OPEN ACCESS
ISSN 2356-5462
socj.telkomuniversity.ac.id/ijoict

Intl. Journal on ICT
Vol. 2, Issue. 1, June 2016. pp. 45-56
doi:10.21108/ijoict.2016.2.1.79

Recommendation of Information Architecture Design on Higher Education Institution Website Using Card Sorting Approach on Goal-Directed Design Method

Mira Kania Sabariah[#1],
Gilang Bintang Hakkun Ashshidhiqi[#2],
Dawam Dwi Jatmiko Suwawi[#3]

Informatics Departement, Telkom University
Jl. Telekomunikasi No. 01, Terusan Buah Batu, Bandung, Jawa Barat, Indonesia

[1] mirakania@telkomuniversity.ac.id
[2] gilangbha@gmail.com
[3] dawamdjs@telkomuniversity.ac.id

Abstract

From the beginning of its discovery, website has been improving its function, one of which is as publication media. Also in the world of education, most of higher education institution employ the website to publish their school and to offer related information to their user. However, many disputes come to the user when using the website due to lack of both usability standard and information architecture design. Thus, this research focuses on a standard of information architecture design which is user-oriented to improve 5 aspects of website usability of the institution. Card sorting is used to arrange the information architecture in line with user expectation while goal-directed design functions to design user interface based on user's goal. The conducted test is Usability Test which has formerly been undertaken on the research. The usability value of students and their parents who use higher education institution website designed by Card Sorting Method can be improved to 71.2% which is higher than the average standard. That is means, user involvement in defining the information architecture is very important for website usability can be achieved.

Keywords: Website, Usability, Information Architecture, Card Sorting, Goal-Directed Design

I. Introduction

MANY companies from all background attempt to function internet as a means to publish their product (Ardiyanto, 2013). Also it happens in the world of education in which website is used to publish relevant information such as their offering majors. At least 94% students willing to study to higher education use related website institution to generate some information (Schimmel). However, users find it hard to navigate the path website due to inappropriate menu layout and unfamiliar usage (Dewiyana, 2008). In addition, less information remains possible due to lack of website standardization and maintenance as well (Bernier, J). As the result of Usability test, the use of website is merely 56.5% with an average 68% which is under the optimum average (Aaron Bangor, 2009). One way to improve website usability aspect is the information architecture. Information Architecture, as described by the Information Architecture Institute (IAI), is the art and science of the formation of product information and experience to help usability and findability. Information Architecture(IA) can assist a usability improvement since the information shown can be provided and meet user's expectation (Gullikson, 1999). The method used on information architecture is card sorting involving respondents who are given one set of random card to be grouped to particular label (Spencer, 2009). In designing the information architecture is done with two types of methods card sorting, that is generative and evaluative methods. On the generative

Received on Jan 2016. Accepted on June 2016

method will be studied and understood the viewpoint of the user on how to structure the information in good according to their website. This way it will be built right information architecture and in accordance with user expectations. At this stage will be used methods open card sort. Evaluative methods given in the analysis and the structure of the information we get from the previous generative methods. Here can be seen whether the architecture of the information obtained is appropriate and comfortable to used by the user. On the use of this method can also be obtained feedback information structure is built and refined again. At this stage will be used methods of closed card sort. Besides, to improve the usability is not only by IA but also supported by other methods. Goal directed design (GDD) is a method of designing a product in accordance with the purpose of target users (Cooper, A. 2007). A derived Information architecture may be proper with user's goal on user interface of higher education institution website using Goals Directed Design (GDD).

II. Literature Review

A. Usability

Usability studies about one's capability to reach either tasks or goals using a product (E. Reiss, 2012). According to Nielsen (1993), usability cannot be described yet it has many components including learnability, efficiency, effectiveness, memorability, error, and satisfaction (Cooper, A. 2007). Firstly, learnability is the easiness of users to learn product navigation path. Secondly, Effectiveness defines the user's accuracy to reach the goal. The third components remains efficiency which describes how website can assist the users to accomplish basic task they undergo with appropriate time and efforts (Belson, & Ho, 2012). Further components is memorability which represents the parameter on how fast users can memorize when they return to use it (Cooper, A. 2007). Error tolerant, as the fourth components, represent how website prevents the error caused by user's interaction and help them return to the right way. Lastly, Satisfaction is how users pleasant to use the design of product.

B. Information Architecture

Many of definitions are related to Information Architecture, one of which has been described by Information Architecture Institute (IAI) that Information Architecture (IA) is the art and science on how product information and its experience are established to assist usability and findability. To separate complex interactions among user, content, and context, it uses the concept of Information Ecology. Context is the goal of website users while content is all of the information obtained by the users on website. Then, User aspect deals with how segmented user meet their expectation by using similar website.

C. Card Sorting

Card Sorting is one of the approach on Information Architecture involving the respondents who are given a set of random cards grouped into a particular label (Spencer, 2009). On the Open Card Sort, the respondents must choose and classify the cards based on their sight. Then they have to describe each of group they made. This method is one of generative method carried out in pre-design to support information structure establishment. On the other hand, Closed Card Sort shows that the respondents may have a set of cards with certain category. They may group them into that categories. This method deals with evaluative method undergone in post-design to evaluate and analyze website whether appropriate with the previous research.

D. Goal-directed design

Goal-Directed Design is designing method of interface based on user's goal and mechanism (see Fig. 1.). However, website which is running well may even have an error in a market. Basically, technology and performance are important yet they are just a part of whole such as designing process concerning to user's goal (Cooper, 2007).

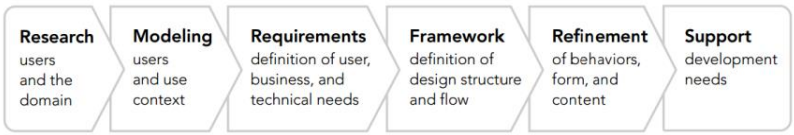

Fig. 1. Steps of Goal Directed Design (Cooper, A. 2007)

E. System Usability Scale

SUS is a scale with 10 common statements related to usability frameworks (Brooke, 1996). Those statements consists of odd statements written positively and even statements written negatively (Figure 1-5). To express the respond on each question, scale 1 to 5 are employed. SUS has a high reliability value compared to other questionnaire such as QUIS and SUQ although it has only a simply applied shape (Thomas S. Tullis, 2004). Each statement has contribution values from 0 to 4. All contribution values on 10 statements would be accumulated. A contribution value of odd statements deals with scale position minus 1. For that of even statements is 5 minus by scale position. Thus, the total of values would be multiplied by 2.5 to gain an average value of System Usability (SU). SUS value as a range from 0 to 100. If the respondents are not able to asses existed statements, they are suggested to put scale 3 on a statement.

III. DISCUSSION

A. Research

Formerly, the research is undergone by interviewing the respondents then they would have questionnaire to fill to find out their experiences with their own website. Dataset are collected from 60 respondents in which each 20 of them represents their own demographics. They comprise staff, students and teachers of SMA N 11 Bandung, SMA Shandy Putra Bandung, lecturers of Telkom University, and student's parents walking down the street in Dago and Buah Batu Car Free Day Event.

The interview is aimed at building a personality based on respondent's characteristic and observing 5 variables designing a Persona. The ongoing interview has shown the same goal of respondents in which they prefer access their expected information on institutional website. They meet the importance of tuition fee, accreditation, curriculum, the profile of major and faculty, scholarship, the experience of students or alumni, and job preferences or institutional networking. The students are willing to know whether they would have a good learning environment in higher education institution while their parents want to meet the demands of getting a good learning environment and a facility provision as well. The respondents may be asked for discovering the information related to tuition fee, accreditation, the profile of faculty and institution, and scholarship. Those information are liked due to their importance to the respondents. Furthermore, the respondents may be asked for filling in the questionnaire. This step is aimed to measure user's experience and calculate the usability of the website. The questionnaire used is the standard of System Usability Scaling (SUS). It is provided in English and not to be translated into *Bahasa Indonesia* in order to avoid misleading. As in point 8, "I found the product felt awkward to use', the word 'awkward', if it is translated into *Bahasa Indonesia*, may occur ambiguity due to two meanings 'aneh' and 'kaku'. According to Kraig Finstad, SUS would rather be used with supporting unit so that respondents may be easy to understand the content. In Fig. 2., the questionnaire concludes that the usability of respondents on higher education institution website remains low. The value shows 56.45% which means under the standard value 68% (Aaron Bangor, 2009).

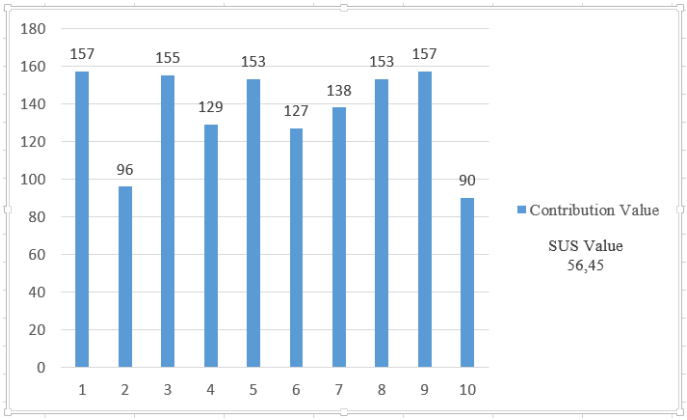

Fig. 2. Contribution Value of Each SUS Statement

B. Modeling

On modeling process, a model Persona is created focused on goal, task and needs of a group of users. It is designed as the characteristics with specific traits that meet with user archetype. To design persona, formerly, behavioral variables need to be identified. Regarding to the preceding research, the result described that participants were identified poses 8 different Behavior Variables including prefer either aesthetics or functions, cost-and-facility-oriented and simply-applied-and-complete information, willing to have a specific information, and complying their activities on website as an entertainment or needs. Therefore, axis variable may emerge to classify the respondents and estimate required persona. Then, 3 Personas can be determined acquired from 3 outstanding groups. Lastly, persona summary can be comprehensively concluded (see Fig. 3.).

Persona Summary		
Demographic: - Age: 17-53 years old - Occupation: Student, Government and Non-Government Employee - Education: High School, College		Expertise: - Intermediate Internet User - Moderate Computer User
Device & Platform: - Laptop - Computer - Smart Phone	Activity: - Primary: School and work - Secondary: Study Group, University Lab	Goals: - Can acquire information as fast as possible - Comfortable and confident when searching for an information - Available information is clear and useful
Attitude: - Outgoing - Clever - Short attention span - Thorough - Easygoing		

Fig. 3. Persona summary

C. Requirement Definition

In this process, higher education institution website requires some details to fulfil their goal, one of which is providing effective information to the users. To do so, user's way to get some information via website must be identified. Thus, Problem Statement must be created to map common user's problems.

The problem Statement needs to be improved to be a main goal in developing further Information Architecture design and user interface. Also it will expand the border of design development. The Persona expectation description and illustration may be determined by Persona's mentality model which illustrates what kind of user activity carried out in discovering information and navigating path of the website. The result shows that required information of Persona are about the profile of institution, faculty and major, facility provisions offered by institution and specifically by faculty, institution contact and location including each faculty and major, tuition fee of each major, major's curriculum, faculty lecturers, student admission, achievements, accreditation, alumni experiences and news, and any other information.

D. Framework

Designing the prototype and the information architecture of the website is done in this step using Card Sorting conducted by 60 respondents. They comprise of 3 demographics including 20 students of SMA (Senior High School), 20 students of University, and 20 parents (see Fig. 4.).

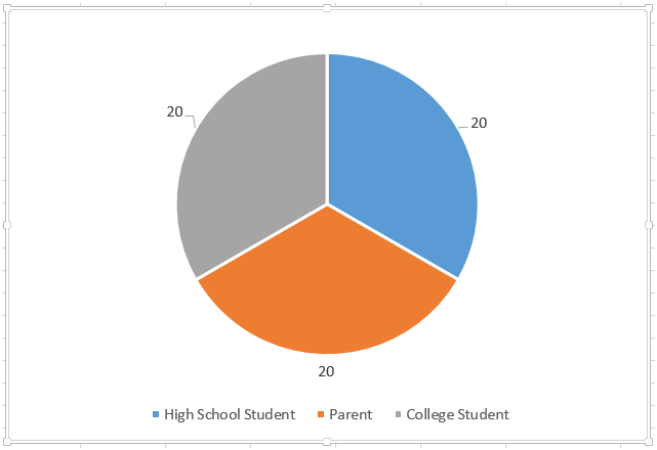

Fig. 4. Respondents of Open Card Sort

The respondents, on the second step, are involved to observe Open Card Sort. Then they may be asked for grouping the card based on their desire. The card placement can be shown on each sort conducted by each respondent (see table I).

TABLE I
CONDUCTED RESPONDENT SORTING

Card no	Card name	Sort 1	Sort 2	Sort 3	Sort 4	Sort 5	Sort 6	Sort 7	Sort 8
1	Accreditation	Faculty	About	Faculty	About	About	Faculty Info	Faculty	Faculty
2	Alumni	Institution	Home	Students	News	Student Affair	Alumni	General	
3	Scholarship	Academics	Education	Information	News	Student Affair	University Info	General	Academics
4	News	News/Agenda	Home	Information	News	About	Alumni	General	Alumni
5	Tuition Fee	Academics	Education	Information	News	Faculty	Faculty Info	Faculty	Institutions
6	Lecturers	Faculty	About	Faculty	Faculty	Faculty	Faculty Info	Faculty	Faculty
7	Faculty Facilities	Faculty	About	Faculty	Faculty	Faculty	Faculty Info	Faculty	Faculty
8	Higher Education Institution Facilities	Institution	About	About	About	About	University Info	Institution	Institution

Card no	Card name	Sort 1	Sort 2	Sort 3	Sort 4	Sort 5	Sort 6	Sort 7	Sort 8
9	Contact		Contact	Information	News	Our Relationship	University Info	Institution	Institution
10	Curriculum	Academics	Education	About	About	Faculty	Faculty Info	Institution	Institution
11	Location	Institution	About	About	About	About	Faculty Info	Institution	Institution
12	Student Admission		Education	About	News	About	Faculty Info	Institution	Academics
13	Achievement	Institution	Home	Faculty	News	About	University Info	General	Academics
14	Faculty Profiles	Faculty	About	Faculty	Faculty	Faculty	Faculty Info	Faculty	Faculty
15	Higher Education Institution Profiles	Institution	About	About	About	About	University Info	Institution	Institution
16	Prospective Jobs	Academics	Home	Faculty	About	Faculty	Faculty Info	General	Link

By analyzing the name of each group and its content, it can be concluded that there are 3 standard groups including 'news', 'institution', and 'faculty'. A faculty group consists of the cards related to faculty information in higher education institution with its information of academics, curriculum and lecturers. A news group represents a group which places the cards about non-institutional information such as scholarship and general news. As shown by table II.

TABLE II
STANDARDIZATION PROCESS OF NAME LABELING OF EACH SORT TASK

Sorter	Original Category	Standardized Category
Sort 1	Institution	Institution
	Faculty	Faculty
	Academics	News
	News/Agenda	News
Sort 2	Home	News
	About	Institution
	Education	Faculty
	Contact	News
Sort 3	About	Institution
	Faculty	Faculty
	Students	News
	Information	News
Sort 4	About	Institution
	Faculty	Faculty
	News	News
Sort 5	About	Institution
	Faculty	Faculty
	Student Affairs	News
	Contact Us	Institution
Sort 6	Alumni	News
	University Info	Institution
	Faculty Info	Faculty
Sort 7	Institution	Institution
	Faculty	Faculty
	General	News
Sort 8	Institution	Institution
	Faculty	Faculty
	Academics	News
	Link	News

The analysis is conducted by observing card grouping on each sort into standardized one in table III.

TABLE III
CARD GROUPING OF EACH RESPONDENT'S SORTING BY STANDARDIZED OPEN CARD SORT

Card No	Card Name	Sort 1	Sort 2	Sort 3	Sort 4	Sort 5	Sort 6	Sort 7	Sort 8
1	Accreditation	Faculty	Institution	Faculty	Institution	Institution	Faculty	Faculty	Faculty
2	Alumni	Institution	News	News	News	News	News	News	News
3	Scholarship	News	Faculty	News	News	News	Institution	News	News
4	News	News	News	News	News	Institution	News	News	Institution
5	Tuition Fee	News	Faculty	News	News	Faculty	Faculty	Faculty	Institution
6	Lecturers	Faculty	Institution	Faculty	Faculty	Faculty	Faculty	Faculty	Faculty
7	Faculty Facilities	Faculty	Institution	Faculty	Faculty	Faculty	Faculty	Faculty	Faculty
8	Higher Education Institution Facilities	Institution	Institution	Institution	Institution	Institution	Institution	Institution	Institution
9	Contact		News	Institution	News	Institution	Institution	Institution	Institution
10	Curriculum	News	Faculty	News	Institution	Faculty	Faculty	Institution	Institution
11	Location	Institution	Institution	Institution	Institution	Institution	Faculty	Institution	Institution
12	Student Admission		Faculty	Institution	News	Institution	Faculty	Institution	News
13	Achievements	Institution	News	Institution	News	Institution	Institution	News	News
14	Faculty Profile	Faculty	Institution	Faculty	Faculty	Faculty	Faculty	Faculty	Faculty
15	Higher Education Institution Profile	Institution	Institution	Faculty	Institution	Institution	Institution	Institution	Institution
16	Prospective Jobs	News	News	Institution	Institution	Faculty	Faculty	News	News

Each card grouping in which the tendency will be calculated is carried out to see respondent's habit in placing the cards (see table IV).

TABLE IV
THE PERCENTAGE OF CARD GROUPING INTO OPEN CARD SORT GROUP

Card No	Card Name	Institution	Faculty	News
1	Accreditation	45%		5%
2	Alumni	10%	10%	
3	Scholarship	15%	15%	
4	News	20%	55	
5	Tuition Fee	35%	35%	30%
6	Lecturer	10%		
7	Faculty Facilities	5%		
8	Institute Facilities			5%
9	Contact			37%
10	Curriculum	20%		10%
11	Location		5%	5%
12	Student Admission	47%	11%	42%
13	Achievement		10%	40%
14	Faculty Profile	5%		
15	Institute Profile			5%
16	Job Prospect	15%	35%	

Table IV shows the resulted information architecture design of higher education institution website in line with Persona's framework and goals. This design consists of three big groups including institution, news, and faculty. Institution information is related to institute profile, location, tuition fee, achievement, contact phone,

and student admission. News information involves alumni, prospective jobs, scholarship, and any other related news. Faculty information provides faculty profile and facility, curriculum, accreditation, and lecturers. The three groups obtained by looking combination at the value of the highest card from each category.

The closed card sort is employed on evaluation process in which respondents may be asked to group the cards on required categories involving institution, faculty, and news. The card used by them are the information cards as well as that of previous Open Card Sort process.

As the former Card Sorting process, the respondents may be motivated and have a self-confidence to clearly categorize the card due to simply apply process. Their categorization process is going to be rewrite on each sort process (see table V).

TABLE V
CARD GROUPING OF EACH RESPONDENT'S SORTING BY STANDARDIZED CLOSED CARD SORT

Card No	Card Name	Sort 1	Sort 2	Sort 3	Sort 4	Sort 5	Sort 6	Sort 7	Sort 8
1	Accreditation	Faculty	Faculty	Faculty	Faculty	Faculty	Faculty	Faculty	Faculty
2	Alumni	News	Institution	Faculty	Faculty	News	News	Faculty	News
3	Scholarship	News	News	Faculty	Faculty	News	News	Faculty	News
4	News	News	News	News	News	News	News	News	News
5	Tuition Fee	Faculty	Institution	Faculty	Faculty	Faculty	Institution	Faculty	Institution
6	Lecturers	Faculty	Faculty	Faculty	Faculty	Faculty	Faculty	Faculty	Faculty
7	Faculty Facilities	Faculty	Faculty	Faculty	Faculty	Faculty	Faculty	Faculty	Faculty
8	Higher Education Institution Facilities	Institution	Institution	Institution	Institution	Institution	Institution	Institution	Institution
9	Contact	Institution	Institution	Institution	News	Institution	Institution	Institution	Institution
10	Curriculum	Faculty	Faculty	Faculty	Faculty	Faculty	Faculty	Faculty	Faculty
11	Location	Institution	Institution	Institution	News	Institution	Institution	Institution	Institution
12	Student Admission	News	News	News	News	News	Faculty	News	News
13	Achievements	News	Faculty	News	News	Faculty	News	News	News
14	Faculty Profile	Faculty	Faculty	Faculty	Faculty	Faculty	Faculty	Faculty	Faculty
15	Higher Education Institution Profile	Institution	Institution	Institution	Institution	Institution	Institution	Institution	Institution
16	Prospective Jobs	Faculty	News	Faculty	Faculty	Faculty	Faculty	Faculty	Faculty

The percentage of tendency of each card with the existed groups will be calculated (see table VI) as well as preceding process on Open Card Sort. Furthermore, Information Architecture improvements will be re-built based on that tendency.

TABLE VI
THE PERCENTAGE OF CARDSORTING INTO AN OPEN CARD SORT GROUP

Card No	Card Name	Institution	Faculty	News
1	Accreditation			
2	Alumni	15%	20%	
3	Scholarship		30%	
4	News			
5	Tuition Fee	30%		5%
6	Lecturer			
7	Faculty Facilities			
8	Institute Facilities			
9	Contact			15%
10	Curriculum			
11	Location			15%

Card No	Card Name	Institution	Faculty	News
12	Student Admission		15%	
13	Achievement		20%	
14	Faculty Profile			
15	Institute Profile			
16	Job Prospect			35%

After evaluation process by Closed Card Sort, the newest Information Architecture will be re-evaluated using card-based classification evaluation found by Donna Spencer on her book (Spencer, 2009). As many as 2 card compositions will be created on that evaluation process (see table VI). The first composition consists of task cards for the respondents, the second one comprises classified cards based on existed category on Information Architecture with their own sub-categories.

When respondents tend to more open-mind to the information, it represents that Information Architecture Design meet their needs. They are able to understand to be the real user who discover the information as they are given the task. The evaluation of Card-Based Classification has made the respondents have a new framework to be analyzed. Therefore, the following process is re-designing Information architecture with some innovation (See Fig. 5.).

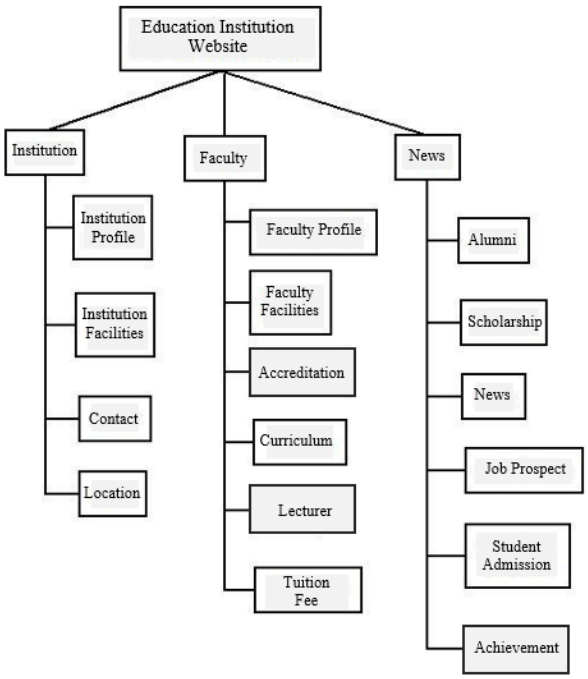

Fig. 5. Final Information Architecture

E. Designing Prototype

Most of users take the higher education institution website in certain time such as in the new school year. The information does not need to be updated in every single day due to monthly information update by the institution. So that, a proper posture is transient posture in which website is functioned as the tool to make users easy to navigate the website and clear information (Cooper, A. 2007). Also Form Factor is important to be defined since the website design is expected to help the Persona use website on daily activities. The way Persona surf on website is by using their own Keyboard and mouse. Persona may choose and press either buttons or menu on website by the pointer controlled through mouse and touch pad provided on their laptop. With the

latest version of laptop and touch screen monitor, Persona may be easy to use the website by only touching the screen. Keyboard is used to input a word or keyword when Persona use search bar provided by higher education institution website. By interaction flow, the way persona navigate the website from one page to another is described based on previous defined context scenario.

Fig. 6. Prototype's Headline

The provided bar menu (see Fig. 6.) is adapted from the designed Information Architecture including dropdown menu information inside. Each news article showing in the headline is the important news selected by the respondents which is fast to be accessed.

F. Refinement

In this step, the design comes to the realization following the created framework and undergone with more details. The prototype interface usability will be examined made on Balsamiq application which offers the function of Wireframing design or mockup without building the actual system. Moreover, the prototype is merely functioned as a basic design of the real higher education institution website. Its content and information may be changed according to the institution's goal and preferences, yet it is expected to keep equal with Information Architecture which has already been made.

G. Data Testing

The conducted test is Usability Test which has formerly been undertaken on the research. It is aimed to generate a usability value on prototype which has been designed. The Usability value will be compared to preceding value acquired from institutional website commonly used by the respondents. The test is conducted by asking the respondent to figure out an information followed by filling in the questionnaires. The respondents comprise a user candidate based on former defined demographics. As many as 60 respondents are being asked to accomplish the test consisting of 20 students of 3rd grade senior high school, 20 student's parents who have children studying in senior high school or university, and 20 students in the last semester or those who want to continue the study. Senior high school students come from SMA 13 Palembang, University students are from

Sriwijaya University Palembang, and student's parents are from Palembang's Local Development Planning Agency. Concerning to the contribution value of each questionnaire statements, SUS remains significant increase.

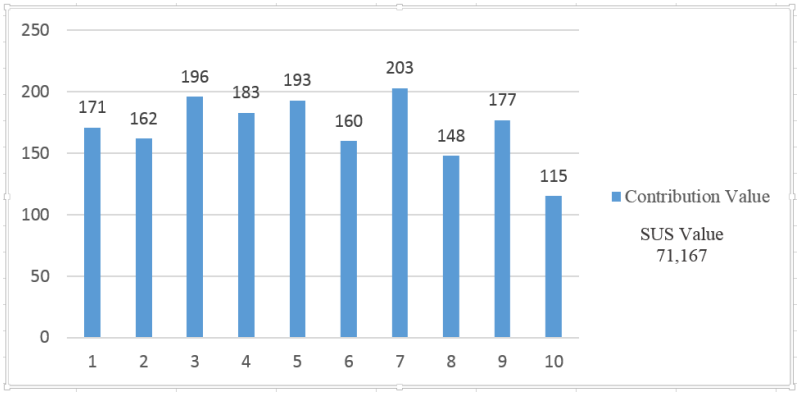

Fig. 7. The results of SUS Website Prototype Questionnaires

In statement 2, 'I found the product unnecessarily complex', most of respondents are disagree since prototype has made them easy to figure out their expected information. Based on statement 3, 'I though was easy to use', most of them thought that the prototype is easy to use. It relates to statement 2 in which the information is more accessible by the user. The refusal from respondents deals with statement 4, 'I think that I would need the support of a technical person to be able to use this product'. It means that there is no assistance such as technical support by that prototype provides a clear and simple menu and buttons. The respondents agree that prototype has many of well-integrated-functions shown by their own answers related to statement 5. Prototype has provided complete information on each page of website and each of which has been completely connected since they are designed based on Mental Model, Interaction Flow, and an existence of Information Architecture. On statement 6, 'I thought there was too much inconsistency in this product', most of respondents are not agree with this statement. Having a clear Interaction Flow, a navigation of each page is more stable. According to point 2 and 3, the respondents agree that prototype has no Big Learning Curves which has made them easy to use it firstly and to generate information on the tasks. This proves that Learnability aspect through the website is getting increase due to easy-to-use website from the first time its usage.

Concerning to the students demographics, SUS value goes up to 71.6% from the standard higher education institution website around 53.6%. It also comes to university student's demographics which results 70.4% from 57% and that of student parents resulting in 71.5% from 58.8%. Therefore, the total of all demographics and SUS final value had become 71.2% from 56.5% as shown in Fig. 7.

IV. CONCLUSION

Based on research and analysis carried out through the higher education institution website, it can be concluded that:

1) The usability value of students and their parents who use higher education institution website designed by Card Sorting Method can be improved to 71.2 % which is higher than the average standard. In other words, user involvement in defining the information architecture is very important for website usability can be achieved.
2) Grouping information process based on Card Sorting implemented to user interface by Goal-Directed Design has made user, students and their parents, easy to use the website due to its efficiency, effectivity, and comfortability.

V. References

Aaron Bangor, P. K. (2009). Determining What Individual SUS Scores Mean: Adding an Adjective Rating Scale. Journal of Usability Studies, 114-123.

Ardiyanto, Indriany, E., Pararta, W. A., Saputro, O. A., & Dhamarstiti, R. (2013). Studi Usabilitas Berita Versi Mobile Pada Komputer Tablet. Jurnal Teknologi Vol.6, 73-82.

Belson, H., & Ho, J. (2012). Usability. Dalam D. C. Rajapakse, A Fresh Graduate's Guide to Software Development Tools and Technologies. Singapore.

Bernier, J. The Service a University Website Should Offer.

Brooke, J. (1996). SUS - A Quick and Dirty Usability Scale. Usability Evaluation in Industry, 189-194.

Cooper, A. (2007). About Face The Essential of Interaction Design 3. Indiana: Wiley Publishing, inc.

Dewiyana, H. (2008). Uji Ketergunaan Antarmuka Situs Web Perpustakaan Universitas Sumatera Utara. Jurnal Studi Perpustakaan dan Informasi Vol.4.

Gullikson, S., Blades, R., Bragdon, M., McKibbon, S., Sparling, M., & Toms, E. G. (1999). The Impact of Information Architecture on Academic Website Usability. The Electronic Library Vol.17.

Reiss, E. (2012). Usable Usability. Canada: John Wiley & Sons, Inc.

Schimmel, K., Motley, D., Racic, S., Marco, G., & Eschenfelder, M. The Importance of University Web Pages in Selecting a Higher Education Institution. Research in Higher Education Journal.

Spencer, D. (2009). Card Sorting Designing Usable Categories. New York: Louis Rosenfeld.

Thomas S. Tullis, J. N. (2004). A Comparison of Questionnaires for Assesing Website Usability. UPA 2004 Presentation, 1.