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BlueHarvest: Enhancing Indonesian Aquaculture with a Market-Driven UI/UX Design

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Abstract

This research aims to design the user interface (UI) and user experience (UX) of an aquaculture marketplace application to improve the promotion and marketing of Indonesian fishery products through an application called "BlueHarvest". Using the double diamond method, this research explored the needs of expert and non-expert users in the field of aquaculture to create an attractive and intuitive solution. The research started with surveys and interviews to collect in-depth data visualized in empathy maps and user journeys, which revealed key user-centric features such as a dynamic price dashboard to know real-time market trends, a pond monitoring system to help fishermen and buyers, and offering articles on aquaculture as well as aquaculture product recommendations. Usability testing results showed that the app design was generally easy to understand, although there were some suggestions to improve the icons, layout and search filter features. These findings indicate that the applied design approach successfully built a solid user experience foundation, although further refinements are needed for optimal usability.

Keywords: UI/UX, Double Diamond, Marketplace, Aquaculture

1. INTRODUCTION

The fisheries and aquaculture industry plays a critical role in ensuring global food security, supporting nutrition, fostering trade, and driving economic growth, particularly in developing countries like Indonesia [1]. However, the sector faces persistent challenges in meeting the growing demand for animal protein due to population growth and other constraints. For instance, Indonesia, the world's second-largest fishery producer, experienced a decline in production from 14.6 million tons in 2019 to lower figures in subsequent years, highlighting the need for innovative solutions to revitalize the sector [2],[3]. Small-scale fishermen and farmers, who form the backbone of the industry, struggle with limited market access, unfair pricing, and insufficient technological adoption, leaving many unable to meet their daily needs or scale their operations[4],[5]. These challenges are further exacerbated by a lack of investment opportunities and collaboration among stakeholders, hindering the sector's potential for economic growth and sustainability[6].

Previous research has highlighted the critical role of aquaculture in economic development and welfare improvement, particularly in developing nations [7]. Studies have also emphasized the need for technological innovation and improved market access to address the challenges faced by small-scale fishermen and farmers [8]. For example, the Food and Agriculture Organization (FAO) reported that global aquaculture production reached 87.5 million tons in 2020, demonstrating the sector's resilience even during the COVID-19 pandemic [2]. However, despite this growth, gaps remain in effectively marketing and distributing aquaculture products, particularly for small-scale producers who lack the resources to compete in broader markets [1],[3]. Additionally, limited promotional efforts and investment opportunities have been identified as key barriers to the sector's growth and sustainability [7].

This study positions itself as an innovative solution to address the gaps identified in previous research by proposing the development of "BlueHarvest," a user-centric aquaculture marketplace application. Unlike existing solutions, BlueHarvest not only connects fishermen and buyers but also introduces an investment feature that enables entrepreneurs to collaborate with fishermen by investing in aquaculture ponds. This dual approach aims to empower fishermen by expanding their market reach and providing access to fair pricing, while simultaneously fostering economic growth and sustainability through increased investment opportunities [5],[7]. By leveraging technology, BlueHarvest seeks to address key challenges such as market access, fair pricing, and investment gaps, ultimately contributing to increased production, improved welfare for fishermen, and enhanced food security in Indonesia.

The importance of this research lies in its potential to transform the aquaculture industry in Indonesia and similar developing countries. By providing a platform that bridges the gap between fishermen, buyers, and investors, BlueHarvest can significantly improve the livelihoods of small-scale fishermen, enhance market efficiency, and promote sustainable economic growth. Furthermore, the app's innovative investment feature has the potential to attract new capital into the sector, driving productivity and innovation. Ultimately, this research contributes to the broader goals of ensuring food security, reducing poverty, and fostering sustainable development in the aquaculture industry.

2. METHODS

2.1 User Interface

User Interface (UI) is a component in an application system or software that acts as a bridge between the user and the system, allowing the user to understand and run the application according to its function [9],[10]. This display focuses on how

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the application's visual appearance can make it easier for users to navigate and access the features provided [11], [12]. The UI consists of various visual elements that are arranged in such a way as to support the overall user experience, such as icons, menus, buttons, text, images, and colour choices [9],[10].

2.2 User Experience

User Experience (UX) is an aspect that refers to how the user's overall experience is in using an application or product, which includes emotional responses, perceptions of convenience, usefulness, and practicality of the application in supporting user goals [13], [14]. UX is not just about appearance but also how the application provides comfort and ease of use [15],[16]. Important elements in UX include several main aspect [13].

2.3 Double Diamond

Double Diamond is a design method developed by the British Design Council in 2005, which is rooted in the design thinking approach to understanding and solving problems effectively through structured stages in the design process [17]. This method is called "Double Diamond" because the process forms two diamonds, which describe the two main phases in design: problem exploration and solution completion [12],[18]. Double Diamond consists of four main stages: discover, define, develop, and deliver [19]. The method applied in this study is the double diamond method, which focuses on the in-depth exploration process of users [19]. Double diamond consists of four main stages, namely discover, define, develop, and deliver [11], [12],[15],[17]. This method allows researchers to comprehensively understand complex problems to produce innovative and measurable solutions [11],[19].

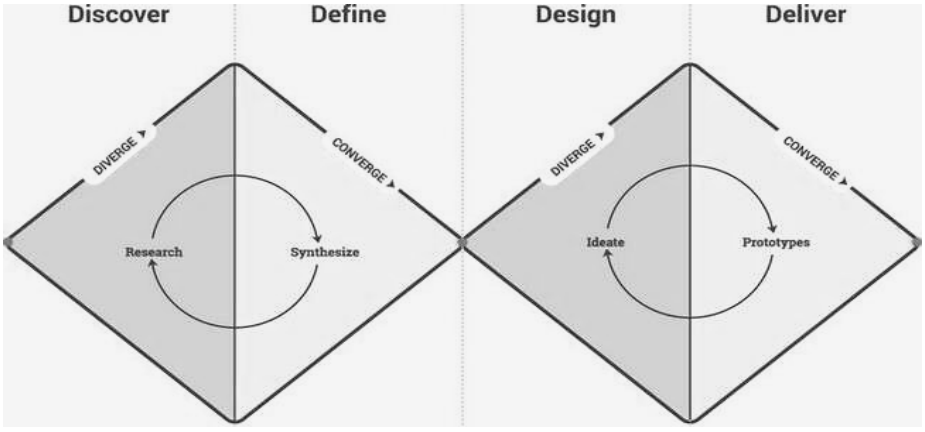

Figure 1. Double Diamond Method Stages

The research method used in designing the BlueHarvest Marketplace is the Double Diamond method, which consists of four main stages: Discover, Define, Design, and Deliver. As shown in Figure 1, each stage has a specific focus, ranging from the exploration of user needs and challenges to the development of a definitive solution. This diagram provides a visual guide to the iterative process flow that allows researchers to identify problems in depth before designing and delivering relevant solutions.

2.3.1 Discover

In the Discover stage, researchers conduct direct observation of users to identify their needs, behaviors, and challenges in the context of aquaculture[12]. Researchers also conduct in-depth interviews with users to explore further the specific problems they experience [12]. Data collected from interviews and observations are then analyzed thoroughly to identify and map the main problems that arise so that researchers gain a clearer understanding of the barriers faced by users in the aquaculture market [17].

2.3.2 Define

The Define stage aims to organize the data collected in the previous stage into a more focused and clear understanding [9],[12]. In this stage, researchers use techniques such as creating user personas, journey maps, and problem statements to formulate the challenges users face [17],[20]. Through this compilation, researchers can determine specific design objectives, which will guide the development of solutions to solve users' main problems [17].

2.3.3 Develop

The Develop stage is where creative ideas that emerge in the Define stage begin to be realized into potential solutions [12]. In this stage, researchers brainstorm and use a mind map to produce relevant concepts [17]. After various concepts are formulated, the most appropriate concept is selected to be further developed into a prototype, such as a wireframe and mockup [19]. This stage allows researchers to visualize ideas and refine designs through iterations so that the resulting solution aligns more with user needs and preferences [12].

2.3.4 Deliver

The Deliver stage is the final stage in the double diamond process, where the solution that has been developed is prepared to be implemented and introduced to users [12]. This process includes the production stage, launch, and evaluation

of the impact of the implemented solution [17]. At this stage, researchers can measure the success of the resulting solution and ensure that the solution provides ongoing benefits to users and can adapt to needs that may develop [19].

2.3.5 Usability Testing

Usability Testing is an evaluation method used to assess the user experience of a product, be it a website or application [16]. The primary purpose of usability testing is to measure how easily users can understand and complete tasks in the application [18],[21]. This testing helps the development team determine whether the product meets user needs or needs improvement [22]. Preparation for usability testing includes determining target users, selecting evaluation metrics, compiling test scenarios, creating prototypes, selecting an evaluation team, and preparing the team that will observe usability testing [17],[23].

3. RESULTS AND DISCUSSION

3.1. Discover

The researcher surveyed two different groups of informants: expert informants who understand aquaculture very well and non-expert informants who do not understand the field. Next, we interviewed the respondents to get more in-depth answers through an online interview session with 5 questions for each of the 2 groups of informants. This data collection method utilizes spreadsheets of the interview results. The researcher obtained interview results from the 2 groups of informants and generated the interview data shown in Table 1 and Table 2.

Table 1. Results of interviews with non-expert aquaculture

NO	Name	Questions	Answers
1.	Person 1	Do you know what aquaculture?	I've heard, aquaculture is similar to animal husbandry but for aquatic animals such as fish, and the place can be in the sea, rivers, and artificial ponds.
2.	Person 2	Do you have experience in the field of aquaculture. If not, are you interested in entering the aquaculture field in the future?	I don't have any experience there yet, but if the interest is not yet and there are still other businesses if it is still a long way to go into that field.

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3.	Person 3	Do you think there is a need for an application that manages aquaculture?	Aquaculture apps are important for improving the efficiency and sustainability of farmers' businesses, with benefits such as monitoring fish health, managing feed, controlling water quality, marketing products, and providing farming information.
4.	Person 4	What features do you need for the application?	Aquaculture apps can provide features such as fish/shrimp health monitoring, feed management, water quality control, product marketing, and access to aquaculture information to support farmers' business efficiency and sustainability.
5.	Person 5	If, we create an aquaculture app. Would you use it to buy aquaculture products that are available? What are your suggestions and expectations for the app?	I would use an aquaculture app if it were available, hoping that it would be easy to use, provide accurate information, be widely accessible, support buyers and fishers, and have good customer service, so as to increase yields, income, and global food security.

Table 2. Results of interviews with expert aquaculture

NO	Name	Questions	Answers
1.	Person 1	Do you know what aquaculture?	Aquaculture is the practice of cultivating aquatic organisms such as fish, shellfish, shrimp, in controlled environments such as ponds, tanks, or cages.
2.	Person 2	What has been your biggest challenge in managing aquaculture?	The biggest challenges in managing aquaculture vary widely, but common ones are water quality, disease control, proper feed, environmental monitoring, waste management, and market and economic factors.
3.	Person 3	What do you need to help you overcome these challenges?	I usually look for articles on the internet about the fish I am cultivating, to overcome health problems. And for the quality of the water environment, I usually discuss or ask someone who has cultivated

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			the same fish as I have cultivated to find solutions for managing the quality of the water environment.
4.	Person 4	Have you tried any specific solutions or technologies to overcome these challenges before?	Some of the solutions or technologies used to overcome challenges in aquaculture are using fish vaccination to prevent diseases, and more efficient use of feed.
5.	Person 5	What types of fish or aquaculture organisms do you manage, and what makes them different in terms of maintenance and cultivation?	I farm on land, cultivate catfish, catfish are not susceptible to disease because of their strong immune system, water changes are rarely done. Change the water once a month, e.g. harvest every 3 months/300 fish. If the number of fish is larger, then the water changes more often. Feed is relatively cheap, e.g. pur, pellets, small shrimp.

The data obtained from the interviews, as listed in Table 1 and Table 2, were further processed and presented in the form of empathy maps to provide a clearer and more in-depth picture of the perspectives, needs, and challenges faced by respondents, as shown in Figure 2 and Figure 3.

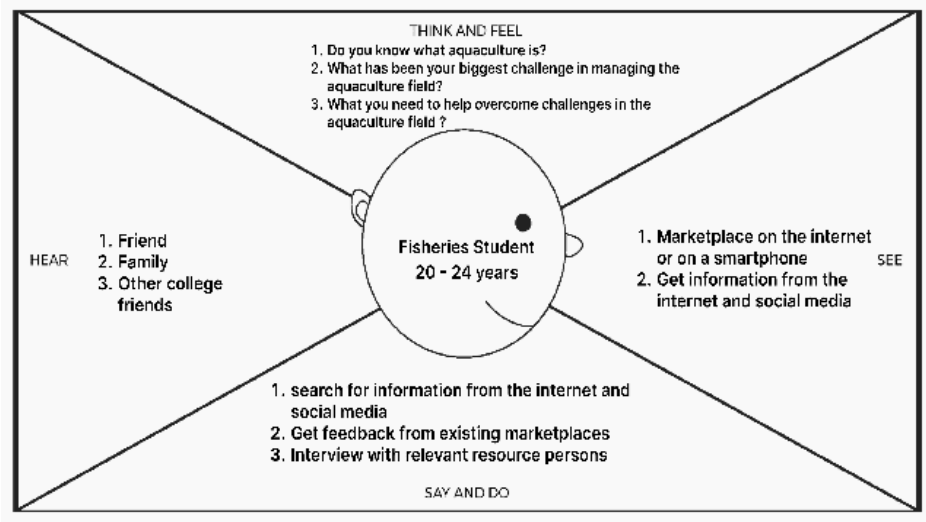

Figure 2. Empathy map from expert

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Furthermore, interview data obtained from non-expert respondents was processed in depth to identify patterns, needs, and challenges often faced by users with a limited level of understanding of aquaculture.

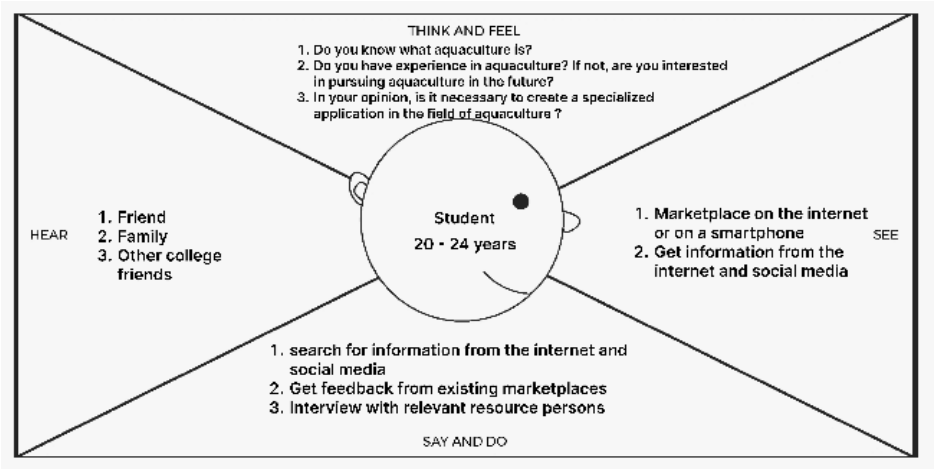

Figure 3. Empathy map from non-expert

Based on the results of the interviews that have been conducted, the author summarizes the various activities carried out by users, then illustrates the series of activities in the form of a user journey to provide a more comprehensive understanding of the user experience, as can be seen in detail in Figure 4 and Figure 5.

Figure 4. User Journey

Figure 5. User Journey

Expert informants needed detailed information about aquaculture product specifications, such as water quality, feed type, and cultivation environment conditions. On the other hand, non-expert informants expressed difficulty in understanding technical terms and wanted a more straightforward and informative display. In the Define stage, these needs were translated into an initial design that included concise but informative product description features and visual aids to facilitate understanding for non-experts.

3.2. Define

At this stage, respondents are carefully selected to ensure proper representation of the target users. The user experience was understood in depth through in-depth interviews, observations, and data collection, so that information about user needs, challenges, and expectations could be clearly identified. Based on the interviews, the authors developed user personas consisting of two main profiles: an expert and a non-expert. These personas were designed to reflect different user characteristics, goals, and behaviors, as illustrated in Figure 5 and Figure 6.

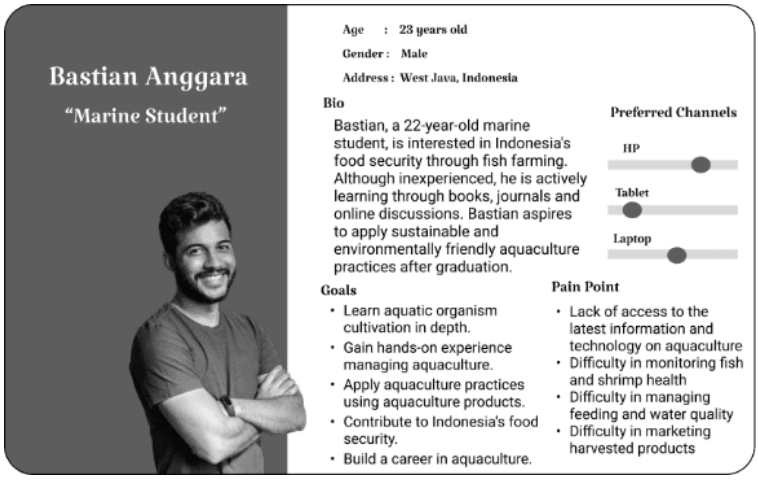

Figure 5. User Persona (Expert)

Next, a user persona was created for Amirah, a non-expert student with limited understanding of aquaculture, based on the interview data to design a user-friendly and beginner-friendly solution.

Figure 6. User Persona (Non-expert)

3.3. Develop

At this stage, researchers focus on designing ideas and solutions based on respondents' needs through brainstorming sessions. The ideas were outlined in the form of a flow chart to facilitate the development of the application prototype.

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This designed flow produces a navigation diagram that displays the features that need to be in the application. The diagram is a flowchart as shown in Figures 7.

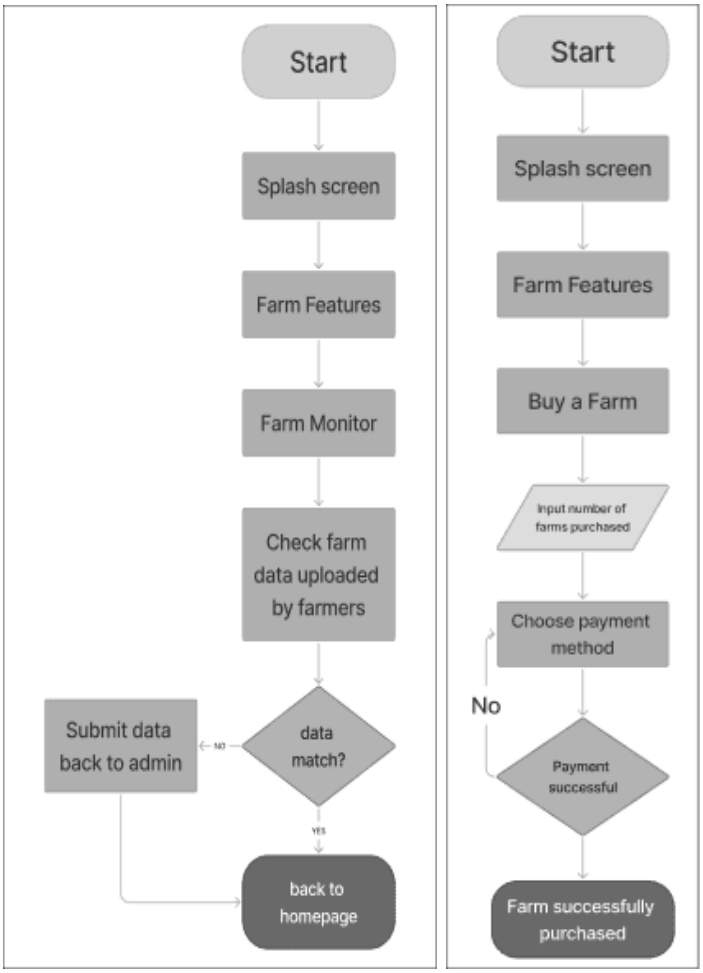

Figure 7. Task flow

Figure 7 is the collection and analysis of pond condition data, such as water quality and fish health, for early detection of problems called pond monitoring. Meanwhile, the farm purchase task flow includes site identification, legality checking, price negotiation, and transaction completion. Both processes ensure efficient and transparent farm management. Next, the researcher created a wireframe as the initial design of the application display, which was then developed in more detail into a medium fidelity form as shown in figure 8. After that, a mockup was prepared to provide an overview of the appearance, function, and user interaction with the aquaculture product.

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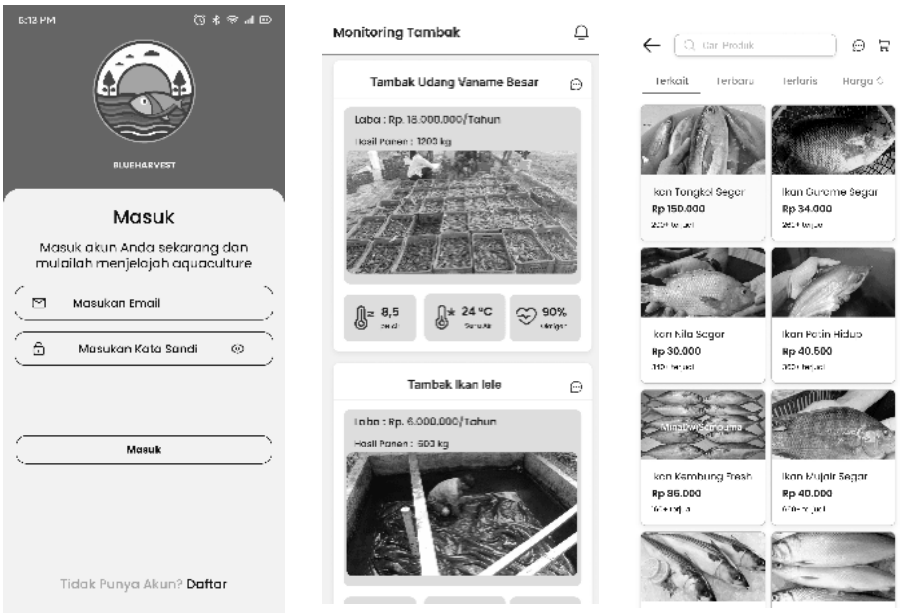

Figure 8. Mockup Blueharvest

Figure 8 is the login view of the BlueHarvest application. Then, the pond monitoring display that can be accessed by users with water monitoring features, temperature, and also product conditions. Finally, the display of aquaculture products that can be purchased by users of the BlueHarvest application. Brainstorming sessions and flowchart analysis resulted in more user-friendly design changes, including navigation improvements and clear helper icons. The navigation diagram was updated with a more engaging flow, and a wireframe was created that included important elements desired by users.

3.4 Deliver

In the deliver stage, usability testing was conducted by asking users to follow directions to evaluate how easy the BlueHarvest application prototype was to use. This testing used software maze to test the application's functionality and interactivity. Five sources with different backgrounds provided input on the application's user interface, navigation, and performance. The findings will be the basis for further improvements and refinements to the prototype. The following is the data collected from these sources.

1) Person 1: 20 years old, a student who does not understand the field of aquaculture
2) Person 2: 21 years old, a student who does not understand the field of aquaculture

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3) Person 3: 21 years old, a student who understands the field of aquaculture
4) Person 4: 20 years old, a student who understands the field of aquaculture
5) Person 5: 20 years old, a student who does not understand the field of aquaculture

The results of the suggestions and input from the five resource persons obtained were:

1) The majority of sources consider the marketplace display to be relatively easy to understand but still needs improvement, especially on icons or buttons that are less informative.
2) Sources generally like an attractive appearance but suggest improvements to the layout and text contrast to make it more comfortable.
3) The transaction feature is relatively easy to understand, but there are complaints about the limited number of payment methods.
4) Mobile phones' display is quite responsive, but some elements, such as text size and layout, need to be adjusted to be more comfortable.
5) The search feature works well; there are suggestions to improve the filter feature to be more specific, such as filtering by product type, location, and number of products.

Usability testing revealed that most users completed the given task without problems, although some had difficulty finding the more specific filter feature. Suggestions include improving the filter icon, adding product categories, and adjusting the color contrast to make it more comfortable. These findings indicate that although the application design is relatively easy to understand, some aspects still need to be improved to improve the overall user experience.

3.4. Usability Testing

In the Maze software, there are calculations to determine the usability score, which includes three formulas:

1. Screen Usability Score (SCUS),
2. Mission Usability Score (MIUS), and
3. Maze Usability Score (MAUS).

Testing has been conducted on five persons to obtain data on an interface that is effective, efficient, and satisfying for its users. The following is the data obtained from the testing results of the BlueHarvest application.

3.4.1 Screen Usability Score (SCUS

Table 3 presents the results of usability testing conducted on three different screens: Login, Application Product Purchase, and Pond Purchase and

Monitoring. On the Login screen, users took an average of 7 seconds to complete the task, with a miss click rate of 11%, resulting in a usability score of 89. For the Application Product Purchase screen, the average task completion time increased to 18 seconds, with a miss click rate of 15%, and the usability score dropped to 86. The Pond Purchase and Monitoring screen required the longest time, averaging 20 seconds, with the highest miss click rate of 21%, and the lowest usability score of 83. These results indicate that as tasks become more complex, the likelihood of missed clicks increases, and the time required to complete tasks also rises. This suggests a need for further optimization, particularly on the Pond Purchase and Monitoring screen, to enhance the user experience.

Table 3. Usability Testing

Screen	Avg Time	Mis click rate	Usability Score
Login	7s	11%	89
Purchase of Application Products	18s	15%	86
Pond Purchase and Monitoring	20s	21%	83

3.4.2. Mission Usability Score (MIUS)

The test of MIUS in Figure 8 shows that 89% of users successfully completed the task. The average task completion time was 7 seconds. Although this shows that users can complete the task, the occurrence of 11.18% of miss clicks indicates that there may be design elements that slow down the process. There needs to be optimization on the login page.

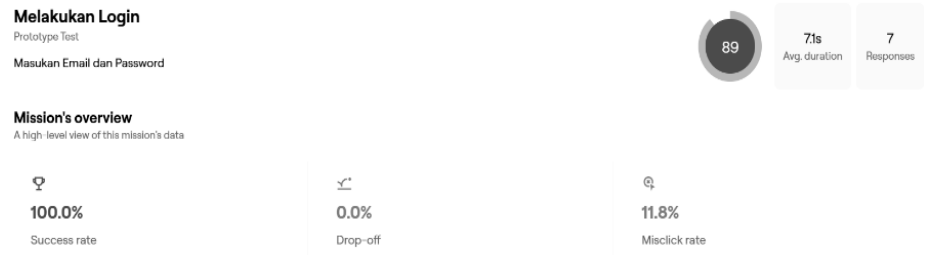

Figure 8. Mission Usability Score (MIUS) Login

The test of MIUS in Figure 9 shows that 86% of users completed the task successfully, with an average time of 20 seconds. However, 15% miss-clicks indicate potential design inefficiencies on the product purchase page, suggesting a need for optimization to improve usability.

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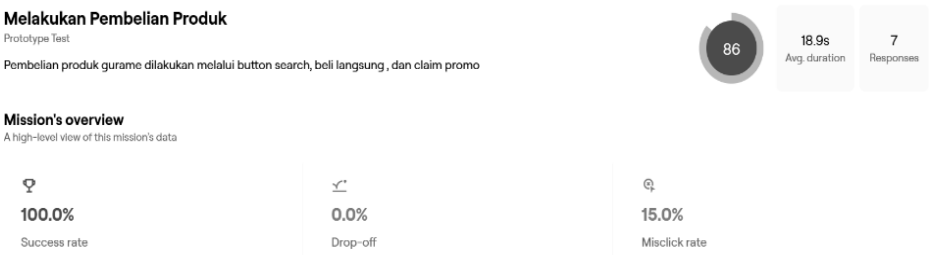

Figure 9. Mission Usability Score (MIUS) Product Purchase

Figure 10 demonstrates that 83% of users were able to complete the task successfully, averaging 20 seconds per task. Nonetheless, the 21% miss-click rate suggests usability issues in the design of the product purchase page, emphasizing the need for further optimization.

Figure 10. Mission Usability Score (MIUS) Pond Purchase and Monitoring

3.4.3. Maze Usability Score (MAUS)

Figure 11 shows usability testing results for the BlueHarvest app using Maze, with an overall score of 86, indicating high user satisfaction. The test included 7 responses and 6 blocks, reflecting the app's effectiveness in task completion. This data helps identify areas for improvement to enhance user experience and support the app's goal of aiding small-scale fishermen and farmers.

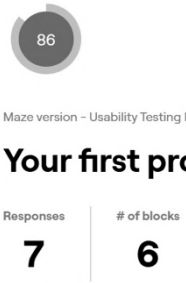

Figure 11. Maze Usability Score (MAUS) BlueHarvest App

3.6 Discussion

This study employs the Double Diamond framework in combination with usability testing to evaluate the design and functionality of the BlueHarvest application. The Double Diamond approach, structured into four key phases—Discovery, Definition, Development, and Delivery—ensures a systematic research process that balances exploration and refinement. This method provides a comprehensive understanding of user needs while allowing for iterative design improvements based on real-world feedback.

The usability testing results indicate a clear relationship between task complexity, interface design, and user efficiency. The Login screen, which involves a straightforward process with minimal interaction points, received the highest usability score. This suggests that clear visual hierarchy, simple navigation, and familiar design patterns contribute significantly to usability. However, as tasks become more complex, such as those on the Application Product Purchase and Pond Purchase and Monitoring screens, usability scores decline. This can be attributed to an increase in cognitive load, the need for multiple interactions, and a higher potential for user errors.

A key factor affecting usability is miss-click rate, which tends to increase as task complexity grows. This pattern suggests that elements such as button placement, icon clarity, and interaction flow may not be fully optimized for intuitive use. A 21% miss-click rate on the Pond Purchase and Monitoring screen indicates that users likely experience difficulty in identifying or selecting the correct actions, which may be due to crowded layouts, ambiguous labeling, or insufficient feedback mechanisms when performing tasks.

Another issue contributing to lower usability scores in complex tasks is task completion time. While users completed simpler tasks, such as logging in, within seconds, more intricate tasks took significantly longer. This extended duration is often linked to unclear workflows, inefficient navigation, or a lack of predictive assistance that could guide users more smoothly through the process.

These findings emphasize the importance of progressive disclosure in interface design, where only relevant information and actions are shown at the appropriate time to prevent overwhelming users. Additionally, streamlining the interaction flow, optimizing button sizes and placement, and enhancing visual contrast can help reduce errors and improve efficiency, particularly for screens handling more detailed functionalities.

Moreover, differences in user expertise also play a crucial role in usability outcomes. Expert users, familiar with aquaculture-related concepts, are better

equipped to navigate complex screens, whereas non-expert users may struggle due to technical jargon, unfamiliar terminologies, or lack of contextual guidance. Addressing this gap requires a more user-centered design approach, incorporating tooltips, guided walkthroughs, and simplified explanations to support diverse user groups effectively.

The usability testing results highlight the need for targeted design optimizations to improve task efficiency, error reduction, and overall user satisfaction. Enhancing interface clarity, interaction predictability, and task-flow efficiency will be key to ensuring that the BlueHarvest application meets its objective of supporting small-scale fishermen and farmers with an intuitive and effective digital tool.

4. CONCLUSION

This study designs the UI/UX of the BlueHarvest aquaculture marketplace application using the double diamond method to support the promotion and marketing of Indonesian fishery products. This approach has proven effective in exploring user needs through interviews, creating user personas, and visualizing user experiences through empathy maps and user journeys. This process helps identify the specific needs of expert and non-expert aquaculture users. The design process produces an easy-to-understand application navigation structure with attractive features, such as easy-to-access product information presentation and simple transaction flow. The designed navigation diagram ensures a more organized and efficient user experience. Creating wireframes and mockups also supports creating an attractive and easy-to-understand interface design. The usability testing results show that most users find the application relatively easy to understand and use. However, several areas were found that needed improvement, such as the quality of icons, layout, responsiveness of visual elements on mobile devices, and more specific search filter features. Other inputs include integrating more diverse payment methods to support user convenience. Overall, BlueHarvest meets basic user needs and shows potential for further development, with future enhancements such as AI-based product recommendations, real-time inventory tracking and educational content for non-expert users. Longitudinal studies assessing the app's impact on fishermen's income and market access would also provide valuable insights for sustainable growth, ensuring long-term benefits for both fishermen and consumers.

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