

Identification of Design and Development Needs for Preschool-aged Children's Educational Bags

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ABSTRACT

Bags for students, especially for preschool-aged children have an important role as learning media in education. Attractive and innovative bag designs are highly required to make them acceptable and favourable for children. This research uses a quantitative method. Design and development of educational bags for preschool-aged children were conducted through early stages of reserach (mind mapping) and concept development (determining identification needs). The concept of development process began with the dissemination of 30 questionnaires to preschool-aged children to identify the consumers' need for the bags. From the development process, there were three primary needs and 14 target specifications which were then linked to 8 matrices in the chart of matrix need. The results of the research in educational bag designs for preschool-aged children is implemented based on matrix need.

Keywords: bags, product design, innovation, primary needs, target specification, matrix need

INTRODUCTION

Non-ergonomic backpack (with a load that does not match the standard with a maximum of 1/3 of weight) can cause several diseases, such as *scoliosis* (a bone disorder that bent to the side). Therefore, it is important to design an ergonomically backpack design which provide comfort and avoid the risk of injury for users (Dian, Velahyati, and Hartati, 2011).

The problem solving for good design should recognize human need and their actions, such as size, postures, and position in activity, behavior, and the manner of human activity. Regarding this, it needs ergonomic consideration to design bags. Ergonomic is one of the qualifications to achieve qualified, certified design and customer need. How far the extent of design fulfills the functional techniques, aesthetics quality and economic, it needs evaluation by using some basic qualifications (Wardani, 2003).

Bags are a tool to carry school supplies. In addition to that, bags for preschoolers are intended as learning media. Preschoolers are just learning to go to school, get to know the school with all its requirements, participate in school activities with the practice of early-learning discipline. Since preschool is the first school for them, it is expected that all school activities are fun. This includes their selection of school bags.

Preschoolers tend to like backpack or trolley to carry their school equipment. Backpacks and trolley bags are considered comfortable for them. This is because the backpack and trolley can distribute the burden evenly at its supporting points.

Children world is full of joy, imagination and creativity, as well as a learning activity. Learning is done not only through books but also through other media, such as games and props. Based on this background, this study designed a school bag

that can function as a learning medium without ignoring the characteristics of preschoolers.

The Definition of Preschool-aged Children

Post-method pedagogy has three parameters; there are uniqueness, practicality, and probability. Uniqueness to the teacher's sensitivity to situations and contexts related to the student, places, and timing of learning takes place, to determine effective learning (Sundari and Rachminingsih, 2015).

According to Wong (2000) in Naraya, et al (2013), preschool-aged children are children aged between 3-6 years old. Preschool-aged children have their own characteristics in terms of growth and development. At that time, their motor skills are improving.

Furthermore Naraya, et al (2013) stated that child's motor skills means the process of acquiring skills and movement required to control his body. There are two types of motor skills: fine motor skills and gross motor skills. Fine motor skills are usually used in indoor activities, whereas gross motor skills are performed outdoors because they cover the movement of a child's entire body or most parts of his body. By using a variety of certain muscle group coordination, children learn to crawl, throw, or jump. Coordinations of balance, promptness, flexibility, strength, and endurance are gross motor activities. While fine motor activities involve small muscle in foot and hand. This movement requires speed, precision and skillfulness to move, such as to write, draw, cut, fold, or play the piano.

Preschool-aged children start learning to go to school. They are eager to learn many things. Many of them go to daycare, playgroup, and nursery school programs. Therefore, to fulfil their needs at school, they must be equipped with school supplies, such as school bags.

In terms of social aspects, three-year-old

children are almost able to dress and feed themselves, have increased attention spans, know their own sex, play games with their own rules but are willing to share. Four-year-old children tend to be independent and stubborn or impatient, physically and verbally aggressive, obtain pride for their achievements, have much fear. By the end of preschool age children are rarely rebellious behaviours, rather are calmer, show independence, trust-worthy, responsibility, nicely behave, try to live by rules, can follow the rules while playing although sometimes they cheat.

According to Piaget in Natadjaja (2002), child development is divided into three aspects: cognitive, psychomotor, and affective development. Cognition is an understanding of thinking and observing behaviors resulting knowledge or knowledge needed to use. Psychomotor is a skill to use organs, an activity of the organs of the body such as muscles, nerves, and glands. Affective (affection, affection), affection, love is a very strong feeling, a broad class of mental processes, including feelings of emotion, atmosphere, heart and temperament.

Meanwhile, in terms of cognitive aspect, three-year-old children are at a perceptual phase. They tend to be egocentric in thinking and behaving, start to understand time, improve their understanding of the concept of space, and be able to view a concept from different perspectives. Four-year-old children are at an initiative phase. They have a better understanding about time, value something according to its dimension, do an assessment based on perception, less egocentric, have higher social awareness, obey their parents because they have restrictions, not because they have understood right and wrong. By the end of the pre-school period, children are able to see other's perspective and tolerate it despite they do not understand it. Children are very curious about the factual world.

Product Development

According to Pahl and Beitz in Hidayanto and Rulia (2016), there are consists of 4 activities or stages in design product, each consisting of several stages. The four phases are: Planning and translating tasks, Designing product concept, Designing product form (design embodiment) and Detailed design.

According to Ulrich and Eppinger, (1995 [translated by Nora A. & Ivelinne AM, 2001: 2]), five dimensions of product specification commonly used to assess the performance of product development, namely:

1. Product Quality
2. Product Cost
3. Product Development Time
4. Development Cost
5. Development Capability

Product Development Phase

Six phases of the development process are used as the initial steps of manufacturing a product until it is ready for use. The followings are six phases of the development process (Ulrich and Eppinger, 1995 [translation by Nora A. & Ivelinne AM, 2001: 9]):

1. Planning

Planning is often referred to *zero phase* because this phase precedes the project approval and the launch of actual product development.

2. Concept development

In this phase, we begin to identify target market needs, make various concept alternatives and then choose the best concept to be continued in the next development process. The concept is a description of the form, function and appearance of a product and is usually accompanied by a set of specifications, analysis of competitor's products and economic justifications of the project.

3. System-level design

This phase includes the definition of product architecture and the decomposition of the product into subsystems and

components. The output of this phase usually includes a geometric layout of the product, a functional specification of each of the product's subsystems, and a preliminary process flow diagram for the final assembly process.

4. Detail Design

This phase includes the complete specifications of the geometry, materials and tolerances of all of the unique components in the product and the identification of all standard components to be purchased from the suppliers. A process plan is established and tooling is designed for each component to be fabricated within the production system.

5. Testing and refinement

This phase involves the construction and evaluation of multiple preproduction versions of the product. In this phase, early prototypes (*alpha prototypes*) and later prototypes (*beta prototypes*) are built. *Alpha prototypes* are made by using parts with the same geometry and material properties as intended for the production version of the product, but with a simpler manufacturing process. *Alpha prototypes* are made to see whether the product can work as designed and satisfy customer needs. While later prototypes (*beta prototypes*) are made with components supplied by the intended production processes, but may not be assembled using the actual assembly process. This prototype is intended to answer questions about performance and reliability in order to identify technical changes for the final product.

6. Production Ramp-up

In this phase, the product is made using the actual production system. The purpose of the ramp-up is to train the *developer* in solving problems that may arise in the actual production process.

Phase 1: Concept Development

From the overall development phase mentioned above, phase 1 or concept development plays the most important role.

Without minimizing the role of other phases, it is during this phase that the team conducts screening and identification of customer needs that are targeted by the market. In this phase, new information may be available or the results obtained may cause the team to repeat the initial activity before proceeding to the next activity. This repetition is generally called iteration. This phase consists of several activities (Ulrich and Eppinger, 1995 [translated by Nora A. dan Ivelinne AM, 2001:18]), including:

1. Identify customer needs

The goal of this activity is to understand customer needs. The output of this activity is a set of statements of customer needs in order, arranged in a hierarchical list with loads of importance for each need.

2. Establish target specifications

The specification is a precise description of how the product works. The specification is also a translation of customer needs into technical requirements. The output of this activity is a list of target specifications. Each specification consists of a metric (quantity), as well as boundary and ideal values for the quantity.

3. Generate product concepts

These activities include a mixture of external research, creative problem-solving processes by the team and systematic research of the parts of the solutions produced by the team.

4. Select product concept

The selection of a concept is an activity in which multiple concepts are analyzed successively and then eliminated to identify which concepts are the most promising. This process typically consists of several iterations and may include additional drafting and concept refinement.

5. Test product concept

Test one or more concepts to find out whether customer needs have been satisfied, estimate the market potential of the product and identify some weaknesses that

must be fixed during the next development process. If the market response is negative, then the team should take a decision whether to stop or repeat some initial activity if necessary.

6. Set final specification

In this activity, the team set final specifications from the previous translation of customer needs. The team should be consistent with the values of specific quantities that reflect restrictions on the concept of the product itself. Those boundaries identified through the technical modelling as well as the choice between cost and performance.

7. Plan project

At the end of concept development activities, the team made a schedule of development in detail, determine a strategy to minimize time development and identify resources used to finish the project.

METHOD

Research methodology of selecting design object according to Naraya C.R., et.al. (2013: 40), as follow:

1. Selecting research objects (products)

Selected products must be products that meet the criteria. The selected products are widely known by the public.

2. Selecting target market (market segmentation)

Market segmentation is required to facilitate the working process of the development project and make it on target. The strategy used to determine the market segment is market pull.

3. Mission statement

The conclusion of the project planning stage is a mission statement (*mission statement*). This mission statement will be used as a suggestion in order to formulate the definition of target market more details and assumptions underlying the operational development process. This mission statement contains six main points, namely:

- a) Product description, briefly outlines

the product to be developed, main benefits and vision of the product.

b) Main business targets, determine the time required for the process of planning and development, expected financial performance and market share targets.

c) Primary market, a market segment that is the main target of marketing the product.

d) The secondary market, a market segment which is below the primary market in terms of priority rank.

e) Assumptions and limitations, the possibilities range of concepts that can be used as a benchmark or the focus of development.

f) Stakeholders contains a collection influenced by the success and failure of a product.

RESULTS AND DISCUSSION

A. Design Object

1. Identify Customers Needs

According to Wison, Hartanti, and Runtuk (2014), the children's product needs some constraints. There are safe material, have interesting shapes and colours, exercising patience, and have simple shapes.

Customer needs contained in the list of customer statements later are translated into customer needs in the form of points of customer desires. The next step is to do the screening of customer needs in order to select the significant customer needs. In that process, customer needs are classified into *primary needs* and *secondary needs* and then analyzed for the level of importance (table 1). After getting the level of importance, the following step is determining target specifications (table 2) and then defining the relationship between the existing needs and targets. The next step is mapping those in the needs metrics matrix (table 4).

The following is mind mapping (figure 1) of the results according to direct observation and data collection from several playgroups, and kindergartens:

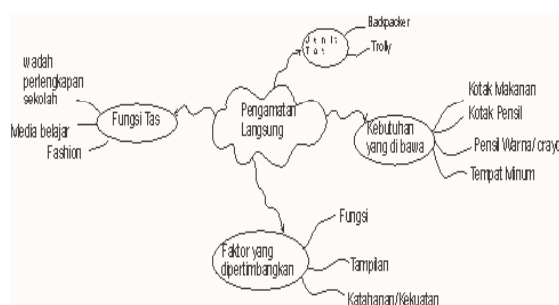


Figure 1 Mind mapping of consumers' needs and desires

The most popular preschoolers' bags are backpacks and trolleys. A backpack is one of the favourite bags because it has several advantages such as make storage easy, manage load better, and prevent injuries to shoulder muscles. The distribution of tasks is to endure a burden laying more on the hip muscle causes the activity to carry the load becomes easier, balanced and stable. In addition to that, a trolley bag is also favoured by preschoolers due to the ease in carrying the bag.

Determining a target market begins with the distribution of questionnaires consisting of the predecessor questionnaires, questionnaires 1, questionnaires 2 and questionnaires 3, direct observations, and internet research. Based on the data processing collected from 30 questionnaires, market segmentation will focus on preschoolers age 3-6 years old. Preschoolers studied were 30 children who went to playgroups/preschools and kindergarten in Samarinda, East Kalimantan.

At present, bags carried by preschoolers in addition to its function as a storage for school supplies, they are parts of fashion or amusement that can serve as learning media for preschoolers.

Bags are needed by preschoolers as a storage to keep things they need at school, such as drinking bottle, lunch box, books/drawing books container, pencil case, and colouring pencil case. Ninety-nine percent (99 %) out of interviewed preschoolers liked with an image of cartoon charac-

ters, pictures of animals as well as images of transportation means with bright colour (children preferences of colour).

On the other hand, the durability/robustness factor is not really considered in selecting bags. Preschool-aged children tend to change bags because they like their motifs and graphics.

Preschoolers love to play especially games that train their motor skills (educational games), such as playing puzzles, mazes, making beads, and many other things. Preschoolers love a picture; they can develop their imagination by a picture. A picture is a deliberately created image by using a particular technique that varies, so it has a form and shows something of a clearly recognizable object and not an abstract image (Pandanwangi, Piliang, and Adisasmito, 2014).

The designed-bags are bags that combine two functions: first, bag as a medium to carry school supplies and bag as a medium of educational learning for children by introducing batik motif and distinct animals of East Kalimantan in a puzzle.

Table 1 Primary and secondary products needs

Primary Need	Secondary Need
Product flexibility	<ul style="list-style-type: none"> The bag can accommodate a small notebook /drawing book, pencil case, a lunch box, a drinking bottle, and a colouring pencil case. The bag functions as a medium of playing and learning (equipped with educational facilities). Bags can be carried in a back (backpack) or dragged (trolley).
The aesthetic values of the product	<ul style="list-style-type: none"> The bag has a simple design that suitable for preschool-aged children. The bag has a shape that suits the characteristics of preschoolers. The bag has children preferences of colour, namely striking bright colours like red, yellow, green, blue and others.

Ergonomic values

- The bag has graphics appropriate for preschool-aged children (cartoons, distinct animals of East Kalimantan, fruit, typical motif of East Kalimantan, etc.).
- The bag is designed to fit anthropometry of preschoolers.
- The bag has partitions to separate different part in order to teach children to put all their needs or belongings according to the proper place.
- The bag lock system consists of 2 zippers in order to facilitate children in taking their needs.
- The bag straps are added by foam to provide comfort for children in carrying the bag. Bag straps are adjustable.
- The handle of trolley bag is designed based on the average anthropometry of children.
- The backpack has a comfortable design to distribute the load evenly.
- The backpack has an ergonomic back pad design (good air circulation, hold the spine position and soft).

Table 2 The level of importance from primary and secondary attributes

No.	Customer Needs	Level of Interest
1	The bag can accommodate a small notebook/drawing book, a pencil case, a lunch box, a drinking bottle, and a colouring pencil case.	4
2	The bag also serves as a medium of playing and learning (equipped with educational facilities including the introduction of distinct animals and motifs of East Kalimantan).	5
3	The bag can be carried in a back (backpack) or dragged (trolley)	4
4	The bag has a simple design for preschoolers	3
5	The bag has a suitable shape for preschoolers characteristics.	5













6	The bag has children preferences of colour such as striking bright colours like red, yellow, green, blue and others.	5
7	The bag has graphics that suit characteristics of preschool-aged children (cartoons, distinct animals and motifs of East Kalimantan).	5
8	The bag is designed to fit anthropometry of preschool-aged children.	5
9	The bag has partitions to separate different part in order to teach children to put their needs in the proper place.	5
10	The bag lock system consists of 2 zippers to facilitate children in taking their needs.	3
11	The straps of the bag are added by foam to give comfort to children when they carry the bag. Bag straps are adjustable as needed.	5
12	The handle of trolley bag is designed based on average anthropometry of children.	5























13	The backpack has a comfortable design to distribute load evenly.	4
14	The backpack has an ergonomic back pad design (good air circulation, hold the spine and soft).	3

Table 3 Needs correlation – bag design matrix

No.	Needs	Matrix
1	The bag is designed with partitions in accordance with the needs.	1, 2, 9
2	There is an educational game space (puzzle) on the bag.	2, 4, 5, 6, 7, 10
3	The design of the backpack strap is flexible in size and felt soft.	3, 8, 11, 13
4	The ergonomic design of trolley system.	3, 8, 12, 13
5	Bag graphics are designed to suit children characteristics.	4, 5, 6, 7
6	Type of bag material.	1, 2, 9, 11, 14
7	Design of bag carry	1, 14
8	Ergonomic backpack design	1, 3, 5, 6, 8, 13

Tabel 1 Need Metrics – Matrix

Need Metrics - Matrix		Metrics	Bag is designed with partitions	It has a space for educational games	Straps of backpack are soft and flexible	Ergonomic trolley system design	Bag graphics design suitable for preschoolers	Type of bag materials	Design of bag carry	Ergonomic backpack design
Product flexibility	Bag can accommodate a small notebook/drawing book, a pencil case, a lunch box, a drinking bottle, a colouring pencil case.	4								
	Bag functions as a medium of learning and playing.	5								
	Bag can be carried on the back (backpack) or dragged (trolley).	4								
Product aesthetics Values.		3								

Ergonomic Values	Bag has a simple design for preschoolers.	5			
	Bag has shape suitable for preschooler characteristics.	5			
	Bag has graphics appropriate for preschooler characteristics.	5			
	Bag is designed according to preschooler anthropometry.	5		 	
	Bag has partitions to separate different sections.	5			
	Bag lock system has 2 zippers.	3			
	Bag straps are added by foam.	5			
	Handle of trolley bag is designed based on average anthropometry of preschoolers.	5			
	Backpack has comfortable design to distribute weights evenly.	4		 	
Backpack has ergonomic back pad design (air circulation, hold back position, soft).	3			 	

CONCLUSION

1. In this bag design process, there are three primary needs identified, namely product flexibility, product aesthetic value, and product ergonomics.

2. Product flexibility consists of secondary needs with a high level of importance, namely bags that function as a medium of playing and learning (added by educational facilities introduction of East Kalimantan culture).

3. Product ergonomic values consist of secondary needs with a high level of impor-

tance, namely bags with shapes suitable for preschooler characteristics, bags with preschooler preferences of colours, and bags with graphics appropriate for preschooler characteristics.

4. According to customer needs, 14 specification targets are defined which then linked to 8 need matrixes.

The following research is expected to analyze customer needs with Quality Function Deployment integrating quality, environment, physics, and cost aspects. The research can be continued by designing

bag products with ergonomic approach in order to develop advanced products.

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