

Elements of Properties of User Experience in Cloud Computing Documentation Platform According to Smart Device Screen Size Changes: Focus on Google Docs and Naver Office

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Abstract. As the smart devices marketplace becomes increasingly more competitive, the usage accessibility of individuals has improved and services development is more active. Among these developments, use of the Cloud Office Platform as a collaboration tool for cooperation in Cloud Computing is on the rise. The N-Screen, with its limited function and amount of information displayed depending on screen size, also requires that a seamless user environment be provided. This paper analyzes user experience (UX) factors and characteristics using patterns and functions that should be taken into consideration for utilization of the Cloud Office Platform based on web browsers on PCs and Mobiles. This analysis is called the “Consistency of Character” analysis, and this paper proposes a research method in which it is incorporated.

Keywords: Mobile services · User experience (UX) · Consistency of character · Cloud computing · Online office · Document authoring tool

1 Introduction

With the development of information environments that interact with information technology (IT), new smart devices of varied screen sizes are released constantly in the market. Users provide smart devices developed with modified screen sizes with new roles and purpose. In recent times, new terms such as “Smart Work” and “Smart Office” have been created, and related services developed. These trends have also affected content usage behavior. Such change is caused by the importance of efficient collaboration and increased tasks in cloud computing environments, led by documentation platforms. Collaboration in cloud computing environments is currently in a phase of constantly creating an ecosystem around documentation platforms developed by portals.

To provide a cooperative tool in cloud computing, it is important to know usage behaviors for the same content on different devices with different screen sizes, as well as the experience and characteristics to be provided to users, in order to provide devices with distinct characteristics and corresponding services. However, related research still remains insufficient.

1.1 Research Objective

The development of Smart work and Smart devices has resulted in “collaboration” action being a key experience. The important task of “document work” exists not only in companies but also in any group that engages in collaboration with a fixed process. In this paper, the functions of a document authoring tool for transferring from PC to Mobile during document processing and the factors and characteristics of the user experience (UX) are analyzed based on the level of importance. This is used to improve the quality of cloud computing office document processing on N-Screen devices.

Therefore, this study aims to analyze the UX elements and properties that must be provided according to screen size in cloud computing, by focusing on documentation platforms. The UX elements and properties to be analyzed are those that establish a relationship between information displayed differently according to device screen size and user context, specified and referred to as Consistency of Character in this study.

1.2 Contents of Research

In this paper, the service context and UX of Clouding Computing based on N-Screen environments is investigated to propose UX factors and characteristics that providers should consider in order to reduce the service information and function based on the device standard. To this end, this study aims to present the UX elements and properties to be considered from the perspective of providers. Therefore, we provide guidelines for the elements and properties of UX-based service design to be considered for new services in cloud computing environments.

2 Theoretical Background

2.1 Cloud Computing and N-Screen

Due to the increased application function according to the evolution of Mobile devices such as smart phones and development of the broadband network, Ubiquitous Mobile service of based on cloud computing is also emerging as the life revolves around [1]. That is, the user is that the same device can be used through a variety of content and can use the contents in accordance with the characteristics of various devices [2]. By providing most of the content and information stored in the cloud and can be used consistently contents UX between devices, it's offering a convenient environment for users and can promote the content consumption. Cloud services will be the backbone N-Screen-to-3S (Sync, Shift, Share), on footing this player, etc. offers a variety of additional services and applications will be [3]. To the application service canvas for receiving in a number of configurations via the connection between the application, it was that the web contents fusion function can be the service is realized only by the user's own [4].

2.2 Consistency of UX in N-Screen Environment

Consistency in design is simply more than one element is not meant to “sound the same”, this is a lot of complex issues to consider. In order to discuss the consistency because there are fundamentally many layers, levels and dimension to consider. That is a consistent design style of integrating into the inner surface than to match the same can be said to attain intuitively [5]. Nielsen [8] said, when the user about the consistency to transfer skills from one system to another, defined as improve user’s Possibility to which time is easy usability and learnability on another system [6]. The workshop opened with the theme of CHI 2006 [9] explain to divide the consistency in user-level and interface-level in multi-platform environments, user-level means “The transfer of knowledge that as the user transfers the platform, you can take the seamless same task”, ‘Cognitive convenience’ and ‘User will feel as if they were in the house’. Consistency of Interface-level means that it would be possible for the same functions, such as the selection of the design, such as the widget is always the same action at the interface of the other platform [6].

The concept of ‘consistency’ to be covering in this study is called ‘Consistency of Character’ which UX elements and properties that to connect information Display each other according to the screen size of the smart device and the relationship between the use context, and it proceeds to deduct the research.

3 Theoretical Background

3.1 Preceding Research on Cloud Office Platform: Understanding the Document Authoring Tool

Classification of Document Authoring Tools. Cloud computing document authoring tools are classified as seen in Table 1 based on research method. For the subject of research relevant to the objective of the study to be selected, the cloud computing office tool (cloud office) that allows compatibility and provides standardized document forms during collaboration is examined.

Definition of the Cloud Office Platform. Before going into the actual research, preliminary research was conducted on document processing using online office tools based on cloud computing on an N-Screen. A document authoring tool developed domestically and abroad was also utilized.

Table 1. Classification of document authoring tools

Online document authoring tool (Based on N-Screen)	Cloud note		Compatible operating systems (Compatible or not)
	Online office (= Cloud office tool)	Based on web browser	
		Based on installation program	

Among the online office tools, the cloud computing office tool that matches with the above conditions to be studied is referred to as the “Cloud Office Platform” in this paper.

3.2 Preceding Research on Cloud Office Platform: Cloud Office Platform Case

Among the Cloud Office Platforms developed, Korean Naver Office and Polaris Office, and American Google Docs and MS Office 365 were used to conduct a case analysis and comparison, as shown in Table 2.

Table 2. Cloud Office Platform—domestic and foreign cases

Korea	Naver Office / Naver Corp.	Polaris Office / Infraware Inc.
Type	Web app based web browser	App based on installation program
Features	<ul style="list-style-type: none"> • Spreads the center of Korea portal: Naver’s users • Possess the office business system ‘Naver Works’ eco-system based on enterprise cloud • Way to web-centric document distribution 	<ul style="list-style-type: none"> • Office program into 60% of the smart phone (Samsung, LG and etc.) is installed in advance • Development of the PC version after mobile and tablet application development
Major-Ex	<ul style="list-style-type: none"> • High compatibility with various office documents: talking into account the specificity of the Korea office market share (HWP, ODF, PDF and etc.) • MS Office documents outside Korea share high domestic word processing ‘HWP’ editable • Utilization is possible of the data provided by the Naver 	<ul style="list-style-type: none"> • Feature Support complex formatting or functionality written in MS Office • Shared document based on a mobile address book
Foreign	Google Docs / Google Inc.	MS Office 365 / Microsoft Corp.
Type	Web app based on web browser	App based on installation program
Features	<ul style="list-style-type: none"> • Possess the enterprise ‘Apps for Business’ eco-system through the Google Apps Marketplace • Syntagmatically available a variety of services through the Google Apps 	<ul style="list-style-type: none"> • Change of MS Office according to Windows version update • Maintaining the existing system of installation MS Office of cloud services: be quick to user’s adapt • Liaison between the installation MS Office and MS Office 365
Major-Ex	<ul style="list-style-type: none"> • To offer personalized service center of the ‘sharing’ and ‘collaboration’ • Auto save recorded: View document update record • Provide correct feedback on usage (ex: WYSIWYG, When collaborating input status, etc.) 	<ul style="list-style-type: none"> • The provision of integrated apps through Office store with installation Office • Use the system that it’s familiar with the existing approach to cloud • Construction of ecological social center (ex: Document access via the Drop box)

4 Research Method

4.1 Research Question

Of the various document authoring tools based on cloud computing, Google Docs and Naver Office met the standards below and were the ones primarily used in this research.

- Office tool developed at a representative portal site based on domestic and foreign standards.
- Cloud computing based web application office tool that can perform word processing in an internet browser and application (no installation-type offline document authoring tool is developed separately, only the online office tool is provided).
- N-screen office tool, facilitating word processing on both PC and Mobile.

In this study, we aimed to utilize the selected Cloud Office Platform to answer the following research questions in regard to information processing services provided in cloud computing:

- *Research Question 1:* How does the context used by users affect the use of the platform based on device changes?
- *Research Question 2:* How do the functions derived on the platform affect the use of the platform?

4.2 Research Procedure: Research Process and Research Analysis Method

Previous Research: For the Service typology from the perspective of Design Information Framework (2013) interaction and UX attributes, 11 different interaction attributes selected by Lim et al. [11] and 18 sub-elements of the UX factors selected by Park et al. [12] were used [7]. Florins et al. [10] argued that consistency needs to be maintained based on three levels: Perceptual continuity, Cognitive continuity, and Functional continuity based on Donald Norman's action theory [5]. These were taken into consideration, and, of the three, our focus was on functional continuity. Further, of the three categories in the sub-elements (Usability, Affect, and User Value), the Usability attribute with a high relationship with functional continuity was used for mapping.

User Research: This user research was carried contextual inquiry (CI) and user in-depth interview out that Targeting the twenties to thirties male and female respondents seen that using Naver Office and Google Docs user of the N-screen service to analyze usage patterns on PC and Mobile for the use context.

In the research investigation, the research subject's function and service range were restricted based on analysis results of preceding investigations:

- a. Depending on the software company's market direction, the supplied operating system's compatibility and support for different web browsers and smart devices, and the possibility of a new function was excluded.

- b. Company Cloud Office Platform is limited in the functions provided and application use of devices based on the pricing policy. Thus, of the company version users, only the Google Docs service is discussed.

4.3 Research Procedure: User Investigation

Cloud Computing Platform Use-Attitude and Use Functions for Each Device:

The CI conducted during the user investigation was to observe the use environment for each device, and conduct in-depth user interviews aimed at observing the Cloud Office Platform function used on PC and Mobiles, depending on the use-attitude and context and also aimed to analyze the main experience users have based on the use functions. First, the comparison function needed to deduct users' use functions was extracted for each document form: Google Docs and Naver Office for PC and Mobile use. In addition, to equalize the levels of the functions to compare in each office document's form, of the functions shown on screen while running on the platform, functions existing at a depth of one were compared. Of the user's use function, more than 70 % had usability, and the same functions of a document form were said to be the main use functions. The operating system was set Windows and Android up.

When the number of functions for comparison is observed more closely, it can be seen that Google Docs doubled Naver Office in terms of the number of functions for the PC. Google Docs showed 3–4 times differences between the number of functions for PC and Mobile while Naver Office showed almost no function differences between the two devices. Thus, for Naver Office, UX based on the function difference between PC and Mobile use is provided identically, regardless of each function's use-frequency.

Looking at the main use functions in Table 3 below, for PC, simple editing functions are in the majority, whereas for Mobile, checking functions are in the majority. The distinctive point is that for PC, the document itself was newly made but for the Mobile the document was opened and only the name was changed. On the Mobile, the existing file was opened and reviewed but a new document was not made and edited. According to CI, for the N-Screen, working on Mobile consecutively after the PC became more inconvenient and vice versa. Further, working on a document on Mobile after creating it on a PC was much less frequent. The main reason for this is that a Mobile was used simply to check the document being worked on using the PC or to briefly modify texts and new documents were not made to edit. Another major reason is that concentration was reduced because of the smaller screen size. Because users did not have high expectations about multiple functions of Mobile, there was no reduction in use. Moreover, there was difficulty using the Mobile functions to input information by touching it. Unlike a Mobile, if a PC is not connected to a wired or a wireless network, internet data cannot be used, causing restrictions. Further, when the network is unstable and multiple users are editing the same document, errors occur, so users do not use the application in this situation. For these reasons, the reliability of automatic saving is guaranteed only for one-time or volatile documents. Mobile is used on the move because of easier mobility and the convenience of relatively free network use, but because of the screen size, the office platform is used less often and the quality of work falls.

Table 3. Google Docs and Naver Office use-behavior on PC and mobile

Device	PC		Mobile	
	Google Docs	Naver Office	Google Docs	Naver Office
Key usage functions	a. Text editing (Font, Font size, Weight, Italic, Underline, Color, Style, Alignment)		a. Document home	
	b. New		b. Changing the file name	
	c. Open		c. Open	
	d. Share		d. Share	
	e. Insert (Shapes, Lines, Tables, Images)		*How to share: Google Docs - files and folders, Naver Office - folders)	
	f. Modification (Copy, Paste)			
	g. Print			
N-Screen usage patterns	From PC to mobile		From mobile to PC	
	1. Screen size changes due to decrease the amount used of features		1. Distance to the entry that occurs due to the small screen size	
	- Simple text entry and editing			
	- The difficulty of finding documents		- No sophisticated editing	
	- UI is different from the PC: Confused about function location		- Operation error (ex: making type error, editing error, etc.)	
	2. Reduce usage: Provides functions that do not fit with the device input methods			
Unused-Key usage patterns	• When you're moving (if notebook)		• When the PC is available	
	• When a network connection is not stable		• When the elaborate operation required	
	• When necessary fonts and keyboard shortcuts are supported and not be compatible		• When the operating system version according to the office version does not match (updated or not)	
	• When collaboration is required			

UX Factor Deduction: According to the results of a user in-depth interview conducted, the main experience on the Cloud Office Platform is continuity. Continuity can be divided into two concepts: compatibility between software for document extension and consistency between PC and Mobile for simple document editing. For the latter, which is applicable to this research, for substituting experience with functions for the 11 types of interaction and UX interaction attributes and seven UX Sub-elements, usability mapping was implemented to classify the main use functions between PC and Mobile based on the main use attributes. The same use behaviors for Google Docs and Naver Office were selected as standards for the use behaviors.

The main use functions, based on usage on different devices, have differences in usage depending on the situation; however, when using the device, the same functions as in the platform were used. In addition, opening and sharing is applicable in all cases. This result shows the usage attribute for users who use the Cloud Office Platform as a collaboration tool, and this can be seen as a function of the Cloud Office Platform in close association with the users. When the use functions of each use attribute are observed, those with the same attributes are grouped and have been reclassified for interaction attributes and UX Sub-elements: usability (Table 4).

Table 4. Main use function mapping based on main use attribute

	PC			Mobile	
	Key usage patterns	Key usage functions		Key usage patterns	Key usage functions
A1	Document sharing is required situation	Open, Share	A2	Document sharing is required situation	Open, Share
B	Implementing sophisticated tasks	Text editing, Open, Share, Insert, Modification	E	Check document enforcement	Document home, Changing the file name, Open, Share
	Sitting in state			Moving state	
C	Reliable network environment		New	Unavailable environment the PC	
D	Flexible work environment		Performed a simple text modifications		

4.4 Research Procedure: UX Attribute Analysis for Different Platform Uses on Cloud Computing Document Processing

On the basis of the mapping materials above, the same use functions of Google Docs and Naver Office were grouped together and reclassified into 11 different interaction attributes and seven UX Sub-elements: Usability. The UX attributes of the main use behaviors and main use functions were matched. They were classified into 22 attributes including two attributes that were different from the 11 types of interaction attributes.

For UX attribute matching, university students and employees working at UX businesses were selected to form two groups of five, and workshops were conducted twice for each group. Through these workshops, the same use attributes that were grouped according to the same use functions were matched. On the basis of the matched attributes, the attributes that were the same for both PC and Mobile were selected and a Cloud Office Platform Consistency of Character was created, as shown in Table 5.

Table 5. PC and Mobile Cloud Office Platform Consistency of Character based on the mapped use attributes and functions.

Google Docs/Naver Office		PC				Mobile	
Interaction attributes		A1	B	C	D	A2	E
Connectivity	Independent						
	Networked	O	O	O	O	O	O
Continuity	Discrete						
	Continuous	O	O	O	O	O	O
Directness	Indirect						
	Direct	O	O	O	O	O	O
Movement	Static	O	O	O	O	O	O
	Dynamic						
Orderliness	Random						
	Orderly	O	O	O	O	O	O
Proximity	Precise	O	O	O	O	O	O
	Proximate						
Pace	Slow						
	Fast	O	O	O	O	O	O
Resolution	Scarce					O	O
	Dense	O	O	O	O		
Speed	Delaying						
	Rapid	O	O	O	O	O	O
State	Fixed						
	Changing	O	O	O	O	O	O
Time-depth	Concurrent	O	O	O	O		
	Sequential					O	O
Elements of UX		A1	B	C	D	A2	E
Sub-elements of Usability	Simplicity	O				O	O
	Directness	O	O	O	O	O	O
	Efficiency	O	O	O			
	Informativeness, Flexibility, Learnability, User Support	O	O	O	O	O	O

5 Research Analysis Results and Conclusion

5.1 Research Results

A total of 15 attributes, Networked, Continuous, Direct, Static, Orderly, Precise, Fast, Rapid, Changing, Simplicity, Directness, Informativeness, Flexibility, Learnability, User support, fulfil A1 and A2, open and sharing functions derived from the same UX factor between PC and Mobile at the same time. Fourteen attributes, excluding simplicity, belong to all use behaviors. The relevant attributes were classified as shown in Table 6 on the basis of their use function. Contextuality is an experience attribute that must be formed when the function used must change owing to an external or internal situation, Accessibility is an experience attribute that must be formed when each function needs to be provided during use, Communicability is an experience attribute that must be formed when the function first provides a function to the user. These three experience attributes, Contextuality, Accessibility, Communicability, are consistency of characters derived depending on the PC and Mobile screen size, when using the Cloud Office Platform.

Table 6. Three types of experience attributes of Consistency of Character

Consistency of Character	Interaction attributes	Elements of UX (Usability)
Contextuality	Networked, Continuous, Fast, Changing	Flexibility
Accessibility	Precise	Simplicity, Directness, Learnability
Communicability	Direct, Static, Orderly, Rapid	Informativeness, User support

5.2 Research Result

This study focused on cloud computing word processing platforms and analyzed the UX factors and characteristics that should be provided based on screen size. The standard screen devices used for comparison were Windows PC and Android Mobiles. The Cloud Office Platforms observed were Google Docs and Naver Office. The use-behavior based on the user environment and the frequency of use for the functions were compared, and UX elements, the open and sharing function, were created. Subsequently, the classified main use functions based on the main use behaviors were mapped together and grouped according to similar function use behaviors. The grouped use behaviors were matched through 11 types of interaction attributes and seven UX Sub-elements based on usability. The matched experience attributes were grouped based on the function's use relationship in terms of Contextuality, Accessibility, and Communicability. In addition, these three experience attributes form the Cloud Office Platform's UX characteristics and Consistency of Character.

The answers to the research questions posed in this study are as follows:

In cloud computing, when information is reduced, services are provided.

- *Research Question 1:* How does the user's use context affect the platform used based on device changes?

A PC is equipped with a large screen, keyboard, and mouse. Consequently, most elaborate and complicated work is done on the PC. Use behaviors change depending on the network situation. When the network is safe and the work environment is relatively fluid, PC was used, but even Notebooks will not be used if the network is unstable. On the other hand, because Mobiles have flexible networks, they can be used while on the move. However, because of their small screens, they are mostly used for viewing or to input simple texts. Mistakes and errors occurring because of the small screens make users wary. The fact that their input methods are different from those of a PC make Mobile use environment worse and reduce the scope of work that can be done on Mobiles.

- *Research Question 2:* How do the functions derived on the platform affect the platform used?

When comparative analysis was conducted on the use behaviors and use functions of Google Docs and Naver Office, the frequency of use of each office platform's distinct characteristic was not mentioned compared to the frequency of use of editing function with simple document writing. Thus, depending on the device used, there were overlapped functions, mostly related to basic editing functions. There was an editing function on a Mobile but even from simple text edits, there were many errors arising because of the touch type input, hence, it was not used with high reliability. Thus, in the Cloud Office Platform, users suggested diversification of document basic templates and functions customized for viewers.

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