From Design to Technology

A Case Study of Children's Perception
Toward the Dechnology Products

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Abstract. Children as future adults are the oncoming high-tech user population; they live in this new-tech epoch with great variety and rapid change and their perception towards the world already changed accordingly. However, they rarely are considered to be participants in the experimental period of technology and design development. In an attempt to understand children's interests and their perception or even aesthetic perception/preference under this high-tech tendency, this research adopted the "Dechnology 2014 New Collection" products as stimuli to investigate elementary school-age children's insights and to explore any gender differences. Results are found that gender variations indeed exist on children's perception and aesthetic preference toward new Dechnology (Design + Technology) products. And the variation often happens when the object is a simile or metaphor of the opposite gender. This study is intended to reveal the ways in which children sense and perceive new Dechnology products and to provide information of children's concern and viewpoint to technologists, designers, and educators.

Keywords: Dechnology · Perception · Aesthetic perception · Aesthetic judgment · Aesthetic preference · Aesthetic impression

1 Introduction

Children have their own interests, curiosities, beliefs and demands that are quite different from adults. Those born in this highly visual and high-tech world have experienced and been heavily influenced by digital and new technologies, and the ways they sense and learn are changed accordingly. However, Druin (2002) indicated that there was a short but rich history of developing shared paths for communication between diverse users and technologists, but there were merely rare instances where children had more direct involvement as users, testers, informants with technology developers, and rarely actually tested experimental technology before release. Yet, with the emergence of children as an important new consumer group and user population of technology, knowing children's concerns about new-tech is becoming more critical than ever.

A recent research on the interaction between children and screen-viewing announced that this transform already influenced children's concepts about digital products, consciousness and life (Jago et al. 2014). Indeed, children's perceptions about this world are constructed by the interaction among the environmental factors. Their perceptions however are not merely built on the aspect of cognition but also on emotions. Hence, under the influences of this era, what does this generation value or what is it interested in? What kinds of technological products would catch their eyes? And furthermore, in what ways do they view current high-technology as future users? And whether the ways they use are based on their perceptions toward the products or even their aesthetic perceptions?

With the aim to investigate above concerns, the research objectives therefore are listed as follows:

1. To explore children's interests under these high-tech effects and to determine whether or not differences between genders exist: and if so, what they could be?
2. To reveal children's perceptions regarding the technological products as well as to determine any gender differences.

2 Framework of Children's Perception to Aesthetic Preference

2.1 Perception

Children who grew up in this digital and new-tech epoch are forced to live with electronic products and become imperceptibly used to them. Under this influence, are their structures of perception being changed? Or in what ways do they recognize and feel high-tech products? According to Piaget's theory, children's perception toward the objective world is based on their knowledge about it. Children select and comprehend their experiences upon their psychological structure, and they modulate these structures to understand more detailed realities. The reality is not isolated but is built on their previous experiences and cognitive bases (Yin 2006).

From Piaget's cognitive development theory, two of the specific characteristics in Concrete Operational Stage as are loss of egocentrism and logical thinking, which means that elementary-school-age children can already have logical thinking in certain concrete situations and can value or judge conditions based on multiple points of view (Jhu 1997). Meanwhile, children's cognition toward reality is a positive, dynamic, and constructive process based on the interaction of the subjects and objects. Their cognition in every stage is different from adults; it varies on the ways of information handling and representation. From Piaget's theory, children assimilate and accommodate stimuli through interaction with their surroundings, and their cognition is consequently changed by it (Piaget 1969).

On the other hand, from Erikson's psychosocial theory of development, he believed that the elementary-school children of the ages in 6–12 have the hope of "industrious" association and with it face their challenges outside. They attain the sense of competence by the interaction among peers, social participation, and academic performance.

They value the relationship of peers, and if they fail on these challenges, feelings of inferiority occur instead (Jhu 1997; Kivnick and Wells 2014). On the other hand, according to Bruner's systems of representation theory, three stages of representation were claimed to exist: enactive, iconic, and symbolic. These three stages of cognitive development occur gradually and also could coexist and are complementary to each other. Any perception could be earned by the learning process of enactive representation (concrete), iconic representation (icon) and to symbolic representation (abstract). Comparing to Piaget's natural readiness of cognitive development, Bruner believed that accelerated readiness is possible for a child through the educational format (Jhu 1997).

Furthermore, Vygotsky, from his viewpoint of cognitive development, emphasized that social context and culture are the important factors affecting children's cognitive development (Wozniak and Fischer 2014). He also proposed the Zone of Proximal Development (ZDP) which means that children can solve problems by implication given from adults or by cooperation with elder peers, when their cognitive function is on the transition period of maturing (Jhu 1997). Namely, that the basis for psychological development generally is not merely in individual cognition, but also in interpersonal relations, communication, and cooperation within sociocultural environment.

2.2 Aesthetic Perception

The concept of "Aesthetic" originated from the Greek "Aisthetika" with the meaning of "things perceptible through the senses". Its related verb "aisthe" denoted "to feel, to apprehend (Abbs 1987). That is, the experiences of aesthetics emerge from perceptions, rather than from concepts (Abb 1989; Kant 1987).

Abb (1987) described that aesthetic is a distinct category of understanding, a both sensual and cognitive mode of knowing. Consistent with children's cognitive development, aesthetic perception was also expected to vary by age, i.e. adults perform better than children and elder children perform better than younger children as well. Over and above age, however, aesthetic perception was predicted to be linked to their experiences (Parsons 1987). Freedman (2001) further asserted that children's aesthetic perceptions needed to be built on meaningful connections within the real world.

Meanwhile, although little is known about the aesthetic developmental mechanisms, there is evidence to suggest that sociocultural factors influence its course. Greenwood (2010) described that aesthetic is culture-based and also a complex and dynamic process. Parsons (1994) argued that in a society that is relatively homogenous and changed slowly, people may come to understand their art without needing aesthetics. But our world today is not only with multiplicity, but also where there is no one stream of thought dominates others. He also claimed that children do in fact think in characteristic ways about the arts and have implicit philosophies of it which are shaped by the development of important underlying cognitive abilities. And the development of abilities with respect to aesthetics is closely related to the development of the more general abilities required for mature aesthetic responses.

2.3   Related Researches on Aesthetic Judgment, Aesthetic Preference, and Aesthetics Impression

Of Parsons' five developmental stages of aesthetic judgment, elementary school-age children are in the second stage of Beauty and Realism. They prefer realistic styles work. And they judge art works merely by beauty and proficient skill of realism (Parsons 1987). Researches also have elaborated upon the finding that traditional paintings are chosen or preferred more often than abstract or revolutionary pieces of work. Katz (1942) claimed that elementary-school-aged children preferred traditional paintings to modern paintings in a ratio of about three to two (Salkind and Salkind 1973). Dietrich and Hunnicutt (1948) further explored the findings that landscapes were more preferred than interiors, and still lives were preferred over portraits by children (Salkind and Salkind 1973). Stallings and Anderson investigated the aesthetic preference of children to reproductions of paintings by requiring the children to rank the stimuli in order of preference, and the resulting introspective responses relating to the followings: (a) subject matter such as details, (b) sensory impressions such as color, and (c) formal qualities such as arrangement (Salkind and Salkind 1973).

Moreover, the research conducted by Valentine (1962) showed that the "revolutionary" or "avant-garde" type pictures obtained lower scores on a scale of preference in contrast to "conventional" ones. On the other hand, 8 to 10 year old children prefer subject, colors, realism, skills and emotion in art work in that order. And the interests in art works of 11 to13 year old children listed from most to least preferred are: subject, skills, colors, realism and emotion (Lark-Horovitz et al. 1967). They gradually pursue the appreciation of logicality. Their ability of aesthetic judgment increases at this stage and they value the experience of visual appreciation as well (Wu 1989).

From the researches above, there were many studies concentrating on children's aesthetic judgment towards art works or art reproductions, but there was less concern focused on design products. Even in the school curriculum, the subject "Arts and Humanities" in Taiwan seldom introduces design products or design appreciation Table 1.

Table 1. The Process of Perception - Aesthetic Preference (Based on the Literature Research)
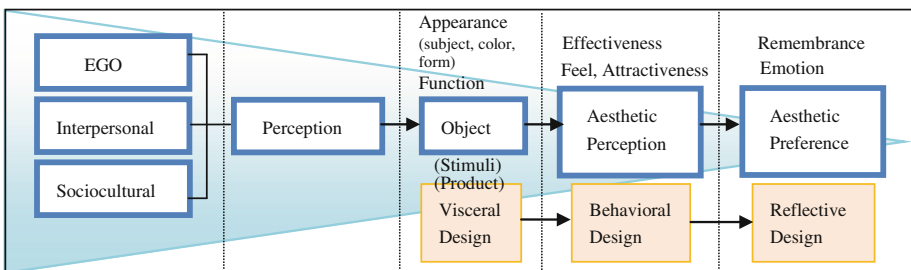
As the concept of "Aesthetic" with the meaning of "things perceptible through the senses" already mentioned in the literature, the term "product aesthetics" may relate to what the product presents to the senses (Lawalski 1988). Aesthetic impression is the context similar to aesthetic perception and aesthetic experience that may relate to the perception of how sensing the process of regarding an object is (Csilkszentmihalyi and Robinson 1990) and as the sensation that results from the perception of attractiveness or unattractiveness in products (Crilly et al. 2004). In comparison with Norman's three stages of design as visceral, behavioral, and reflective (Norman 2002), this study concluded the process of perception to aesthetic preference and tried to visualize this process as children's perception and aesthetic preference towards technology and design products.

3 Methodologies

A survey was made in order to study children's perceptions toward technological products and also their interests. The survey comprised the following two stages. (1) Choosing the stimuli: the 41dechnology products as known as Dechnology 2014 New Collection (www.dechnology.com.tw) are the target dechnology products in this stage. A web-based questionnaire was administered to 13 experts as a pilot study, and by choosing their favorable top 20 dechnology products plus the worst favorable one as the stimuli for the second stage. (2) Questionnaire research: the second stage administered a questionnaire to 72 elementary school students (41 boys and 31 girls, ages 10–11) of grade 5. They were from three different classes of an urban area elementary school and of normal distribution of academic performance.

"Dechnology" here is defined as "Design + Technology", which describes a complete product design cycle that starts from the raw materials, to manufacturing, and to crucial technology developments. Beginnings in 2009, the Department of Industrial Technology with other eight high-tech institutes have made a great effort towards animating technology into product design cycles. They are trying to provide a field for cooperating research institutes and the industry designers to explore a new dimension and to earn more commercial opportunities in the paring of "Technology R&D" and "Industrial Design" (Hung and Huang 2013).

The 41 "Dechnology 2014 New Collection" products therefore were designed by the eight institutes mentioned above. The web questionnaire displayed pictures of 41 products with the description of their functions and characteristic. The experts in this stage were doctoral students at design graduate schools. They were asked to choose 20 favorable products from the 41without ranking them. Based on a frequency distribution of the choices, the favorable top 20 dechnology products plus the worst favorable one are illustrated in Table 2.

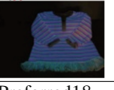The survey questionnaire was distributed in a one-period class and the examiner used the same descriptions and terms to all the students. The questions were grouped into three main parts: (1) Interests; (2) The attributes of dechnology products; (3) Preferences on the products. The quantitative findings of the three parts were on the five-point Likert Scale (5 = most agreeable (favorable), 1 = totally un-agreeable (unfavorable)).

According to Lin and Lin (2010), Lin (2012), Lin et al. (2014), the tendency of Taiwan design development already changed from technology innovation to user experiences, and this evolution can be viewed as a process of adaptive design which is a fusion of Dechnology (Design-Technology) and Humart (Humanity-Art). Therefore, the attributes of technology products here are categorized into three parts as "the Application of Advanced Technology", "The Display of Aesthetic & Design", and "The Expression of Human Caring".

Table 2. The top 20 faborable dechnology products and the worst one elected by the experts

Preferred 1	Preferred 2	Preferred 3	Preferred4	Preferred	Preferred 6	Preferred 7
Preferred 8	Preferred 9	Preferred10	Preferred11	Preferred12	Preferred13	Preferred14
Preferred15	Preferred16	Preferred17	Preferred18	Preferred19	Preferred20	Preferred41

4   Results

4.1   Children's Preferences/Interests

From the quantitative survey of the first part, a frequency distribution was used to analyze the interests of the 72 student participants. According to the results, the aspects "Manga and Games" interested the students the most (mean = 4.34) and "Political Issues" the least (mean = 2.04). The variety of interests between the participants exist on the aspect "Model and Toys" as the most different one (variance = 2.507), and "Manga and Games" is the aspect earned identical agreement (variance = 1.170) (Fig. 1).
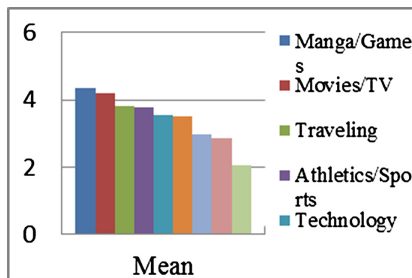

Fig. 1. The chart of mean of children's interests
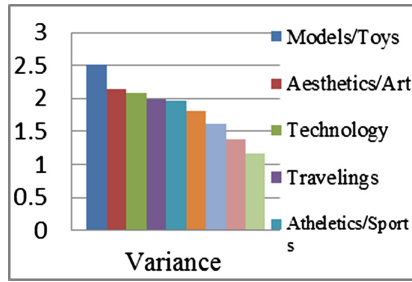
Fig. 2. The chart of variance between children's interests

4.2 Gender Variation in Preference/Interests

And from the result through the Independent Sample T-test, the interests on the aspects as "Aesthetics and Art" (t = −3.682, P < .001), "Manga and Games" (t = 3.726, P < .001), "Traveling" (t = −2.427, P < .05), and "Models and Toys" (t = 3.002, P < .05) have significant differences between genders. Girls have more interests on "Aesthetics and Art" (mean = 3.65) and "Traveling" (mean = 4.23) as opposed to boys (mean = 2.46; mean = 3.48) Tables 3 and 4. And boys pay more attentions to "Manga and Game" (mean = 4.72) and "Models and Toys" (mean = 3.98) compared to girls (mean = 3.84; mean = 2.90) (Fig. 2).

Table 3. The statistic analysis of the interests between genders

Aspect	Gender	N	Mean	SD	SEM
Aesthetics and art	M	41	2.46	1.380	.216
	F	31	3.65	1.305	.234
Manga and games	M	40	4.72	.905	.143
	F	31	3.84	1.098	.197
Traveling	M	40	3.48	1.601	.253
	F	31	4.23	.990	.178
Models and toys	M	41	3.98	1.557	.243
	F	31	2.90	1.423	.255

Table 4. The Independent Sample T-test of the interests between genders

Aspect	N	MD	SE	DF	t	Sig. (2-tailed)
Aesthetics and art	72	−1.182	.321	70	−3.682	.000**
Manga and games	71	.886	.238	69	3.726	.000**
Traveling	71	−.751	.309	69	2.427	.018*
Models and toys	72	1.072	.357	70	3.002	.004*

*p < .05; **p < .01

4.3   Children's Perception Toward Dechonology Products

From the second stage of the research, frequency distribution analysis revealed that the product 16 as "Water Rescue Boat" received the most high appreciation on the two attributes "Advanced Technology" and "Aesthetic & Design" (mean = 4.28; 4.14). Oppositely, product 06 -"Cardio Care" -was the worst on those two aspects (mean = 3.19; 2.83). On the other hand, the product 10 as "Beauty Mirror" hed the most variation of agreement (variance = 2.365) on the attribute as "Advanced Technology", and so did the product 05 "Fun Water Purification" (variance = 2.225) on the attribute as "Aesthetic & Design". However, product 21, "Touch Handlebar", was the worst favorable product judged by the experts in the pilot study and here it is the product with the least variation (variance = 1.284) among school-age participants on the attributes both of "Advanced Technology" and "Aesthetic & Design". Meanwhile, product 21 on the attribute "Human Caring" attained the most appreciation (mean = 4.07), and the product 01, "Dual Ray Desk Lamp", gained the worst appraisal on this attribute (mean = 3.21). On the variations of agreement, the product 10 "Beauty Mirror" was the one with the most different opinions on this attribute between the participants, and the product 15, "Un-flip IRB", was the one earning identical agreement.

4.4   Gender Variation in Dechnology Perception/Aesthetic Perception

According to the Independent Sample T-test, products 01 (p < .016), 07(p < .013), 08 (p < .031), 09(p < .031), 10(p < .001), 12(p < .007), 13(p < .045), 20(p < .025) have significant differences between genders on the attribute of "Advanced Technology". And the differences exist on the girl participants giving higher agreement to the eight products on this attribute.

From the result displayed, product 10 "Beauty Mirror" (t = −2.763, p < .007), 11 "Float Lamp" (t = −2.089, p < .040), 12 "Sit Properly" (t = −2.977, p < .004), 13 "3D Printer" (t = −2.265, p < .027), 20 "Curve Warning Auxiliary Equipment" (t = −2.123, p < .037) have significant differences between genders on the attribute of "Aesthetics & Design" (Table 5).

Table 5. The statistic analysis of the agreement on "Aesthetic/Art" between genders

Product	Gender	N	Mean	SD	SEM
10	M	41	3.17	1.564	.244
	F	31	4.06	1.181	.212
11	M	41	3.39	1.498	.234
	F	31	4.03	1.110	.199
12	M	41	3.34	1.460	.228
	F	31	4.16	.860	.154
13	M	39	3.51	1.449	.232
	F	31	4.16	.934	.168
20	M	41	3.29	1.487	.232
	F	31	3.90	.944	.169

And also products 09 "Personal Water Purification Bag" (t = −3.024, p < .004), 10 "Beauty Mirror" (t = −3.029, p < .003), 12 "Sit Properly" (t = −2.846, p < .006), 14 "Electric Cart" (t = −2.735, p < .008), 20 "Curve Warning Auxiliary Equipment" (t = −2.388, p < .020) were found as the products with significant differences between genders on the attribute of "Human Caring". The survey result also revealed that the product 10 "Beauty Mirror", product 12 "Sit Properly" and product20 "Curve Warning Auxiliary Equipment" are the ones without agreement between genders neither on the attribute of "Advanced Technology", nor of "Aesthetic & Design" and "Human Caring" (Fig. 3).
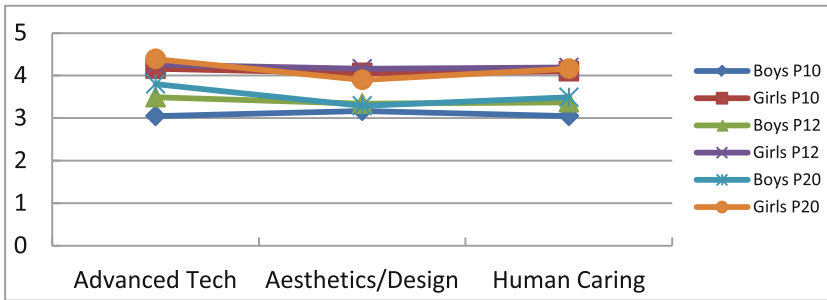

Fig. 3. Gender variation in perception on Product 10, 12, and 20

4.5   Gender Variation in Dechnology Preference/Aesthetic Preference

For the preferences, the top three preferred products elected by elementary-school-aged children are product 16 "Water Rescue Boat" (mean = 4.11), product 17 "Health Travel Band" (mean = 3.94), and product 09 "Personal Water Purification Bag" (mean = 3.93). Compared to these positive results, the worst three products "Cardio Care" product 06 (mean = 2.81), "Electric Cart" product 14 (mean = 3.15), and "Sheathing Fabric Pot" product 02 (mean = 3.18) achieved the least preferences. However, the difference of preference between genders still occurs among the products. Significantly, product10 "Beauty Mirror" attained extreme significant difference (p < 0.001) between genders (Table 6).

Table 6. Gender variation in dechnology product preference

Product	N	MD	SE	DF	t	Sig. (2-tailed)
2	72	−.759	.307	70	−2.473	.016*
3	72	−.666	.286	70	−2.327	.023*
10	72	−1.341	.308	70	−4.349	.000**
20	72	−.562	.276	70	−2.038	.045*
*p < .05; **p < .01						

5 Discussion

5.1 The Possible Factor of Gender Variation in Dechnology Perception

Although there is no obvious difference on intelligence of genders among elementary-school age, the varieties do exist on the aptitude and their academic performance. And the factors underneath could be explained include: the objective factors (e.g. the effect of traditional culture and education), the subjective factors (e.g. stereotypes of gender characteristics), and the physical factor (e.g. body maturation) (Chang, 1996). From the research of Qiu (2007), it indicated that elementary-school-aged girls have higher achievement than boys on the concept of art. And also it appears on the ability of aesthetic analysis. Oppositely to the boys, girls from the results indeed pay more attention on the aspect of "Aesthetic and Art" and mostly, their preference on every dechnology product is higher than boys. Namely, girls in this age can accept more varieties and possibilities of new-dech products and as well as give more their appreciation on it. On the other hand, compared to the attributes of "Aesthetic & Design" and "Human Caring", there are more products existing wider differences on agreement of "Advanced Technology". It might indicate that identification of technology is more difficult to define in their age. Moreover, before the questionnaire survey, the researcher asked children verbally predicted the functions of each product. Most boys predict it far away from the recent technology possibility while girls predicted it based on their known reality instead. Also, from the class observation, the student who has more related knowledge or experience on certain product would predict the product more accurately. On the attitude towards the dechnology products, students pay high attention on them, but when the real function was revealed, boys showed their disappointment and came to reject the product. It might be because children of elementary-school-age are not as socialized as adults, and they, especially the boy participants, individuals directly respond their thoughts relied on their intuitions.

5.2 The Possible Factor of Gender Variation in Aesthetic Preference

Students of test age have their own aesthetic judgment. They focus on the subject and skills of realism, and have the ability to distinguish between aesthetics and non-aesthetics. They strongly prefer the picture which has a familiar subject and with bright colors. From this view of point, comparing back to the result, we can recognize that the top three preferred products all have bright colors and the subject matter is easily understood by children and also have a close connection to their real life. In opposition, the subject matter of the worst three products is unfamiliar to children of this age and is beyond their life experiences. Also the colors of these three products are pale to catch children's eyes.

The other fact found is that products with too familiar appearance to children's eyes are hard to earn appreciation and gain identical agreement on "Aesthetic & Design". It might be because the outer form of the technology product is not as same as the realism of art works; they don't admire the skills upon it, instead, they prefer technological products with creative appearance. On the other hand, the product "Touch Handlebar"

which is the worst choice by the experts but is the product with high appreciation on all the three attributes to children. Considering the possible reasons for this, it might be because the product is symbolic of mature man and therefore successfully touches a boy's heart. Oppositely, the product "Beauty Mirror" least favored by most boys because they might consider it symbolic of the female. This might reveal some hidden information, i.e. while the product obtains children's immediate preference, it earns his/her heart, and vice versa.

5.3 The Oncoming Threat to Future Adults

From the study results, elementary school children rarely concern about human caring. In addition, they do not pay much attention on technological products which only focused on human care, especially focused on the elders. However, according to the Population Projections for R.O.C. (Taiwan): 2012–2060 and the statistics data released by the National Development Council, the percentage of old-age population (65+) of the total population was 10.9 % in 2011, which defined Taiwan as an aging society under the delimitation of the World Health Organization. As the percentage of the old-age population in 2018 is predicted to be 14 %, Taiwan therefore will be defined as an aged society; furthermore, the super-aged society with 20 % old-age population ratio will soon arrive in 2025. Simultaneously, when the respondents of 10–11 year-of-age today (2015) grow up as adults in 2036, the potential support ratio of agers 15–64 years old to the elders above 65 years old will be 2.2:1. Namely, almost two persons of 15–64 year-of-age should take care of one old person above 65 year-of-age at that time. Even more, the median age of population in 2036 is going to be 51 years old (Ministry of the Interior, 2013).

Aiming to decrease the social pressure under both the trend of fewer children and an increasingly aging society, technology focused on human care is earning higher and higher attention than ever. According to the literature review on children's perception and cognitive development, children are able to be educated on it. Since they are naturally and intangibly educated by the circumstances among them, educators possibly could provide or build for them appropriate and challengeable surroundings to enhance their learning possibilities.

6   Conclusions and Suggestions

Based on the results of this study, conclusions follow:

1. Gender variation indeed exists on children's dechnology perception and aesthetic preference, and the variation often happens when the object is a simile or metaphor of the opposite gender.
2. Children's perceptions and preferences are intuitive and grounded on their experiences, and can also easily be affected by peers and surroundings.
3. Children of this age seldom concern about human caring. And their interests are actually affected by high-tech tendency.

Therefore, on the basis of previous studies, aesthetic education could be suggested and positioned to instruct children how to experience and value beauty and its relation with human life (Madeja 1971). Namely, instead of generating concepts about the aesthetic, releasing the practical function from the products and focusing directly on what makes it unique might assist children's appreciation of new-tech design.

On the other hand, in order to assist future adults to confront their coming aged society, the concepts about universal or user-centered design and the concerns about human caring must be more involved in their daily life from now on. Therefore, in which ways could be practicable to educate our future adults the concepts of design toward a sustainable world and the attitude toward the coexistence of both organisms and the environment, might be the following concerns and further research issues or even the social responsibilities of technologists, designers, and educators.

References

Abbs, P.: Living Powers: The Arts in Education. Falmer Press, London (1987)

Abbs, P.: Aesthetic education: an opening manifesto. In: Abbs, P. (ed.) The Symbolic Order: A Contemporary Reader on the Arts Debate. Falmer Press, London (1989)

Chang, C.S.: Educational psychology. Tunghua Press, Taipei (1996)

Chang-Peng, W.: Instructing appreciation of chinese painting to elementary school children. Inf. Res. **51**, 14–18 (1989)

Crilly, N., Moultrie, J., Clarkson, P.J.: Seeing things: consumer response to the visual domain in product design. Des. Stud. **25**, 547–577 (2004)

Csikszentmihalyi, M., Robinson, R.E.: The Art of Seeing: An Interpretation of the Aesthetic Experience. J. Paul Getty Museum, Los Angeles (1990)

Dietrich, G.L., Hunnicutt, C.W.: Art content preferred by primary grade children. Elementary Sch. J. **48**, 557–559 (1948)

Druin, A.: The role of children in the design of new technology. Behav. Inf. Technol. **21**(1), 1–25 (2002). http://hcil2.cs.umd.edu/trs/99-23/99-23.html

Freedman, K.: How do we understand art? Aesthetics and the problem of meaning in the curriculum. In: Duncum, P., Bracey, T. (eds.) On Knowing Art and Visual Culture, pp. 34–46. Canterbury University Press, Christchurch (2001)

Greenwood, J.: Aesthetic learning, and learning through the aesthetic. In: Schonmann, S. (ed.) Key Concepts in Theatre/Drama Education, pp. 47–52. Sense Publishers, Rotherdam (2010)

Hung, W.K., Huang, W.: Creating value for technology by design: a case study of dechnology project. J. Des. **18**(1), 41–64 (2013)

Jago, R., Thompson, J.L., Sebire, S.J., Wood, L., Pool, L., Zahra, J., Lawlor, D.A.: Cross-sectional associations between the screen-time of parents and young children: differences by parent and child gender and day of the week. Int. J. Behav. Nutr. Phys. Act. **11**(54), 29 (2014). http://www.ijbnpa.org/content/11/1/54

Jhu, J.-S.: Education Psychology. Wanan Press, Taipei (1997)

Kant, I.: Critique of Judgment (trans. W. Pluhar). Indianapolis, Hackett (1987)

Katz, E.: A test for preferences for traditional and modern paintings. J. Educ. Psychol. **33**, 668–677 (1942)

Kivnick, H.Q., Wells, C.K.: Untapped richness in Erik H. Erikson's rootstock. The Gerontologist **54**(1), 40–50 (2014)

Lark-Horovitz, B., Lewis, H.P., Luca, M.: Understanding Children's Art for Better Teaching. Charles E. Merrill, Columbus (1967)

Salkind, L., Salkind, N.: A measure of aesthetic preference. Stud. Art. Educ. **15**(1), 21–27 (1973). National Art Education Association

Lewalski, Z.M.: Product Esthetics: An Interpretation for Designers. Design and Development Engineering Press, Carson (1988)

Qiu, L.-L.: The Study of Elementary School Senior Graders' Aesthetic Ability in Art Appreciation Education. Unpublished master's thesis, National Hsinchu University of Education, Hsinchu, Taiwan (2007)

Lin, R., Lin, C.L.: From digital archives to E-business: A case study on turning "art" into "business". In: Proceedings of the 2010 International Conference on e-Business (ICE-B), pp. 1–8. IEEE, July 2010

Lin, R.: From Dechnology to Humart in Taiwan Design Development. Research Project Supported by Taiwan National Science Council (2012)

Lin, R., Yen, C.-C., Chen, R.: From adaptive design to adaptive city-design in motion for taipei city. In: Rau, P.L.P. (ed.) CCD 2014. LNCS, vol. 8528, pp. 643–649. Springer, Heidelberg (2014)

Madeja, S.S.: Aesthetic education: an area of study. Art Educ. **24**(8), 16–19 (1971)

Ministry of the Interior: 2013 Demographic Fact Book R.O.C

National Development Council: Population Projections for R.O.C. (Taiwan): 2014∼2060

Norman, D.A.: Emotional design. Basic Books, NY (2002)

Parsons, M.J.: How We Understand Art. Cambridge University Press, London (1987)

Parsons, M.J.: Can children do aesthetics? a developmental account. J. Aesthet. Educ. **28**(3), 33–45 (1994). Special Issue: Aesthetics for Young People, University of Illinois Press

Valentine, J.: The Psychology of Beauty. E. Puffer, New York (1962)

Piaget, J., Inhelder, B.: The psychology of the child. Basic Books, New York (1969)

Wozniak, R.H., Fischer, K.W. (eds.): Development in Context: Acting and Thinking in Specific Environments. Psychology Press, NY (2014)

Su, Y.-H.: What kind of aesthetic education we need? Aesthetic education in opposition to art education. J. Aesthet. Educ. **165**, 58–68 (2008). National Taiwan Arts Education Center

Yang, C.F., Wu, C.S., Gong, Y., Sung, T.J.: Transformative service design: from technology to dechnology. In: Advances in The Human Side of Service Engineering, vol. 1, p. 210 (2014)

Yin, Z.-Z.: On dialectics in the theory of children's cognitive development by jeam piaget. J. Shanxi Normal University **33**(3), 136–138 (2006). (Social Science Edition)