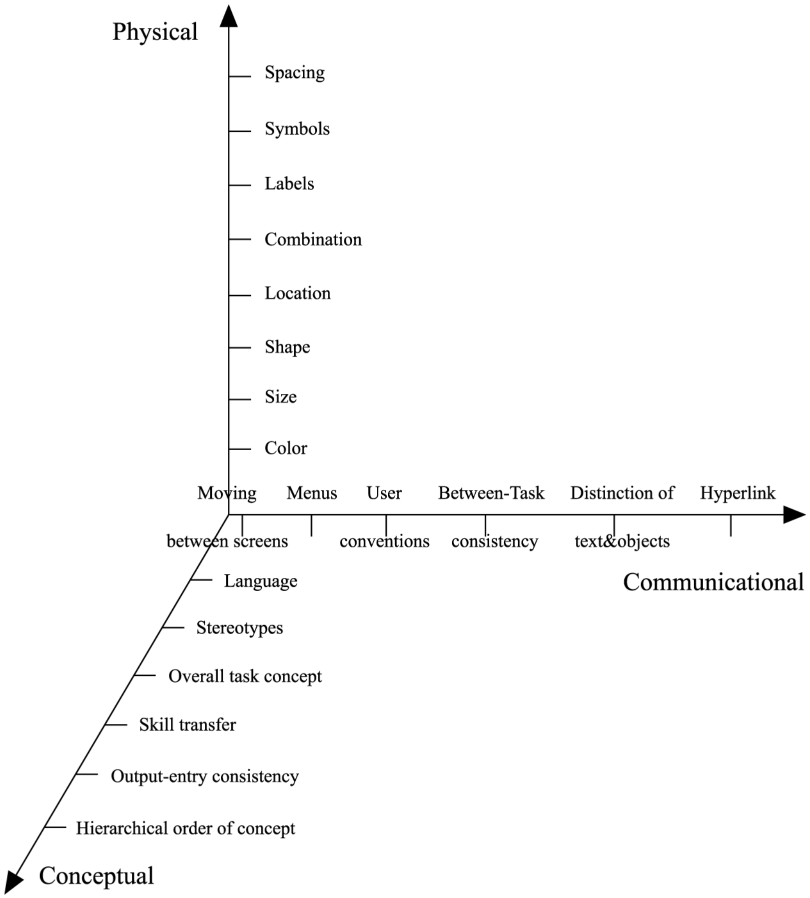
Interface consistency has been studied for more than a decade, and thus there are several perspectives on it. However, most literature showed that the consistency level of an interface is related to work performance with PC-based and web-based computer tasks (Ozok and Salvendy, 2004). For detailed descriptions, refer to the literature review sections of Ozok and Salvendy (2000) and Satzinger and Olfman (1998).

There are several views on interface consistency, but in some circumstances it is very difficult to define consistency (Grudin, 1992). Grudin (1989) emphasised that even a group of 15 experts were unable to produce a definition of consistency during a two day workshop and in most cases there is no absolute rule of interface consistency—it is perceived by the user. On the basis of a literature review, following Ozok and Salvendy (2000) and Satzinger and Olfman (1998), this study defines interface consistency as user-perceived multidimensional attributes of an interface which include the similarity of features, functions, and positioning across a system and between systems.

Grudin (1989) divided interface consistency into internal interface consistency and external interface consistency. Internal interface consistency refers to consistency within a task or a system and external interface consistency means consistency among different tasks or systems. Ozok and Salvendy (2000) dealt with the internal consistency more carefully and classified it into three sub-types: conceptual consistency, communicational consistency, and physical consistency. Based on this classification, they established the three-dimensional model of interface consistency as shown in Figure 2.

Physical consistency is the consistency of the graphical appearance or the visual characteristics of an interface feature. It indicates that the features are supposed to be consistent with the recognition of users. Users, for example, may deal with menus, check boxes, radio buttons, combo boxes, screen buttons, and so forth (Ozok and Salvendy, 2000, 2004). Appendix, Figure A1, illustrates an example of physical inconsistency. Those two pages exist on the same e-learning system. However, different font types, font sizes, and font colours were used between two pages. Also, the spacing of characters is not consistent. Moreover, menu items on the top of these pages also look inconsistent and confusing.

Communicational consistency is the consistency of the input and the output of the interface. It deals with how the user interacts with the computer interface and whether the means of interaction are consistent for fulfilling the same or similar tasks. The interaction is usually in the form of the user's retrieval of information from the interface (Ozok and Salvendy, 2000, 2004). Appendix, Figure A2, illustrates an example of communicational inconsistency. Those two pages exist on the same library information system, but the overall location of web features on the interfaces is inconsistent. For instance, to access the next list on the web page, students will need to use the scroll bar on a page, but on another page, they are supposed to use hyperlinks



Source: Ozok and Salvendy (2000)

Figure 2.
Three-dimensional model of interface consistency

to access it. Also, the location of the menu bar differed between two pages, which can be confusing.

Conceptual consistency is the consistency of metaphor applied to an interface feature or an action that is embodied within a feature. Frequent and inconsistent use of synonyms, instead of using the same words for the same items, is unhelpful. Leaving something to students' imagination and interpretation due to lack of explicitness is also regarded as conceptual inconsistency (Grudin, 1989; Ozok and Salvendy, 2000). Appendix, Figure A3, illustrates an example of conceptual inconsistency. The first page looks conceptually consistent within the page, but several conceptual inconsistencies are found between the two pages. Several terms were changed, making it difficult for students to understand that they refer to the same things:, e.g. "blog/weblog" and "bloggers/blog users/users" were used inconsistently. The abbreviation "BSP" was not clearly defined and was randomly used across those pages. Students will be bewildered by mixed use of the terms "e-community/internet community/online community". Several ambiguous sentences are found on the second page, including frequent use of synonyms and lack of explicitness.

This study follows Ozok and Salvendy's (2000) view of interface consistency and their three-dimensional model of interface consistency (see Figure 2) because this model has been validated through appropriate quantitative methods (e.g. Ozok and Salvendy, 2000, 2003, 2004) and because the model was recently designed for web-based systems. McIntyre and Wolff (1998) mention that the world wide web is a universally accepted format that can be accessed world-wide easily via inexpensive computer systems for e-learning. Thus, this study asserts that Ozok and Salvendy's (2000) three-dimensional model is a relevant tool to demonstrate current e-learning systems with respect to interface consistency.

Method

Implementation of e-learning systems for the experiment

In order to examine the effect of interface consistency on learning via an e-learning system, the authors conducted an experiment. The first step in setting up the experiment was to develop four different types of web-based e-learning systems (see Table I). The e-learning systems were developed based on Ozok and Salvendy's (2000) idea. Their experiment focused on workers' task performance, but the experiment in this study was oriented to learning a topic through the systems. All systems for this experiment dealt with the same topic for learning: technology adaptation in the area of agriculture. That is, all students were supposed to learn the same content and the same amount of information on each topic. Each system was composed of about ten web pages dealing with the topic written in Korean, the native language of the participants. Finally, four different types of e-learning systems were completed, and the differences between the four systems are illustrated in Table I.

Type I is a standard system which has high interface consistency. Interfaces in Type I were designed to be physically, communicationally, and conceptually consistent on the basis of Ozok and Salvendy's (2000), (2004) work. The text and label sizes, colour, background colour and overall text format were standardised as indicated in Ozok and Salvendy (2000).

Type II was designed to be physically inconsistent. Different inconsistent colours were used for labels, background, and text characters within or between pages. The sizes of the features on pages, such as characters, buttons, combo boxes, radio buttons, etc. were made inconsistent as well. The spacing of characters was also manipulated to be inconsistent throughout the web interface.

Type III was designed to be communicationally inconsistent. As indicated by Ozok and Salvendy (2000), the overall location of the text, pictures, and other features on the interfaces was made inconsistent. For example, in some pages, students can move on to

Table I. Experimental manipulations of e-learning systems

E-learning system type	Physical consistency	Communicational consistency	Conceptual consistency
Type I	High	High	High
Type II	Low	High	High
Type III	High	Low	High
Type IV	High	High	Low

the next paragraphs or parts by using the scroll bar, but on other pages in the same system, the students needed to click a hyperlink to complete the same tasks instead. Also, the locations of the buttons were inconsistently arranged. On some pages, the locations of buttons were at the bottom-right, but sometimes their locations were at bottom-centre, or in the corners. Finally, on some other pages, students had to use hyperlinks instead of buttons.

Type IV was made conceptually inconsistent. The language of the text was changed, making it difficult for students to understand. Sometimes long paragraphs were displayed, and terms were used inconsistently within the interface. For example, in explaining the situation of North Korea related to the agriculture industry, the Type VI system sometimes used the term "North Korea", but in some other parts it used "The Democratic People's Republic of Korea" instead. In the same way, synonyms of several terms were used interchangeably across the system, and mixed uses of direct expressions and metaphors also made the sentences ambiguous (Ozok and Salvendy, 2000, 2004).

Experiment design

The goal of this experiment was to examine the effect of interface consistency on learning, and as mentioned earlier, this study also explores differences between skilled users and novices on the computer in learning through e-learning systems. After building four types of e-learning systems, we sought participants for this experiment and divided them into two groups: an IT professional (skilled user) group and a novice group. The IT professional group subjects were composed of GIS (Geographical Information Systems) professionals, web administrators, web designers, and knowledge workers. All members of the professional group were very skilled on the computer, possessed their own computers, and lived in urban areas. All of them graduated from community college or higher. In contrast, novice group subjects were composed of farmers in rural areas who were not experienced computer users, and most of them did not have their own computer. Moreover, more than half of them had never used computers before, and most of them (93.5 percent) graduated from high school or lower. Table II illustrates the different profiles of each group.

The members of each group were randomly divided into four subgroups—four professional subgroups and four novice subgroups. Each subgroup was assigned to

Profile category	Professional group ($n = 112$)	%	Novice group ($n = 124$)	%
Age (average)	28.9		34.2	
Gender				
Male	91	81.3	119	96
Female	21	8.7	5	4
Education level				
High school or lower	0	0	116	93.5
Community college	16	14.3	6	4.8
College	78	69.6	2	1.6
Graduate school or higher	18	16.1	0	0
Household/personal computer ownership	112	100	42	33.9

Table II. Profiles of the two groups one of the four types of e-learning systems. Thus, one subgroup of professionals and one subgroup of novices were assigned to the Type I system, and so forth. In this way, each e-learning system was matched to two subgroups: one subgroup of professionals and one subgroup of novices.

Participants were asked to use the assigned e-learning system to learn about technology adaptation in the area of agriculture, and also asked to answer 14 prepared questions on the topic as quickly as possible. All studied the same topic and answered the same questions using different e-learning systems. To answer the questions, it was necessary to click buttons, use radio buttons and combo boxes, and fill out input forms, using the mouse and the keyboard. Learning times and all answers by individuals were recorded for analysis. After completing the experiment, participants were also asked to respond to a survey on their learning experiences using the e-learning system. The aim of the survey was to measure satisfaction levels with the e-learning experiences, and the survey form, using a seven-point Likert scale, was based on that of Ozok and Salvendy (2000).

All "students" voluntarily participated in the experiment, and were advised that they could withdraw from participation at any time without adverse consequence. There were 112 in the professional group and 124 in the novice group as shown in Table II. Unexpectedly, 42 members of the novice group withdrew from participation during the experiment. We investigated and found that it was because most of them felt that using the keyboard and/or mouse was very difficult, or in some cases they did not know how to use the equipment. However, there were no withdrawals from the professional group. This unexpected finding provides further evidence of the existing digital divide. We had to exclude those 42 people from the experiment and then looked over collected data to remove unusable data. Data which contained at least one missing value during the experiment were removed from the analysis so that this study could be free from inaccurate or irrelevant results. Finally, data collected from 71 members of the professional group and 40 of the novice group were used for analysis.

Results

Table III illustrates descriptive statistics from the experiment conducted in this study.

According to Table III, overall, the novice group spent more time on learning, had lower error rates (lower percentages of wrong answers), and felt higher satisfaction with the learning process through the e-learning system than the professional (skilled user) group. However, the differences were not considerable.

Professional group versus novice group

In order to explore different effects of interface inconsistency on these two groups, we used two-tailed *t*-tests and found that ($\alpha = 0.1$):

- students using the Type II (physically inconsistent) system in the professional group recorded significantly higher error rates than those using that system in the novice group ($t = 1.77$, df $= 32$); and
- learning satisfaction levels of students using the Type II system in the professional group were significantly lower than those of students using that system in the novice group ($t = -1.91$, df $= 32$).

Table III. Descriptive statistics of results

	Professional group			Novice group		
	n	Mean	SD	*n*	Mean	SD
Overall						
Learning time	71	226.59	104.33	40	265.31	295.65
Error rate	71	8.46	4.51	40	6.95	3.68
Satisfaction	71	17.26	6.66	38	20.09	6.4
Type I. Standard						
Learning time	19	242.11	92.51	11	257.44	92.85
Error rate	19	8.47	5.43	11	7.54	2.84
Satisfaction	19	19.18	5.21	11	21.04	6.4
Type II. Physically inconsistent						
Learning time	24	233	141.3	10	236.61	126.77
Error rate	24	9.62	5.44	10	7.4	1.83
Satisfaction	24	16.58	6.95	10	20.15	3.83
Type III. Comm. inconsistent						
Learning time	17	223.76	74	9	368.78	595.34
Error rate	17	7.11	1.36	9	6.44	5.54
Satisfaction	17	17.35	7.66	9	20.33	9.66
Type IV. Conceptual inconsistent						
Learning time	11	190.19	63.86	10	209.56	151.5
Error rate	11	8	3.46	10	6.3	4.21
Satisfaction	11	15.31	6.64	8	18.43	5.3

We found that if the interfaces of the e-learning system were designed to be physically inconsistent, the professional group (skilled students) will be more influenced by its effect on error rate than the novice group. That is, the physically inconsistent interfaces of the e-learning system perplexed skilled students because skilled students have numerous prior experiences using computers so they have expectations about features of the interface. They might notice a big discrepancy when they encounter the unexpected on the interface. Their learning processes are interfered with and consequently more errors in learning processes will occur. However, novice students were less influenced by physically inconsistent interfaces than skilled students were because novice students did not have as many preconceived ideas about the interface.

This disparity yielded a significant mean difference between the two groups in error rates.

Regarding learning satisfaction using the Type II system, the satisfaction level of the professional group (skilled students) using physically inconsistent interfaces was much lower than that of the novice group. This finding could be due to the fact that the learning satisfaction of skilled students is more influenced by physical inconsistency due to their prior experiences than that of the novice students.

Accordingly, these findings illustrate that skilled students are relatively more sensitive to physical inconsistency than novice students. However, these analyses only partially explain the effects of interface consistency on e-learning because we simply compared means between two different groups. Thus, mean comparisons between subgroups (e.g. Types I and II, Types I and III, and Types I and IV) within each group will provide more valuable understanding of the effects of interface consistency. Such analyses will show whether interface consistency improves learning performance of similar or homogeneous students in the next section.

Effects of interface consistency on learning within each group

On the basis of Table III, we conducted mean comparisons between subgroups within each group. First, in the professional group, a *t*-test was applied to compare means (learning time, error rate, and satisfaction) of the Type I-use subgroup with those of the Type II-use subgroup. Then, also in the professional group, another t-test was applied to compare means of the Type I-use subgroup with those of the Type III-use subgroup. In the same way, mean comparisons between the Type I-use subgroup and the Type IV-use subgroup in the professional group were performed. The same procedures were applied to subgroups in the novice group. Finally, we hypothesised that the Type I system would yield shorter learning times, lower error rates, and higher learning satisfaction than the other three systems within each group. That is, high-consistency interfaces would result in improvement in learning processes. We found that ($\alpha = 0.1$, two-tailed): in the professional group, learning satisfaction levels of students using the Type I (standard) system were significantly higher than those of students using the Type IV (conceptually inconsistent) system ($t = 1.76$, df $= 28$).

There were no other significant effects of interface inconsistency on learning based on the results from the two-tailed t-tests at the 0.1 level. The findings from a series of *t*-tests revealed that interface consistency improves students' learning satisfaction with the e-learning system, and this tendency is stronger among skilled students than in the novice group. In other words, perceptually inconsistent interfaces of the e-learning system reduce the learning satisfaction of skilled students. The dissatisfaction will discourage the students from involving themselves in further learning.

As follow-up analyses, we conducted *F*-ratio analyses. *F*-ratio analysis is suitable for comparing variances between two groups. In education, to determine whether a new method or e-learning system produce better results, the mean scores of learning performance of the control group and the experimental group are compared (or pretest and posttest), and then the standard deviations of learning performances of both groups are compared. If the mean score of learning performance of the experimental group (posttest) is better and also the standard variation of the group is smaller than the other group, it is concluded that the method produces better results (Alessi and Trollip, 1992; Hess, 1995; Sheen *et al.*, 2004). Smaller standard deviations of learning performances of students are regarded as closing the achievement gap between students, which is one of the important principles for improving educational success (Alessi and Trollip, 1992; Schwartz, 2001).

Accordingly, we hypothesised that the standard deviations of learning time and error rate would decrease (i.e. causing better learning performance) when students use the Type I system rather than other types. F-ratio analyses were applied to compare standard deviations (learning time, and error rate) of subgroups using Type I with those of subgroups using Types II, III and IV, respectively. The same procedure was applied to each group, and found that ($\alpha = 0.05$, two-tailed):

- in the novice group, the standard deviation of learning time for the subgroup using Type I (standard) was significantly lower than that of the subgroup using Type III (communicationally inconsistent) ($F = 0.02$, $df_1 = 10$, $df_2 = 8$); and
- in the professional group, the standard deviation of error rate for the subgroup using Type I (standard) was significantly higher than that of the subgroup using Type III (communicationally inconsistent) ($F = 15.85$, $df_1 = 18$, $df_2 = 16$).

According to the descriptive statistics in Table III, in the novice group, average learning time slightly decreased when subjects used Type I (mean = 257.44 sec.) compared with Type III (mean = 368.78 sec.), and the standard deviation of learning time also significantly decreased from 595.34 in those using Type III to 92.85 in those using Type I. This result illustrates that communicationally inconsistent interfaces reduce the effectiveness of e-learning systems, leading novice students to spend more time and widening the achievement gap in learning.

It was surprising that in the group of skilled students, the standard deviation of error rates increased significantly from 1.36 when using Type III to 5.43 using Type I. This result indicates that communicationally inconsistent interfaces might increase the effectiveness of e-learning for skilled students. Experiments conducted by Satzinger and Olfman (1998) found that in most cases, inconsistent interfaces degrade workers' task performance, but surprisingly found that task accuracy can be increased with inconsistent interfaces, which is partially consistent with this contradictory result. Satzinger and Olfman (1998) suggested a possibility that highly activated visual cues of the participants due to inconsistency enhanced their concentration on the given task, resulting in the contradictory finding.

We investigated the experimental setting in this study again in order to explain the contradictory result, and found one possibility. All e-learning systems for this experiment included several long articles as learning material. The Type I system consistently provided related questions at the bottom of each article, and students needed to use the scroll bar to read questions at the bottom of the articles on several pages, and to use the scroll bar again to move on to the other parts of articles. In contrast, the Type III system sometimes provided the same sort of interfaces as Type I, but a couple of interfaces asked students to click a hyperlink to see the questions, which is communicationally inconsistent. When students clicked the hyperlink, a pop-up page opened and provided related questions. Students could move between two pages using the hyperlink, instead of using the scroll bar. We believe that these pop-up pages which included questions in Type III might better activate some students' cognitive cues in answering the questions, or frequent use of the scroll bar in Type I might detract from some students' learning processes, which resulted in high standard deviation in error rate.

In short, through these follow-up analyses, this study finds that communicationally consistent interfaces enhance novice students' learning performance, but this finding does not always apply to skilled students. Emphasising careful application of interface consistency, Grudin (1989) pointed out that "If a consistent interface impedes skilled performance, and if its major use is by a skilled user, then consistency is working against good design". Thus, the best interface design in certain circumstances might violate consistency (Grudin, 1989).

Conclusion

The goal of this study was to examine how the interface consistency of the e-learning system influences students' learning processes.

We found that skilled students make more errors than novice students when they use a physically inconsistent e-learning system. It is because prior experiences give skilled students fixed ideas about interfaces. The learning satisfaction of skilled students is also more affected by physically inconsistent systems than that of novice students. That is, learning satisfaction levels of skilled students are lower than those of novices when using a physically inconsistent system. It was also found that a conceptually consistent e-learning system facilitates skilled students' learning satisfaction. The communicationally consistent system turned out to be effective in improving novice students' learning processes, increasing interactivity between novice students and the interface. However, the effect of communicational consistency on skilled students is very little or might be contradictory.

In conclusion, this study leads to several important implications in designing interfaces for e-learning. Skilled students are generally more sensitive to interface consistency than novice students, but there might be more critical design factors for skilled students. Since communicational consistency is a critical factor for novices on the computer, interface designers must handle it carefully when they develop e-learning systems for such users.

While conducting the experiment for this study, we found a serious digital gap. Many subjects who lived in rural areas could not even finish the experiment due to their unfamiliarity with the hardware. It was initially hoped that e-learning would improve educational equity, but this will not be accomplished unless the basic digital gap is closed through computer ownership, in-home internet connections, computer education, and so forth.

Interface consistency is also applicable to the web sites of libraries and portals. One of the key findings of this study is the importance of understanding varying characteristics of users. A good understanding of the characteristics of frequent users must precede web site or system analysis and design. For example, when a public library in a rural area is planning to develop their web site, they should put more focus on communicational consistency of the interface.

Interface consistency alone does not guarantee the best web-based e-learning system; it is an aspect of interactivity and usability. As indicated in most literature on consistency, interface consistency sometimes conflicts with other factors of usability, and sometimes has to be downplayed. However, rejecting consistency as a primary user interface goal does not argue for randomness in user interface design (Grudin, 1989). Relevant strategies for high-quality interactivity and usability of e-learning systems can be established only through a good understanding of students.

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Appendix

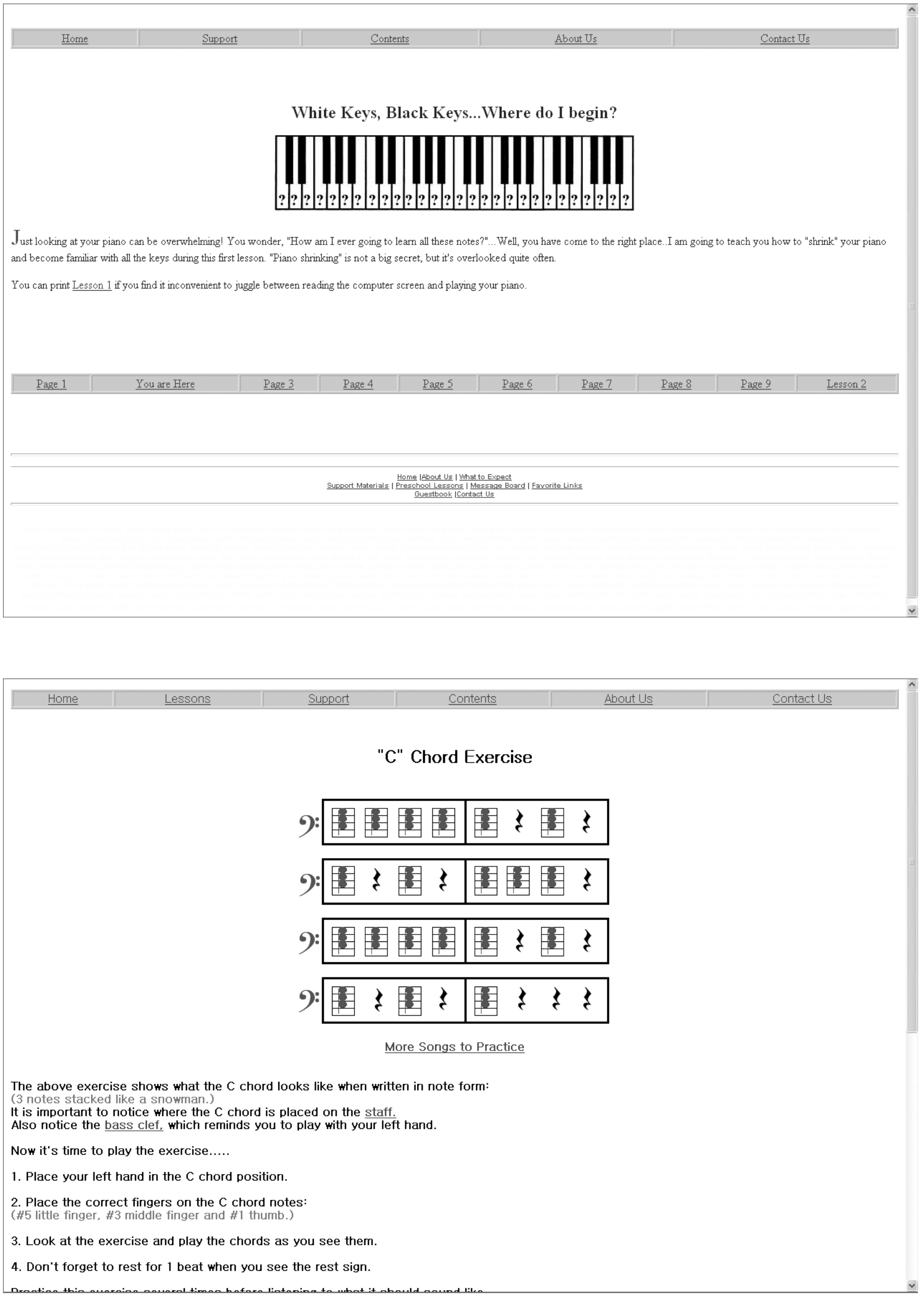


Figure A1.
An example of physical inconsistency

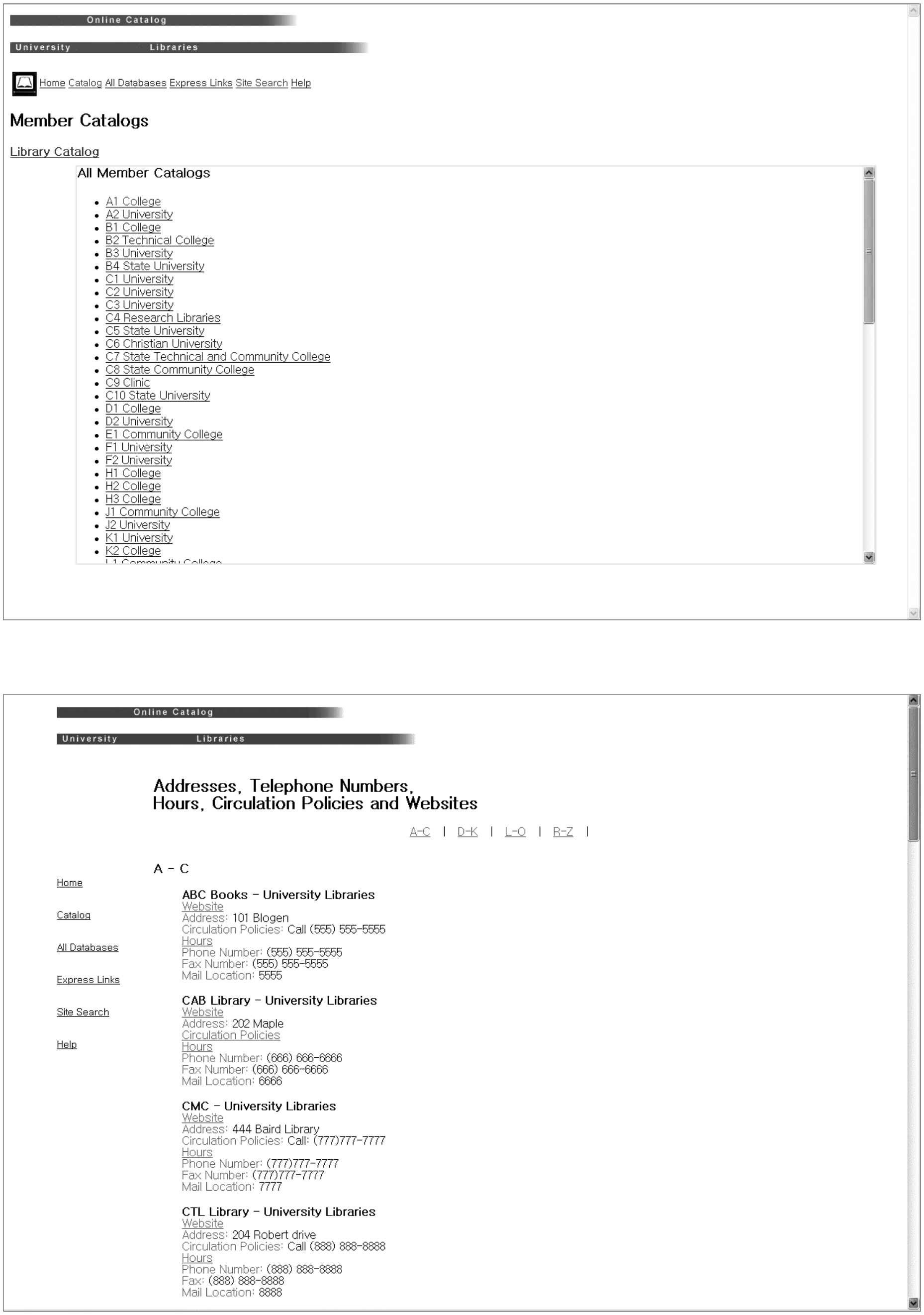
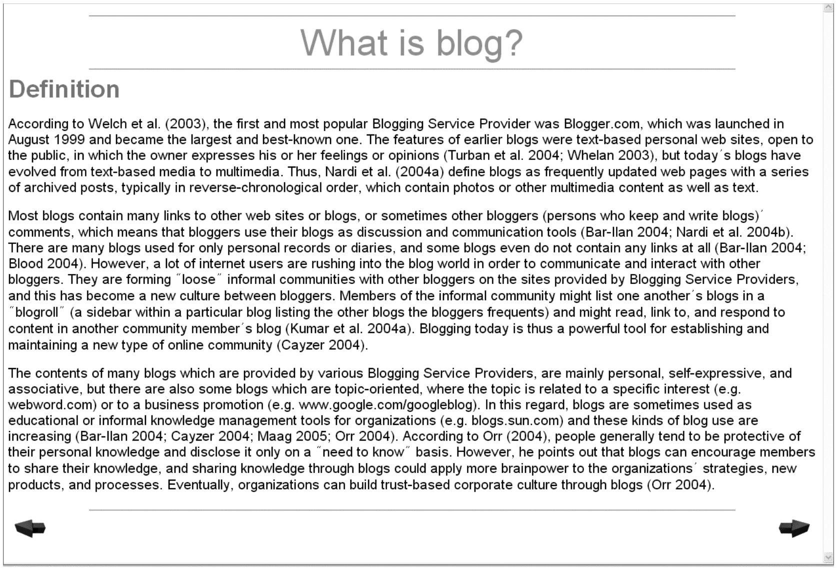


Figure A2.
An example of communicational inconsistency



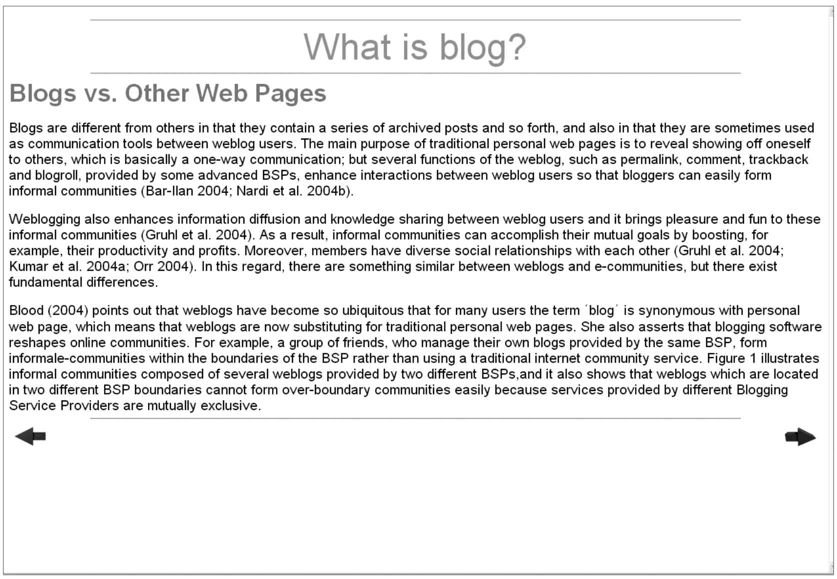
What is blog?

Definition

According to Welch et al. (2003), the first and most popular Blogging Service Provider was Blogger.com, which was launched in August 1999 and became the largest and best-known one. The features of earlier blogs were text-based personal web sites, open to the public, in which the owner expresses his or her feelings or opinions (Turban et al. 2004; Whelan 2003), but today´s blogs have evolved from text-based media to multimedia. Thus, Nardi et al. (2004a) define blogs as frequently updated web pages with a series of archived posts, typically in reverse-chronological order, which contain photos or other multimedia content as well as text.

Most blogs contain many links to other web sites or blogs, or sometimes other bloggers (persons who keep and write blogs)´ comments, which means that bloggers use their blogs as discussion and communication tools (Bar-Ilan 2004; Nardi et al. 2004b). There are many blogs used for only personal records or diaries, and some blogs even do not contain any links at all (Bar-Ilan 2004; Blood 2004). However, a lot of internet users are rushing into the blog world in order to communicate and interact with other bloggers. They are forming ˝loose˝ informal communities with other bloggers on the sites provided by Blogging Service Providers, and this has become a new culture between bloggers. Members of the informal community might list one another´s blogs in a ˝blogroll˝ (a sidebar within a particular blog listing the other blogs the bloggers frequents) and might read, link to, and respond to content in another community member´s blog (Kumar et al. 2004a). Blogging today is thus a powerful tool for establishing and maintaining a new type of online community (Cayzer 2004).

The contents of many blogs which are provided by various Blogging Service Providers, are mainly personal, self-expressive, and associative, but there are also some blogs which are topic-oriented, where the topic is related to a specific interest (e.g. webword.com) or to a business promotion (e.g. www.google.com/googleblog). In this regard, blogs are sometimes used as educational or informal knowledge management tools for organizations (e.g. blogs.sun.com) and these kinds of blog use are increasing (Bar-Ilan 2004; Cayzer 2004; Maag 2005; Orr 2004). According to Orr (2004), people generally tend to be protective of their personal knowledge and disclose it only on a ˝need to know˝ basis. However, he points out that blogs can encourage members to share their knowledge, and sharing knowledge through blogs could apply more brainpower to the organizations´ strategies, new products, and processes. Eventually, organizations can build trust-based corporate culture through blogs (Orr 2004).



What is blog?

Blogs vs. Other Web Pages

Blogs are different from others in that they contain a series of archived posts and so forth, and also in that they are sometimes used as communication tools between weblog users. The main purpose of traditional personal web pages is to reveal showing off oneself to others, which is basically a one-way communication; but several functions of the weblog, such as permalink, comment, trackback and blogroll, provided by some advanced BSPs, enhance interactions between weblog users so that bloggers can easily form informal communities (Bar-Ilan 2004; Nardi et al. 2004b).

Weblogging also enhances information diffusion and knowledge sharing between weblog users and it brings pleasure and fun to these informal communities (Gruhl et al. 2004). As a result, informal communities can accomplish their mutual goals by boosting, for example, their productivity and profits. Moreover, members have diverse social relationships with each other (Gruhl et al. 2004; Kumar et al. 2004a; Orr 2004). In this regard, there are something similar between weblogs and e-communities, but there exist fundamental differences.

Blood (2004) points out that weblogs have become so ubiquitous that for many users the term ´blog´ is synonymous with personal web page, which means that weblogs are now substituting for traditional personal web pages. She also asserts that blogging software reshapes online communities. For example, a group of friends, who manage their own blogs provided by the same BSP, form informale-communities within the boundaries of the BSP rather than using a traditional internet community service. Figure 1 illustrates informal communities composed of several weblogs provided by two different BSPs,and it also shows that weblogs which are located in two different BSP boundaries cannot form over-boundary communities easily because services provided by different Blogging Service Providers are mutually exclusive.

Figure A3.
An example of conceptual inconsistency

Corresponding author
Junghoon Moon can be contacted at: jmoon@icu.ac.kr