A STUDY ON COGNITIVE CHARACTERISTICS OF CHILDREN'S INFORMATION ARCHITECTURE USING PARTICIPATORY DESIGN TECHNIQUE

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When the design process involves the participation of children, it requires methods that take into consideration the users' characteristics such as immature cognitive ability, language skill, motor-sensory capability and shyness so that it can effectively elicit their needs. In response to such demand, a variety of methods and guidelines specialized in children have been developed from the 1960's. Participatory design deals with design problems allowing users to participate in design process and generate ideas with the aid of generative toolkits and workshop. Therefore, participatory design allows designers to look at problems from children's standpoint and simultaneously overcome children's immature language skill or shyness. In this research, two participatory design toolkits – 'Info Block' and 'Info Tree' – are introduced. As tools that can elicit user needs in information architecture design for children's websites, they allow users to collaborate and build the structure that reflects their cognitive process. In the case study, the toolkits are applied to evaluate the usability of the directory structure of Yahoo! Kids, Korea (from now on, Yahoo Kids). The result shows that children's information architecture differs from that of adults in depth and breadth, clarity of contents and logicalness, and that the novel methods can effectively elicit users' needs.

INTRODUCTION

Conventional user study methods for information architecture design often fail to find user needs effectively when they are applied to children. It is because they were originally developed for adult users and thus, do not consider the developmental characteristics of children. While there are many design methods specialized in children's technology, participatory design is useful to elicit users' tacit and latent needs, and thus to provide abundant data on user's cognitive process for information architecture design.

Participatory design process uses collective generativity to solve design problems that are very specific to the context. (Sanders, 1999) By analyzing what users create with an aid of generative toolkits, researchers can elicit users' needs which cannot readily be expressed in words. This research aimed at developing generative toolkits to analyze children's cognitive process and its influence on the navigation of websites for children. Two types of cognitive toolkits – Info Block and Info Tree - enable children to create information architecture for themselves. Based on the principles of play therapy, toolkits were designed to resemble children's everyday toys in form and function, thus deriving natural behaviours during the test. By analysing the structures, it is possible to compare the cognitive characteristics of a child's information architecture with an adult, and presume the possible causes. The result provides designers with framework for designing information architecture from users' standpoint.

PARTICIPATORY DESIGN

While traditional design research methods focus primarily on observational research and traditional market research methods focus on customers' opinion, participatory design focuses on what participants create to elicit what they think, feel and dream.(Sanders, 1999) In participatory design, designers hold a workshop to discuss design issues with stakeholders. They use so-called 'Make Tools' (or generative toolkits) to connect ideas of people from different

disciplines and perspectives.(Sanders, 1999) Participants use this 'quick-and-dirty' prototyping to visualize their thoughts in the generative phase of design process, which designers analyze to elicit their needs.

Participatory design can be useful to designing website structure for children for the following reasons: first, by making use of generative toolkits such as drawing or making which children are friendly with in everyday life, this method can overcome their incomplete language or societal skills which often result in insufficient data in verbal-oriented tests. Second, by collaborating with adults, children are inspired and empowered to generate new ideas. Third, participatory design approaches design problems from children's standpoint, therefore overcoming a prejudice that adults may have against children.

In this research, two types of generative toolkits were developed to help children create information architecture with fun and ease.

TOOLKITS

Info Block and Info Tree are cognitive toolkits for participatory design that can elicit user needs related to cognitive process. Since the toolkits were to be used by children, they were to satisfy the following directions:

1. The toolkits enable users to produce prototypes, which contain their tacit needs, i.e., children's cognitive process.
2. The toolkits solve the problems of conventional approach to information architecture design for children such as children's passive attitude and shyness, heavy dependence on conversation and lack of fun in the process.

The main focus in the development of the toolkits was to design them so as to achieve design goals and simultaneously provide fun to the users. Based on the fact that children at the stage of concrete operational period are able to play games with rules, Info Tree and Info Block resemble a construction play with rules.

Info Block

Info Block allows children to generate ideas and construct hierarchical information architecture from them. It consists of 40x40x20 (mm^3) blocks of 7 hierarchies, with Velcro attached so as to be easily grouped and stacked. Info Block is used in the following order:

1. Generate ideas related to a given subject, and label them on the red Info Blocks, which is of the lowest hierarchy.
2. Randomly place the blocks, and group the related ones.
3. When grouping is over, generate keywords that represent the groups and label them on the orange blocks.
4. Stack the grouped blocks and put the orange block that represents the group (step 3) on top of it.
5. Repeat step 2~4 until no more group is formed. As the grouping proceeds to higher levels, use the keyword blocks in the order of seven spectral colours.
6. Discuss the result with teammates in terms of logicalness, clarity and consistency of groupings.

Info Tree

Info Tree is based on the principle of radiant thinking of Mind Map developed by Tony Buzan and provides children with a rapid and easy way to generate and organize ideas. It employs the metaphor of a tree to help children comprehend the concept, and consists of a Styrofoam trunk, wood sticks and Styrofoam balls of different sizes. Info Tree is used in the following order:

1. The trunk symbolizes the main topic.
2. Generate ideas that are related to the topic and using post-it's, label them on the biggest Styrofoam balls which are of the 1st hierarchy.
3. Generate sub-ideas which are related to the 1st hierarchy keywords and using post-it's, label them on the 2nd biggest balls.
4. Repeat step 3 for the lower hierarchies.
5. Discuss the result with teammates in terms of logicalness, clarity and consistency of groupings.

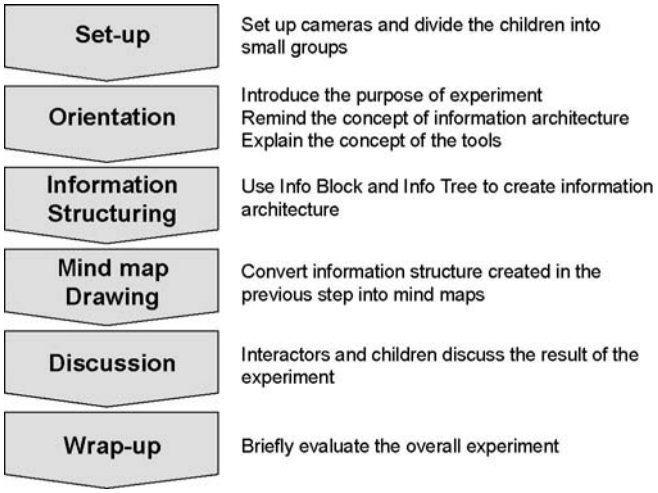
A case study was carried out to verify the toolkits. In the experiment, children were asked to create information structure of Yahoo Kids directory, which was then compared with the current structure. The result was analyzed based on children's development to find the usability problems and suggestions were made.

EXPERIMENT METHOD AND PROCEDURE

A test subject pool consisted of 26 children (14 boys, 12 girls) who were evenly selected among the 3rd to 6th graders. They were divided into 9 groups, consisting of 2 to 4 members, and one adult tester was allocated on each team. The testers were all graduate students from industrial design major, aged from 21 to 23, one female and the rest males.

The experiment was conducted in a classroom to avoid problems of arbitrary behaviour and attitude frequently observed in usability lab testing. The process is described in figure 1.

Figure 1. Experiment procedure



4 teams were given Info Tree with a task to build a portal website for kids. Another 4 teams used Info Block to reorganize the directory of Yahoo Kids.

RESULTS

Cognitive characteristics of children's IA

In order to analyze children's cognitive process, information architecture was analyzed in two ways: keyword analysis and hierarchy analysis. In keyword analysis, every relationship between parent and child in hierarchy was analyzed to measure the logicalness of information architecture. In hierarchy analysis, the hierarchy structure of information architecture was analyzed in terms of breadth and depth. The two analyses were carried out to compare and contrast the information architecture of adults – i.e. the current structure of Yahoo Kids – with that of children.

The analysis of children's information architectures revealed the following 3 characteristics:

A. There are more illogical errors found in children's information structure than in adults'. Every relationship between parent and child was identified and categorized into 6 types; *Related* (e.g. four seasons→travel), *Inclusive* (e.g. mammal→lion), *Illogical jump* (e.g. sports→Tiger Woods), *Inversely inclusive* (e.g. puppy→pet), *Unrelated*, and lastly, *Identical* relationship.

Among the six relationships, only the *inclusive* relationship describes the logical relationship between parent and child in a hierarchy.

Table 1 shows that children's structure allowed 50% errors in contrast to 11% in the structure of current Yahoo Kids directory. In the case of the latter, some of the popular keywords are intentionally brought out – like hot keys – to enhance searching. In the case of the former, illogical jumps exist more than twice compared to the latter, showing that children are less influenced by the convention of logic. This is also supported by the fact that children showed strong tendency to depend on association in navigation or searching. To children, logicalness does not mean as much as to adults. They are satisfied as long as the search is efficient and easy.

Table 1. Relationship of keywords in children's information architecture

Relationship between keywords	Children's IA	Adults' IA (Yahoo directory)
Related	18%	0%
Inclusive	50%	89%
Illogical jump	24%	11%
Inversely inclusive	4%	0%
No relationship	1%	0%
identical	3%	0%
	100%	100%

B. Contents are divided rather ambiguously and a piece of information may belong to more than one category. Ambiguity of contents is not only caused by the subjectivity of human beings but also by the innate ambiguity of the language itself. Therefore it is presumed that children with underdeveloped language skills will have more ambiguous knowledge structure than adults, which will be recognizable in their information architecture.

C. Information structure is wider and shallower than that of adults. Table 2 shows that the former is 33% shallower and 70% wider than the latter. The reason being despite children's flourishing ideas, they lack the ability to organize them systematically. In the experiment, they often put the related items altogether and thought that the hierarchy was complete. Lack of a logical criterion for organizing ideas caused information architecture to grow horizontally rather than vertically.

Table 2. Comparison of IA created by children and adults

	Directory of Yahoo Kids that children	IA of a portal website that children	Directory of Yahoo Kids

	perceive	created	
toolkit	Info Block	Info Tree	-
no. of info units	55	68.1	45
breadth			
1st hierarchy	7	9.4	6
2nd hierarchy	25	28.3	24
3rd hierarchy	38	28.8	7
4th hierarchy	2	6.0	8
5th hierarchy		2.0	
depth	3	3.6	4
avg. breadth (no. of info units/depth)	20	19.6	11.3

Suggestions for designing IA for children

Based on the result of experiment, three suggestions for designing IA for children were made:

1. *Logicalness of information architecture for children should be determined based on the level of users.* It sounds very obvious, but many websites are more logical than they need to be. The experiment result reveals that children do not think as logically as adults and their searching pattern is very diverse. Information architecture, which is designed from an adult's logical level, may result in inefficient searching due to relatively deeper hierarchy than the one in a child's mental model. As the comparison of information architecture by a child and an adult shows, a hierarchy with high logicalness tends to have more sub-categories and therefore, deeper level. By finding the optimum depth of categories, the efficiency of search can increase.

2. *Considering children's short-term memory span, 5±2 is an appropriate number of 1st hierarchy keywords in the structure.* As one way of enhancing search, the number of the 1st hierarchy keywords of an ambiguous system is set to 7±2.[Note 2] By putting the main keywords within the boundary of one's short-term memory span, one is able to search information more efficiently. Whereas the short-term memory span of an adult is 7 units, an elementary school student has only 5 units, and a kindergarten student 3~4 units.[7] This implies that the number of directories of a website for children should be set to 5±2.

3. *Because kids are less influenced by the conventional rule of logic, they should be allowed to search information in multiple routes by increasing cross list and associative links.* The analysis of information architecture built by children shows that children think in a more creative and flexible way than adults. The routes to a certain destination in searching process are very diverse, too because they are less influenced by logical thinking process. For example, whereas the category 'Travel' is usually located under 'World and Society' (Yahoo Kids) or 'Entertainer, fun' (Juniver), a child may put it in a place almost unpredictable by adults ('Nature and Science' → '4 seasons' → 'Travel' by a fifth grade girl). Since there are so many possible routes to a certain destination, a single route will result in a high failure rate. Flexibility of websites can be achieved via the use of cross list and associative links. In the websites for children, it is necessary to increase cross list – thus, increase the number of routes to a destination - at the cost of clarity of the content in order to facilitate searching. At the same time, associative links can reduce the failure rate by providing children with a set of keyword associated with a topic.

CONCLUSION

In this paper, two participatory design toolkits for designing information architecture are introduced. They allow children to participate in the design process and build information structure that reflects their tacit needs. The experiment reveals the unique characteristics of children's IA and based on this, three suggestions are made to help design IA from children's standpoint.

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