Identification Customer Need for Redesign Feet and Hands Strength Training Equipment for the Post-Ischemic Stroke Patients

Ade Sri Mariawati, Fatin S.D, Ani Umyati, Moh Fawaid, Muhammad Nurtanto

Abstract—Based on Indonesia health data, an increasing number of stroke patients ranging from 8.3 per 1,000 people in 2007 to 1 per 1000 people in 2013. Stroke is a sudden attack that occurs in the brain that involve blood vessel in the brain blocked until the rupture and cause diverse paralysis symptoms such as impaired speech and swallowing disorders. Based on type stroke, 85% stroke is ischemic stroke and 15% are hemorrhagic. Ischemic stroke is a stroke caused by blockage of blood vessels and leads to paralysis on one side of the body. Post-ischemic stroke patients in particular need of exercise when post-cure. Post-exercise recovery process that has an important role in everyday life include strength training the legs and arms. Now there are tools and hand leg exercises for patients with post-ischemic stroke in the form of a static bike, but this tool still has shortcomings, ranging from the type of pedal is used, and the absence of static load for bicycle users. The aim of this study was to design a strength training tool for the patient’s feet and hands after ischemic stroke. Based on previous observations followed the design of the product development cycle using the static design method of product development Karl T. Ulrich. The method consists of five phases namely, Phase 0 planning, phase 1 concept development, phase 2 level system design, phase 3 detailed design, phase 4 testing and repair, phase 5 product launch. In this study only used two steps. Result from identification Safe when used (for users), Adjustable load as needed , Comfortable during use (for users), Easy to take care, Sturdy, Light, Work manually, Easily to use (for users), Easy to be overhauled, Attractive design, Durable, Pedal appropriate size with the hands and feet, Affordable prices, Easily stored

Index Terms— Ischemic Stroke Post, Ulrich, Customer need

1 INTRODUCTION

Stroke is the third cause of death in the world [1]–[4] after heart disease and cancer, and is the leading cause of disability in the world [5]. In Indonesia [6] and neighboring countries [7], stroke is the one number cause of death. Based on Health Research (Riskesdas) the prevalence of stroke has been increased from 8.3 per 1000 (Riskesdas, 2007), to 12, 1 per 1000 for respondents aged 15 years and over [8], [9].

Stroke is a sudden attack that occurs in the brain [10] involving blocked or ruptures blood vessel [11] and eventually cause a variety of symptoms ranging [12] from loss of speech paralysis, impaired swallowing, and so on. There are two major kinds of stroke, ischemic and hemorrhagic [13]. Ischemic stroke caused by obstruction or blockage in the blood vessels of the brain so that networks of brain cells in the area die and no longer function, while hemorrhagic strokes occur due to rupture of blood vessels. The incidence ratio of Ischemic strokes are 85% of all strokes while 15% are hemorrhagic strokes [14], [15].

Every year there are increasing number of stroke patients in RSUD Cilegon and RSUP Fatmawati. Post-stroke patients need physical exercise [16] such as strength training for legs and arms [17], [18]. Strength training process of legs and arms patient with post-ischemic stroke is usually done in the hospital with the help of tools or a physiotherapist. The frequency of exercise [16] is important for patient’s recovery development, and strength training exercise of legs and arms patient should conduct not only in hospitals but it can be done independently at home or anywhere by the patient. Nowadays there are flexible strength training tools for legs and arms such as static bicycle. However, this tool has some shortcomings such as the type of pedal used for training the legs and arms have the same shape, and no load for users. Based on interviews with several doctors and physiotherapists, the leg and arm strength training tools should be given a load. The installation of the load depends to the ability of each patient’s muscle after ischemic stroke [19].

Based on these circumstances, this study has the objective of designing a strength training tool for the patient’s legs and arms after ischemic stroke. The design of this tool using Karl T. Ulrich’s method of designing and developing products [20]. Stationary bikes are the strength training equipment for leg and arm patients with post-ischemic stroke. Stationary bikes are intended for post-stroke ischemic patients with muscle strength MMT (measurement muscle test) 4 and did not experience spastic wrist flexors. This study has several limitations. This research was conducted in RSUD Cilegon and RSUP Fatmawati Jakarta. Respondents of the study include physicians who treat patients with ischemic stroke muscle strength MMT 4, therapist, patient and family after ischemic stroke. Karl T. Ulrich methods is method of designing and developing product that has several stages. In this study only used two steps. The stages are the identification of customer needs, product specification

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2 RESEARCH METHODS

There are several phases in this study. The phases are initial observation, data processing questionnaires and redesign strength training equipment for the legs and arms post-ischemic stroke patients using the method of Karl T. Ulrich [21].

1. Initial Observation
At this stage the researchers conducted interviews with doctors, physiotherapists, patients and their families after ischemic stroke and then gather explanation about equipment that already exist in Indonesia, especially in RSUD Cilegon and RSUP Fatmawati Jakarta.

2. Data processing questionnaires
Researchers conducted the deployment of two types of questionnaires, open questionnaire and enclosed questionnaire to 30 respondents in RSUD Cilegon and RSUP Fatmawati Jakarta. Questionnaires were obtained and processed by:
   a. Adequacy Test
      This test has the aim to determine the measured data is sufficient or not.
   b. Validity Test
      This test used to determine whether the measured data is valid or not.
   c. Test Reliability
      This test used to determine whether the measured data has been reliable or not.

3. Karl T. Ulrich Methods
The method consists of five phases namely, Phase 0 planning, phase 1 concept development, phase 2 level system design, phase 3 detailed design, phase 4 testing and repair, phase 5 product launch. In this study only used two steps. The stages are the identification of customer needs, product specification. The breakdown phases are as follows:
   a. Processes and Organizations
      This step included in phase 0-1.
   b. Product Planning
      This step included in phase 0.
   c. Identification of Customer Needs
      This step included in phase 1.
   d. Product Specifications
      This step included in phase 1-2.
   e. Concept Preparation
      This step included in phase 1.

3 RESULTS AND DISCUSSION
3.1 Process and Organizational Development
The stakeholders involved in the process of product development strength training tool for legs and arms, in the form of stationary bikes are:
   a. Researcher
   b. Specialist Doctors Occupational Therapy
   c. Physiotherapy
   d. Occupation
   e. Ostetic Prostetic
   f. Respondents

3.2 Product Planning

<table>
<thead>
<tr>
<th>TABLE 1. Mission Statement</th>
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<tbody>
<tr>
<td><strong>Mission Statement Post – Stroke Stationary Bike (PASTROK)</strong></td>
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<tr>
<td><strong>Product Description</strong></td>
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<td><strong>Major Business Goals</strong></td>
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<td><strong>Main Market</strong></td>
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<td><strong>Secondary Market</strong></td>
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<td><strong>Assumption and Limitations</strong></td>
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<td><strong>Stakeholder</strong></td>
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3.3 Identify Customer Needs
Here’s a customer needs as a basis for preparing product specifications:
   a. Safe when used (for users)
   b. Adjustable load as needed
   c. Comfortable during use (for users)
   d. Easy to take care
   e. Sturdy
   f. Light
   g. Work manually
   h. Easily to use (for users)
   i. Easy to be overhauled
   j. Attractive design
   k. Durable
   l. Pedal appropriate size with the hands and feet
   m. Affordable prices
   n. Easily stored

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<tr>
<th>TABLE 2. The Sequence of Relative Importance</th>
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<td><strong>No</strong></td>
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TABLE 1: Importance Level

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<tr>
<th>No</th>
<th>CN</th>
<th>Importance Level</th>
<th>Percentage</th>
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<tr>
<td>13</td>
<td>10</td>
<td>Affordable prices</td>
<td>6.972973</td>
</tr>
<tr>
<td>14</td>
<td>9</td>
<td>Easily stored</td>
<td>6.972973</td>
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</tbody>
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Explanation:
NK = Classification Number Importance

Questionnaire data were obtained from 30 respondents then processed as follows:

a. Adequacy Test

Adequacy of test data is performed based on data collected from 30 respondents using closed questionnaire as a data collection tool. This study uses a 95% confidence level with a level of accuracy of 5%. If the K value = 1.96, S = 0.05, then obtained k / s = 1.96 / 0.05 = 39.2. Here is an adequacy test calculation using the formula:

\[ N' = \left( \frac{1}{k^2} \frac{\sum x^2 - \left( \frac{\sum x}{N} \right)^2}{\sum x} \right)^{\frac{1}{2}} \]  

......(1)

b. The Reliability Test

Questionnaire by respondent answer were tested for consistency. The reliability test using SPSS software version 16. A variable declared reliable if the value of Cronbach’s Alpha > 0.6. Based on the data that has been collected and then processed using SPSS version 16, the results are based on the value of Cronbach Alpha 0.836 > 0.6, all data are reliable.

3.4 Product Specifications

Here are the stages of product specifications:

Figure 1: Score Requirement Specification Matrix

Figure 2: Black Box

Based on the picture above, the absolute interest value of the technical characteristics from stationary bikes by using the following formula:

\[ NKA = \frac{NK}{B} \times 100\% \]

Explanation:
NKA : Absolute Interests Values
NK : Technical Characteristics Values

B : Load

Load is made with different weight

\[ NKA = \frac{393}{2757} \times 100\% = 14.25\% \]

3.5 Concept Preparation

Here are the design concept stages of strength training tool for the legs and arms after ischemic stroke patients in the form of an exercise bike.
4 CONCLUSION

Result from identification Safe when used (for users), Adjustable load as needed , Comfortable during use (for users), Easy to take care, Sturdy, Light, Work manually, Easily to use (for users), Easy to be overhauled, Attractive design, Durable, Pedal appropriate size with the hands and feet, Affordable prices, Easily stored. Importance level list are : Solid product 7.675676, Pedal appropriate size with the hands and feet 7.621622, Easily used products 7.513514, Durable Products 7.513514, Products safely used 7.459459, Comfortable product during use7.459459, Product is moved manually 7.459459, Products load can be set as needed 7.243243, Easily stored 6.972973, Affordable prices 6.972973, Easy-care products 6.810811, Product easy to be overhauled 6.486486, Light products 6.432432, Attractive design 6.378378.

NOTED

The authors of this article, have the same contribution.

REFERENCES