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Design of Digital Targets for Slingshot Using the Quality Function Deployement (QFD)

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Abstract
The research aims to determine user criteria regarding digital slingshot targets using the Quality Function Deployment (QFD) method based on ergonomic tool design. This study employs a case study approach, using questionnaires distributed to members of the East Java Indonesian Traditional Slingshot Association (PERKATIN). A total of thirty-eight respondents from PERKATIN participated, providing insights through a structured questionnaire comprising 11 targeted questions. Based on the weight of relative importance, the attribute priority results are color variations (12.57), material economic life (12), ease of operating the tool (12), material strength (11.57), choice of tool shape (11.08). These results highlight that users place significant emphasis on aesthetic aspects, durability, usability, and design flexibility when selecting a digital target for slingshots. The conclusion drawn from this research underscores the necessity of integrating these prioritized attributes into the design process to align product development with user expectations effectively. This study not only contributes to the field of ergonomic tool design but also demonstrates how QFD can be effectively utilized to capture and translate user needs into actionable design specifications. By embedding the voice of the customer into the development process, this research aims to enhance user satisfaction and product functionality in the realm of digital slingshot targets, ultimately fostering innovation in this niche market.

Keywords: Digital target; slingshot; catapult; QFD

1. Introduction

The values found in traditional games are still not as socialised by parents to the younger generation, as the times and technological advancements have made them less interesting and challenging for kids. In contrast, kids these days are more likely to be familiar with, adept at using, and enjoy the games on various forms of electronic media (Tanjung and Siregar, 2021). However, currently, various academics and practitioners are aggressively trying to ensure that traditional games do not disappear from the nation's culture. One of the traditional games that needs to be preserved is the slingshot game.

Slingshot is a simple game that uses a Y-shaped tool, the top two ends of which are joined together with rubber, and in the middle, a piece of leather is tied to hold the stone that will be thrown (DPMPD DUKCAPIL NTB, 2018). The slingshot itself is known as a type of traditional weapon used by ancient people as a means of protecting themselves from danger and is usually also used for hunting (Hadiwiyanti *et al.*, 2020). Ancient people preferred to use slingshots for hunting because slingshots were small and easier to carry, and ammunition was easy to obtain (it didn't have to be made using a complicated process to a certain size), stones or other materials in any form could be used as ammunition (Ventura, 2003).

Currently, the slingshot game is a newly developed achievement sport in Indonesia, better known as the slingshot sport. In every sport, achievement requires the infrastructure used in that sport, and this is also the case in the slingshot sport (Gunawan *et al.*, 2021). One of the tools used in this slingshot sport is a target. A target is a tool used as a shooting target in the slingshot sport. This tool in the form of a target in the slingshot sport is a medium used for the judging system.

In this case, quality function deployment (QFD) is recommended as an instrument to know consumer criteria and design an ergonomic slingshot digital target product design tool (Kelesbayev *et al.*, 2016). QFD is a methodology that helps translate customer needs into design requirements to ensure that outputs, whether this product or process meets needs (Rizal *et al.*, 2023). The quality function deployment (QFD) method is used to collect expert opinions and the voices of customers regarding the design to be created. It is hoped that this method will determine the main priorities in designing digital-based slingshot targets.

2. Method

This research is survey research through distributing questionnaires using the quality function deployment (QFD) method. Thirty-eight respondents from the East Java Indonesian Traditional Catapult Association (PERKATIN) filled out a questionnaire consisting of 11 questions. This research was carried out in several stages: (1) *Data Collection*: The initial phase involved distributing questionnaires to respondents to identify the target criteria for the digital-based slingshots to be developed. This step was crucial for gathering insights directly from potential users regarding their preferences and requirements; (2) *Design Determination*: Following the data collection, expert opinions were solicited to determine the design and dimensions of the digital-based slingshot targets. This stage ensured that the design considerations were grounded in both user feedback and professional expertise; (3) *Second Questionnaire Distribution*: A second questionnaire was distributed to potential users to evaluate the proposed design of the digital-based slingshot targets. This feedback loop allowed for further refinement of the product based on user impressions and suggestions.

The indicators in the questionnaire used to assess digital-based slingshot target designs are a selection of sensor type, tool weight, material economic life, material strength, ease of use of the tool, choice of tool shape, size variations, color variations, ease of operating the tool, material selection and tool multifunctionality. Data collected from these indicators encompassed user interest, user satisfaction, target goal data, improvement ratio data, selling point value, and interest weight. Upon completion of data collection, the analysis focused on determining the percentage of top priorities among consumers regarding the quality characteristics of digital-based slingshot target products. This analytical approach aimed to translate user preferences into actionable design features, ensuring that the final product aligns with consumer expectations and enhances overall satisfaction.

3. Result

The results of the research have produced a digital target prototype for the slingshot sport.

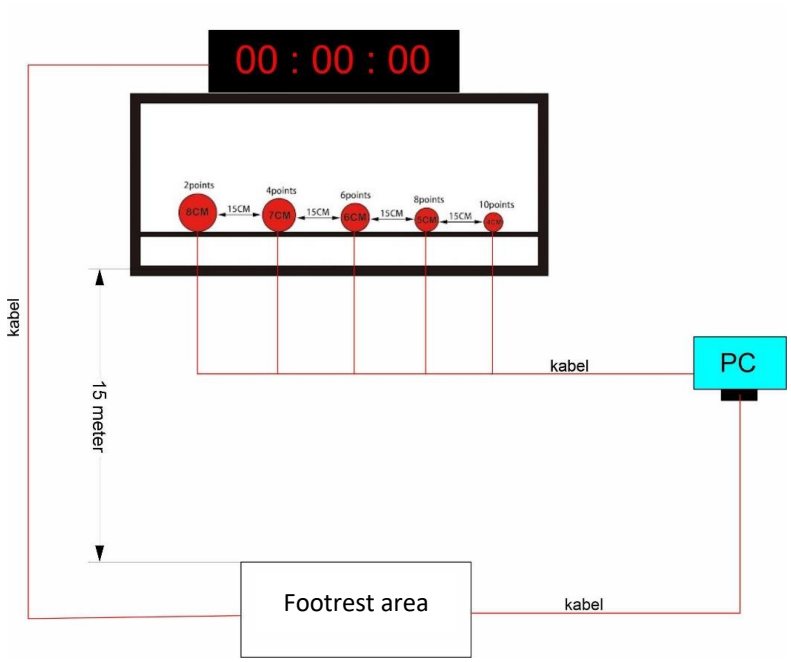

Fig 1. Design of prototype digital slingshot target

Data was gathered via the Quality Function Deployment (QFD) technique at the East Java Indonesian Traditional Slingshot Association (Perkatin). The questionnaire data collected from slingshot players revealed that the QFD method had been implemented. Following the distribution of the questionnaire and subsequent testing of its validity and reliability, the measuring instrument test yielded an Alpha cronbach value of 0.823, suggesting a high level of reliability. The information is presented in the following manner:

a. Level of Importance to Customer

From the 11 established indicators, we calculated the average and standard deviation to assess the level of user interest effectively. This statistical analysis provides valuable insights into the central tendency and variability of user preferences, enabling us to identify which attributes resonate most strongly with respondents.

Table 1. Level of importance customer

No	Indicator	Mean ± SD	Sequence of Importance	Level of Importance
1	Sensor type	3.37 ± 0.63	3	3
2	Tool weight	3.63 ± 0.49	2	4
3	Material economic life	3.29 ± 0.69	5	3
4	Color variations	3.24 ± 0.63	8	3
5	Ease of use of the tool	3.13 ± 0.58	9	3
6	Material selection	3.26 ± 0.64	6	3
7	Size variations	3.11 ± 0.56	10	3
8	Material strength	3.34 ± 0.58	4	3
9	Ease of operating the tool	3.26 ± 0.45	7	3
10	Tool multifunctionality	2.95 ± 0.73	11	3
11	Choice of tool shape	3.76 ± 0.43	1	4

Based on Table 1, the results show that the highest order of user importance is the choice of tool shape, with a mean value of 3.76 ± 0.43, and the lowest is multifunctional tools, with a mean value of 2.95 ± 0.73.

b. Customer Satisfaction Performance

Measuring consumer satisfaction with a product aims to assess how well the product meets user expectations and needs after it has been utilized. This evaluation provides valuable insights into the overall user experience, identifying strengths and areas for improvement, ultimately guiding future enhancements and ensuring that the product aligns with consumer preferences.

Table 2. Customer satisfaction performance

No	Indicator	Mean ± SD	Total score	Satisfaction performance
1	Sensor type	3.58 ± 0.55	136	3.58
2	Tool weight	3.66 ± 0.48	139	3.66
3	Material economic life	3.50 ± 0.60	133	3.50
4	Color variations	3.34 ± 0.71	127	3.34
5	Ease of use of the tool	3.47 ± 0.51	132	3.47
6	Material selection	3.39 ± 0.50	129	3.39
7	Size variations	3.55 ± 0.60	135	3.55
8	Material strength	3.63 ± 0.54	138	3.63
9	Ease of operating the tool	3.50 ± 0.51	133	3.50
10	Tool multifunctionality	3.24 ± 0.63	123	3.24
11	Choice of tool shape	3.79 ± 0.41	144	3.79

c. Determining the Target Value (Goal)

Determining engineering characteristic targets is very important to control the production process. Even though in the implementation of the production process, adjustments often occur, they are still standardized at certain value intervals to ensure that variations that occur are within the predetermined range. In this study, the target values are as in Table 2.

Table 3. Target value (goal)

No	Indicator	Goal
1	Sensor type	3
2	Tool weight	3
3	Material economic life	4
4	Color variations	4
5	Ease of use of the tool	3
6	Material selection	3
7	Size variations	3
8	Material strength	4
9	Ease of operating the tool	4
10	Tool multifunctionality	3
11	Choice of tool shape	4

d. Improvement Ratio

The improvement ratio serves as a critical metric that compares the value anticipated by the producer with the actual level of consumer satisfaction regarding a product. This ratio highlights the

discrepancies between expected outcomes and user experiences, providing valuable insights into areas where enhancements are needed.

Table 4. Improvement ratio

No	Indicator	Improvement Ratio
1	Sensor type	0.84
2	Tool weight	0.82
3	Material economic life	1.14
4	Color variations	1.20
5	Ease of use of the tool	0.86
6	Material selection	0.88
7	Size variations	0.84
8	Material strength	1.10
9	Ease of operating the tool	1.14
10	Tool multifunctionality	0.93
11	Choice of tool shape	1.06

From Table 4, it can be seen that the improvement ratio is the largest in the color variations criterion with an improvement ratio value of 1.20.

e. Determining selling point

The selling point is the contribution of consumer needs to the selling power of the product. The value of the selling point is determined by the designer after considering market conditions while conducting research and taking into account the opinions of experts and respondents. So, the assessment of the selling points of the digital target design for slingshot sports is as follows:

Table 5. Selling point

No	Indicator	Selling point
1	Sensor type	1.20
2	Tool weight	1.20
3	Material economic life	1.50
4	Color variations	1.20
5	Ease of use of the tool	1.20
6	Material selection	1.20
7	Size variations	1.20
8	Material strength	1.20
9	Ease of operating the tool	1.20
10	Tool multifunctionality	1.20
11	Choice of tool shape	1.50

The assessment of selling points consists of: 1 = No selling points; 1.2 = Intermediate selling point; 1.5 = Strong selling point

f. Importance Weight

The process of calculating the relative weight is then completed when the importance weight values of each attribute have been determined. The relative weights of these factors aid in setting development priorities based on customer needs.

Table 6. Importance weight

No	Indicator	Satisfaction performance	Goal	Improve-ment Ratio	Selling point	Improve-ment Weight	Relative Weight
1	Sensor type	3.58	3	0.84	1.20	2.51	6.60
2	Tool weight	3.66	3	0.82	1.20	2.46	6.46
3	Material economic life	3.50	4	1.14	1.50	4.57	12.00
4	Color variations	3.34	4	1.20	1.20	4.79	12.57
5	Ease of use of the tool	3.47	3	0.86	1.20	2.59	6.80
6	Material selection	3.39	3	0.88	1.20	2.65	6.96
7	Size variations	3.55	3	0.84	1.20	2.53	6.65
8	Material strength	3.63	4	1.10	1.20	4.41	11.57
9	Ease of Operating the tool	3.50	4	1.14	1.20	4.57	12.00
10	Tool multifunctionality	3.24	3	0.93	1.20	2.78	7.30
11	Choice of tool shape	3.79	4	1.06	1.50	4.22	11.08

Table 6 shows that the 3 main priorities for the quality characteristics of digital-based slingshot target products are Color variations, Material economic life, and Ease of operating the tool.

4. Discussion

Data collection with the QFD method is done by giving a number of questions to the source. The source is a person who is an expert in product design and the accuracy of the digital target product slingshot. From the results of the data collection, 11 attributes of the target digital product slingshot were obtained: sensor type, tool weight, material economic life, color variations, ease of use of the tool, material selection, size variation, material strength, ease of operating the tool, tool multifunctionality, and choice of tool shape (Kusdinar, Pasmawati and Muzakir, 2018).

Product quality pertains to the efficacy of a product in generating advantages for its users. Product quality typically encompasses attributes such as product reliability, efficiency in achieving desired outcomes, and the capacity to be improved or updated to minimize costs. These attributes contribute to the overall value and benefits provided by the product (Lina, 2018). Based on the weight of relative importance, the attribute priority results are Color variations (12.57), Material economic life (12), Ease of Operating the tool (12), Material strength (11.57), Choice of tool shape (11.08). The perception of color is the most delicate aspect of human visual perception. The incorporation of user experience and color design is crucial in establishing a favorable outlook across several domains. In order to showcase the visual appeal of a successful product, the strategic utilization of colors and shapes will effectively captivate the attention of consumers on a psychological level. Color language has a provocative impact on the desired emotions of the buyer. The effects of colors can vary significantly in certain circumstances, both in terms of psychological and physiological aspects (Odillia, 2022; Srivastava *et al.*, 2022).

Material economic life is the measurement of the durability of a product that covers both economic and technical aspects. Technically, the duration of the product is defined as the amount of usefulness gained by a person before the loss of quality. Economically, durability is defined as the economic age of a product seen through the amount of usefulness gained before damage occurred and the decision to replace the product. (Sun, Bellezza and Paharia, 2021; Mesa *et al.*, 2022). The circular economy pertains to the process of reusing commodities and materials through various methods, including product-level reuse (such as repair and refurbishment), component-level reuse (such as remanufacturing), and material-level reuse (such as recycling) (van Loon, Diener and Harris, 2021). Consumers hope that materials that are more durable and do not break quickly will reduce the cost of repairing tools or even replacing digital tools that target slingshot, so they can save on their budget.

Following the consideration of color variations and material durability, the next factor to be assessed is the tool's simplicity of operation. The users emphasized that the operational simplicity of the digital target slingshot is a top priority for them. Make sure that this digital equipment's malfunctioning operation won't cause the user any inconvenience. Zehir and Nacikara (2006) asserts that fulfillment, customer service, personalization, usability, experiential/atmospheric factors, ease of use, informativeness, selection, and security/privacy are fundamental aspects of service quality (Zehir and Narcıkara, 2016). Ease of use is defined as a degree or condition in which one is convinced that using a particular system does not require any effort or, in other words, the technology can be easily understood by the user. Ease of use refers to the degree to which information technology is considered to be straightforward and user-friendly. While individual approaches to utilizing technology may vary, it is typically important for a service to be easily applicable to users without requiring excessive effort in order to prevent public rejection of the established service. The degree of utilization and engagement between the consumer and the system can also serve as an indicator of the quality of user-friendliness (Gu, Lee and Suh, 2009). The convenience indicator, according to Yogananda and Dirgantara (2017), is: (1) Easy to learn, which means that technology is easy to learn so that users can easily understand a device or application program. (2) Easy to use, meaning that easy-to-use technology shows the capabilities possessed by devices or applications that are easy to operate and have other abilities that make users feel comfortable using them. (3) Easy to access, meaning technology is easily accessible by users who want to use devices or programs on such applications (Yogananda and Dirgantara, 2017). These indicators can be used as guidelines for creating a user-friendly digital target slingshot tool.

The next priority attribute is the material strength of the product material. The process of selecting materials and designing a product are interconnected aspects in the development of any cost-effective and competitive product. Without understanding the significance of material selection in design, it becomes challenging to choose suitable materials for any product design (Maleque and Salit, 2013). Material strength is the capacity of a substance to withstand external forces without fracturing or deforming. The ultimate strength of a material refers to the utmost stress it can endure before undergoing destructive failure (Murugan, 2020). The slingshot target frame is made of solid iron and aluminum. It is expected that the base material is sturdy and durable so that the user is comfortable and not afraid of rapid damage or fragility.

The last priority attribute is the choice of tool shape. One thing to pay attention to in order to improve the quality of the product is the raw material. According to Sulaiman and Nanda (2015), raw material is something that is used to make finished goods; the material must stick to the finished product. In a company, raw materials have a very important meaning because they have become the capital of the production process until the output of production (Sulaiman and Nanda, 2015). Slingshot target raw materials are made of rubber material that is resistant to slingshot bullets. Besides, the material is also sensitive to bullets, so it directly, in real time, gives a response to the achievement of scores by slingshot players.

5. Conclusion and Recommendation

To choose the requirements for utilizing a digital slingshot target tool according to your demands, it is advisable to prioritize qualities such as color variations, material economic life, ease of operation, material strength, and choice of tool shape. The suggestion is to develop a digital slingshot target tool that aligns with its primary objectives in order to effectively cater to the requirements of slingshot sports enthusiasts.

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