Setting & Designing the Children Exclusive Toilet in Public Spaces

Yi-Tsu Peng, Po-Hsien Lin, Rungtai Lin
(Graduate School of Creative Industry Design, National Taiwan University of Arts, Taiwan)

Abstract: There are few toilets exclusively for children in many public spaces, especially those who are mainly designed for children such as playground, Children Theater, zoo, or recreation area in the park. This is quite a strange phenomenon but few people concern about it. It seems normal that children were deemed to be accessories of adults. This study is thinking about such issue and composing by two parts: Deliberation for the necessity of children toilet in the public space where children are main users as universal design mention and, conclusion of basic design principle for children toilet through the interactive consideration of human factor engineering, Kansei design, and public space design. It is based on the information of literature research and observation interview. There are some relevant suggestions from Kansei thinking were approved too.

Key words: children toilet, public space, universal design, ergonomics design, Kansei design

1. Introduction

This study considered that every individual entity shall be regarded as unique and be respected since born. If children grow up in such an environment, we can assume that they would take social responsibility when being as adults because they have dignity and mutual respect. The younger they live in such environment, the healthier personality they will have. This idea which take cares each different type users with their unique characteristics is identical with the spirit of Kansei design and ergonomics.

In addition, there is necessity for children toilet based on the consideration of usage. Because of the great difference of height between adults and little children, it is quite non-ergonomic and even dangerous to enforce children to use adult toilet. Further, it is somewhat embarrassed to choose the gender toilet when father takes daughter or mother takes son outside. Currently, even though gender-neutral toilet was gradually placed in parts of public places, the supply still can’t meet the demand in places for children. Therefore, we submitted our idea of children toilet.

There are two purposes of this study as shown below:

(a) This study will try to understand the situation that how children using public spaces and toilet as well as their basic attributes by observation and interview of surrounded public spaces which meet our criteria. Meanwhile, the data and theories from the literature research were aggregated to proof and support this proposal of unique and exclusive toilet for children.

(b) This study achieved conclusion of basic design principle and other relevant suggestions from Kansei thinking perspective for children toilet through the interactive consideration of human factor engineering, Kansei
design, and design principle of public place.

Here we define that the public space explored hereafter is the entire public field outside the private area. In addition, children involved in this study are aimed at 3 to 7 years old that means children in kindergarten and primary grades of elementary school who have the ability to go to the toilet by themselves. Beside that this study suggests the children toilet both suitable for girls and boys using together cause of such the young age.

2. Review of the Literature

2.1 Universal Design

American architect Michael Bednar first proposed Universal Design. It was not until 1989 did American designer Ronald L. Mace begin to use the term “Universal Design” frequently, which basically means products, environments, and communications that can be used by everyone (Michael Bednar, 2008). At the Center for Universal Design (CUD) at North Carolina State University, a group of architects, product designers, engineers, and environmental design researchers established seven principles of UD to provide guidance in the design of products and environments (Sheryl Burgstahler, 2012). See Table 1.

<table>
<thead>
<tr>
<th>Principle</th>
<th>Design reference criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equitable Use</td>
<td>• Provide all users with same or equivalent methods</td>
</tr>
<tr>
<td></td>
<td>• Avoid user discrimination</td>
</tr>
<tr>
<td></td>
<td>• Provide all users with same privacy or safety measures</td>
</tr>
<tr>
<td>Flexibility Use</td>
<td>• Provide options for application methods</td>
</tr>
<tr>
<td></td>
<td>• Adjustability in coordination with user’s pace</td>
</tr>
<tr>
<td>Simple and Intuitive Use</td>
<td>• Eliminate unnecessary complexity</td>
</tr>
<tr>
<td></td>
<td>• In compliance with user’s expectation and intuition</td>
</tr>
<tr>
<td>Perceptible Information</td>
<td>• Enhance the legibility of important information</td>
</tr>
<tr>
<td></td>
<td>• Provide sensory disabled with diversified equipment operating techniques</td>
</tr>
<tr>
<td>Tolerance for Error</td>
<td>• Arrange the sequence of devices in order to reduce the danger or error, and provide warnings and safety protective devices</td>
</tr>
<tr>
<td>Low Physical Effort</td>
<td>• Allow user to maintain natural pose</td>
</tr>
<tr>
<td></td>
<td>• Use reasonable operating force</td>
</tr>
<tr>
<td></td>
<td>• Reduce repeated actions</td>
</tr>
<tr>
<td>Size and Space for Approach &amp; use</td>
<td>• Sufficient and appropriate spaces and devices with easy access</td>
</tr>
<tr>
<td></td>
<td>• Provide a clear line of sight for important device</td>
</tr>
</tbody>
</table>

2.2 The New Statistics Data of Children and Facility Size of Public Toilet

2.2.1 The Average Height and Weight of General Adults and Children

According to the published survey of variation condition for nutrition and health in Taiwan in 2009 by National Health Research Institutes at Ministry of Health and Welfare in Executive Yuan, the height and weight distribution of children before school, youngsters (19-30 years old), thirties (31-44 years old), middle-age (45-64 years old), and elders (above 65 years old) is as below Figure 1 (National Institutes of Health, 2009).

From the data in Figure 1, the average height of children before and after school (taking average value of 5-year-old children as an example) is 113.9 cm for boy and 112.4 for girl. The differences between the values of children and adults (taking average value of group 31-44 as an example) are 57.3 cm for male and 45.7 cm for female. As for the weight, the differences between adults and children are more than 2.5 times.
Setting & Designing the Children Exclusive Toilet in Public Spaces

2.2.2 Fundamental Space And Size of Toilet and Sink in Public Restroom (An Example As Caesars Bathroom Device) Shown in Figure 2.

From the information above, the toilet height for adult is 39 (±1) cm and the height of sink is around 80 cm that reached to the shoulder of children.

2.3 The Current Usage for Children in Public Spaces and Their Conditions While Using the Toilet

Based on the relevant literature research and observation interview, the current usage for children in public spaces as well as their conditions while using the toilet is listed as below:

2.3.1 The Current Usage for Children in Public Spaces
(1) The public spaces which children are main users
Include playground in public park, every kind of public amusement area for children, children theater, city zoo, etc.

(2) Percentage of children using public spaces where children are main users
According to field observation, the percentage of children using public spaces is as high as 50% around or over.

(3) The time and frequency of children using public spaces where children are main users
From field observation and interview, the frequency of usage in holiday and weekend for various amusement parks and Children Theater is higher. In addition, there are many children use playground in public park during
holiday and weekend which using time is around 2 to 3 hours or above.

2.3.2 The Condition for Children Using Toilet
(1) The frequency for children using toilet
Voiding frequency was inversely related to age; most children between 3 and 12 years old urinated 5 to 6 times per day (Bloom et al., 1993). Therefore, if we define daytime as 14 hours, they need to go to the toilet around 2 hours a time by average.

(2) The independence when children going to the toilet
Generally speaking, children can go to the toilet by themselves when they were three years old around. The children hospital in Philadelphia, USA found that children will be more successful if they were trained to go to the toilet by themselves during 33 to 36 months old. The result shows that children will go to the toilet by themselves at 36.8 months old by average. In addition, the data of girls is 35.8 months old which is earlier than boys’ data, 38 months old (Children’s Hospital of Philadelphia, 2010).

(3) The support or notice children needed while going to the toilet
Generally the support or notice that children needed while going to the toilet is as below:
(a) For security perspective
Children can’t completely handle the height of toilet and self-compatibility especially when they are before school and just started to learn to go to the toilet by themselves.
(b) For sanitation perspective
This part includes the completeness of using tissues and the cleanness of clothing and toilet after use.

(4) The physical and mental condition when children go to the toilet
Some boys reject or were rejected by other women when their mother takes them to the women toilet; and fathers do not know whether to take their daughter to women’s toilet or men’s toilet when needed too.

2.4 Relevant Theories about Children Formative Education
2.4.1 Formative Education for Children Independence
The independence is extremely important in the physical and mental development of children. Independent children usually do things based on their clear purpose without the expectation of assistance from others, surrender while under the coercion, or following the direction from others. Further, they tend to adhere to targets with aggressiveness, astute observation, rich imagination, strong curiosity to think and ask questions, confidence, and strong will to overcome difficulties (Overseas Chinese Language and Education Online, 2011).

2.4.2 Formative Education for Children Social Ability and Skill
Social cognition is the procedure to know others and their motivation, intention, and expectation through observation of others’ behaviors. It is the most fundamental part to compose children social ability (Kenneth, 1986). The cognitive competence of children is subject to their age but not under the consistent relationship. Psychologists think that there are two fast development periods during 3 to 7 years old, which are 3 to 5 and 6 to 7 years old. The key period for children to develop their social adaptability and cognition is between 5 to 6 years old.

2.4.3 Formative Education for Children Learning Ability
It is best to cultivate children learning ability during their daily life. Through letting go, children will learn to manage themselves to do things they can do and further cultivate their self-care ability. It is against the cultivation and development of children learning ability if the limitation and treatment were imposed without giving them any chance to manage by themselves and considering their ability, preference, and physical and mental development.
2.5 Ergonomic Design

Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance (International Ergonomics Association, 2013). The ergonomic design is the study of designing equipment, devices, and environmental system that fit the human body and its cognitive abilities under the interaction and combination of human, devices, and environment to achieve the target of efficiency, safety, health, and comfort while using.

2.6 Research of Kansei

Published by Japan scholar M. Nagamachi, he regards Kansei Engineering as a fundamental skill to develop product based on consumers that the Kansei means the feeling or image generated from a product. Mr. M. Nagamachi defined Kansei Engineering as “turning the feeling or image consumers generated from a product to a skill of design element” (Nagamachi, 1989).

3. Result of Literature Research and Observation Interview

Based on relevant literature research and observation interview, we conclude as below:

(1) According the current usage of children in public spaces, the percentage children using public spaces where children are main users is around 50% or higher. There are children to use various places whether weekday or weekend which their using time is around 2 to 3 hours or above. Due to little children need to go to the toilet 2 hours a time by average, we define here that children have demand to go to the toilet when they are in public spaces.

(2) Based on statistics data, there are great differences for average height and weight between general adults and children. Asking children who are much shorter than adults to use adult toilet is completely beyond their physical permission and even dangerous. From the information of toilet size mentioned above, the height of adult toilet is 39 (±1) cm and the sink is around 80 cm high. For children with average height (5 years old) are around 113 cm, it is really dangerous to go to the toilet by themselves and therefore the adult accompany is necessary.

(3) Whether in the cultivation of independence, social ability, social skill, or learning ability, all of them mentioned that children deserve chances to learn how to take care themselves.

(4) If children need to go to the toilet with the assistance of adults, it not only deprives the opportunity children learn how to take care themselves but also generate safety and hygiene concern because of the crowded toilet space. Moreover, children will have disagreement and embarrassment if they go to the toilet not for their own gender.

Therefore, based on the conclusion above, children toilet in the public space is absolutely necessary with great demand. This action not only regards children as independent individuals with respect but also prevent them and adults from troublesome measures because of the toilet size. Legislator Tsai, Chi-Chang mentioned in April, 2013 that the design of public toilet does not consider the demand of children so he proposed to require Ministry of Transportation and Communications install toilet, sanisette, and sink suitable for children at public toilet in typical spot and important traffic junction area. Hence, children toilet in the public space shall be under implementation and action.

Nagamachi (2006) describes kansei as an “individual’s subjective impression from a certain artifact, environment, or situation using all senses of sight, hearing, feeling, smell, taste as well as recognition”. Furthermore, the children toilet will be more accepted and loved by children if the Kansei design with senses experience inside were added.
4. Analysis Model Construction

4.1 The Correlation between the Concept of Universal Design and Children Demands for Public Toilet

The correlations of environmental application of Universal Design concepts, especially for the children demands for public toilet, can be summarized as shown below:

<table>
<thead>
<tr>
<th>Universal Design Principles</th>
<th>Children Demands for Public Toilet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equitable Use</td>
<td>Safety</td>
</tr>
<tr>
<td>Flexibility in Use</td>
<td>Total design is suitable for children to use and avoid dangerous.</td>
</tr>
<tr>
<td>Simple and intuitive Use</td>
<td>Spatiaility</td>
</tr>
<tr>
<td>Preceptible information</td>
<td>Approve the unique space matched children body and psychology.</td>
</tr>
<tr>
<td>Tolerance for Error</td>
<td>Basic facility</td>
</tr>
<tr>
<td>Low Physical Effort</td>
<td>Approve the suitable facility for children instead the original facility for adult.</td>
</tr>
<tr>
<td>Size and Space for Approach &amp; use</td>
<td>A sense of belonging</td>
</tr>
</tbody>
</table>

The color lines represent the parts closely related to children use public toilets, which are showed as Table 2.

### Table 2: The Correlation between the Concept of Universal Design and Children Demands for Public Toilet

<table>
<thead>
<tr>
<th>Universal Design Principles</th>
<th>Children Demands for Public Toilet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equitable Use</td>
<td>Safety</td>
</tr>
<tr>
<td>Spatiality</td>
<td>Approve the unique space matched children body and psychology.</td>
</tr>
<tr>
<td>Basic facility</td>
<td>Approve the suitable facility for children instead the original facility for adult.</td>
</tr>
<tr>
<td>Beauty and atmosphere</td>
<td>Color and form design as what children really like instead the mature style.</td>
</tr>
<tr>
<td>A sense of belonging</td>
<td>Designing a space that is children look like to approve the belonging feeling for kids.</td>
</tr>
<tr>
<td>Flexibility Use</td>
<td>Spatiality</td>
</tr>
<tr>
<td>Simple and Intuitive Use</td>
<td>Flexible space let children easy to involve.</td>
</tr>
<tr>
<td>Preceptible Information</td>
<td>Basic facility</td>
</tr>
<tr>
<td>Tolerance for Error</td>
<td>Flexible facility let children easy to use.</td>
</tr>
<tr>
<td>Low Physical Effort</td>
<td>Spatiality</td>
</tr>
<tr>
<td>Size and Space for Approach &amp; use</td>
<td>Simple and direct spatial allocation easy for children to recognition.</td>
</tr>
<tr>
<td>Basic facility</td>
<td>Simple and easy use facility for children.</td>
</tr>
<tr>
<td>Safety</td>
<td>Special perceptible information system for children to avoid dangerous.</td>
</tr>
<tr>
<td>Basic facility</td>
<td>Use associative and easy way such as use picture instead character to help children perceptible situation.</td>
</tr>
<tr>
<td>Safety</td>
<td>Approve Tolerance for Error to match the recognition of children to avoid dangerous.</td>
</tr>
<tr>
<td>Basic facility</td>
<td>Designing the facility that can be tolerated errors for children.</td>
</tr>
<tr>
<td>Safety</td>
<td>Designing entire field of view for children toilet for safety.</td>
</tr>
<tr>
<td>Spatiality</td>
<td>The size of space match children body and psychological need.</td>
</tr>
<tr>
<td>Basic facility</td>
<td>Designing facilities that are match the size of children and their space.</td>
</tr>
<tr>
<td>Beauty and atmosphere</td>
<td>Designing the smaller size space for match children body and psychology to let them feel good and beauty.</td>
</tr>
<tr>
<td>A sense of belonging</td>
<td>Designing the suitable size and psychological space for children to let them feel just like the masters.</td>
</tr>
</tbody>
</table>

As for the examination of aforementioned universal design principles corresponding to the children demands for public toilet, further case study will be carried out in the following Chapter 5.
4.2 The Analysis Model of Ergonomic System Design for Children Toilet

The ergonomic system design its feature meets the demand of children toilet in public places so this study builds the fundamental principle of children toilet design with ergonomics in the core of analysis model. The model is as below Figure 3.

![Figure 3 The Analysis Model of Ergonomic System Design for Children Toilet](image)

5. Case Study

According to the Universal Design and the analysis model of ergonomic system above, a prototype of ideal children toilet was developed and constructed as below Figure 4.

![Figure 4 Illustration Figure of Space and Structure for Children Toilet](image)

Several fundamental principles for children toilet design prototype in public spaces were achieved based on
the research above. The core idea of those principles is Kansei design. Its design may be quite different from which for adults and may become an important part in social education for preschool children. In addition, the children toilet in public spaces may be shaped as a good social environment for children under this design.

5.1 The Introduction of Kansei Design

Through adding five senses and feeling into design, children toilet can be closer to users.

(1) Vision perspective — Transmission by vision shall be as simple as possible to respond the intellectual development of children and include their preferred color and cute image.

(2) Hearing perspective — Personify model that is the hearing using music and human sound children used to hear is suggested to use to replace emotional transmission and communication by pictures and texts.

(3) Smell perspective — Smell such as candy, fruit, or flower that are preferred by children can be filled in the space to close the gap between facility and users.

(4) Taste perspective — Providing clean drinking water.

(5) Touch perspective — Due to children skin is tender and sensitive to touch, it is suggested to choose appropriate material and facility for touch while designing. In addition, touching facility can be introduced by this feature for children to use and learn.

(6) Feeling perspective — the kind atmosphere can let children learning happiness.

5.2 Space & Hardware Facility

Supply of space and facility suitable for children is needed.

(1) Principle for space and structure — safe and able to see through.

Space design shall be based on the space children convenient to move before and after going to the toilet. There are no other walls between each toilet door and outside to shelter sight so that adults and children can communicate and see through with high safety.

(2) Principle for route planning — simple and instinct entrance/exit route.

(3) Principle for facility — meet the height of children and easy to use.

Contrast to adult toilet, children toilet shall provide toilet and sink whose sizes are shown in Figure 5.

![Figure 5 The Fundamental Size of Children Toilet and Sink (mm)](image)

The height obstacle can be removed by lowering the height of toilet from 39 (±1) cm for adults to 29 (±1) cm for children and the height of sink from 80 (±1) cm to 60 (±1) cm. Furthermore, sink shall be replaced to a larger and shared one for both inside and outside toilet use in order to significantly improve the accessibility, keep
clothing dry, and prevent from sliding. Therefore, children will feel safer and more comfortable while going to the toilet and washing hands after use by themselves.

(4) Principle for material and facility design — safe, easy to clean, maintain, and use.

The material for pavement shall be with the feature of anti-slip to prevent children from slipping. The material for wall shall be easy to clean and maintain. The material overall can’t be too coarse or sharp and safe edge & corner cushion shall be installed if necessary. The door lock is easy to open both inside and outside for safety concern and prevention that children were locked inside. Hanger shall be adjusted to fit children height as well.

(5) Principle for color design — use primary color with high saturation as main color.

Viewing that general children had positive reactions to bright colors and negative emotions for dark colors (Boyatzis, 1994). This study suggests using this kind of colors as main color while designing.

(6) Principle for style — with affinity and safety.

Use the cute style with affinity that was preferred by children and arc edge instead of right angle for safety and affinity concern.

5.3 Overall Environment Design

Be safe, bright, draughty, clean, and dry as fundamental principles.

(1) Safety — The toilet space and waiting area shall be prevented from blind spot so that parents and children can communicate at any time. Toilet with partially closed door shall be applied to those children with special demand.

(2) Brightness and Ventilation — It is very important to keep bright in children toilet that not only make children feel secure but also avoid any difficulty while using facility under dim sight.

(3) Cleanness and Dryness — Because the wet floor is one of the key factors to cause injure for children in the toilet, prevention of slipping shall be put into consideration.

(4) Enough Supplement — Ample supply of tissue, hand wash (it is suggested to place mild foam hand wash instead of soap or hand wash gel so children are easy to wash hands without getting wet), and auto hand dryer.

5.4 Esthetics and Sensory Atmosphere

Introduction of Kansei concept can make overall environment more humanization. Different degree of design and planning can be made in respect of place characteristics and budget. Examples of those feasible projects are as below:

(1) Music Broadcast — Interactive devices were activated to play music when children enter toilet so to make them feel welcome, encouraging, and happier.

(2) Guidance Demonstrative toilet — An educational toilet with interactive devices to guide smaller children to learn can be set up for demonstration which was suggested to apply to the public place with ample budget and more children users. When children enter toilet, one to two toilets will make an interactive teaching guidance to them. For example, the sound device will be activated and broadcasted that “Hi sweety, would you please close the door and sit on the toilet. Thank you.” when children enter the toilet and “Please come down carefully and remember to flush or use automatic flush system when you leave. Thank you.” after use.

(3) Interactive Education Device – 1:1 Human body billboard with sensor points can be set up on the wall of both entrances for health education (see Figure 4). As long as children touch the relative position of human organ
such as heart, interactive receiver will sense the message and light up the organ to introduce its function in the body by voice. This idea is aimed to provide an interesting environment to attract children to go to the toilet so to enhance their health knowledge through interactive devices and social opportunities to learn from each other at the same time.

6. Results and Discussion

Based on the above analysis result, under the interactive consideration of Universal Design, Kansei and public space design as well as the application of engineering mechanism, we concluded the design principle for children toilet as below Table 3.

<table>
<thead>
<tr>
<th>Kansei Concept</th>
<th>Design Principle for Children Toilet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Factor Analysis Model for Children Toilet</td>
<td>Function</td>
</tr>
<tr>
<td>Ergonomic system Design vs. Space Design (+ Engineering Mechanism)</td>
<td>Education</td>
</tr>
<tr>
<td>Interaction</td>
<td>Interesting</td>
</tr>
<tr>
<td>Esthetics</td>
<td>Operation</td>
</tr>
</tbody>
</table>

The profoundness of design is that the object is subject to the meaning designer given. If children toilet was regarded as place children can cultivate their independence, hygiene education, or even social skill, well it is not just a toilet at all.
7. Conclusion and Suggestion

All the principles for children toilet submitted under this study are exclusively aimed at children to have a suitable space for independently using and cover both knowledge and interactive social skill learning opportunities so that children can learn self-care ability step by step and new knowledge by games at the same time. Our society has acknowledged demand from various vulnerable groups such as children. Japan is the birthplace of Kansei Design so they have very detail and astute observation for demand from users. Taking Qs Mall which close to Tennoja and opened this year as an example, there are considerate and cute children toilet beside the children playground in 2nd floor. Children toilet is between men toilet and women toilet so that children can have their own toilet space.

Along with the time, our public places are gradually aimed at demand from each user which developed from aiming at general users in the beginning to the women users twenty years ago. Until now, they tend to respect vulnerable groups more which can be seen in many public places such as gender-neutral toilet. Therefore, we believe children toilet in public places will be an unavoidable part and trend in the comprehensive and quality public space design in the future.

References