

Interface design features and evaluation of batik 4.0 mobile application

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ABSTRACT

The use of information and communication technology could increase the quantity and quality of small medium enterprises (SME) production, including batik industry. This study focuses on the development of batik 4.0, a custom batik mobile-based interface that makes it easier for customer which can be used to quickly produce high-quality digital batik designs. The findings of this study simplify the ordering process for potential clients who want to acquire custom batik designs. Ease of transactions, namely down payments (DP) where users can make advance payments, so that users are relieved in terms of payment transactions. In designing mobile devices, applications, and user interfaces (UI), it is important to consider the user experience (UX). This paper focuses on UX design rooted in the user-centered design (UCD) approach, placing emphasis on understanding user requirements and prioritizing empathy for users. This ensures the recognition of user needs and the creation of a high-fidelity prototype. Then it was validated by the UI experts to identify problems and user difficulties in interacting with the UI. The experts responded positively towards the application and suggest for prototype improvement. Lastly, UX testing; based on the user experience questionnaire (UEQ)-S benchmark results, the batik 4.0 mobile is included in the "Excellent" category.

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1. INTRODUCTION

The use of mobile application increases the accessibility. In designing mobile devices, applications, and user interfaces (UI), it is important to consider the user experience (UX). Its perspective gains more attention by practitioner and scientist along with the rapid integration of mobile information technology in daily lifestyles, including batik industry sector. UX encompasses the overall effects experienced by users due to their interactions, the context of use, the impact of usability, the emotional resonance during interactions, and the memory formed after the interaction [1], [2]. A crucial aspect of UX involves the manner in which users influence the experience of using a product from their initial encounter [3]. This is defined by ISO 9241-210: 2019 as user perceptions and responses arising from the use of a system, product, or service [4], [5]. UX design plays a significant role in the development of applications by taking into account considerations related to user capabilities and limitations.

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along with the rapid integration of mobile information technology in daily lifestyles. Mobile UI/ UX designs are focus on accessibility and efficiency to optimize these on-the-go interactions [2], [6]. The investigation of user-centered design (UCD) principles and usability guidelines can improve the use of and satisfaction on the design of mobile apps has been investigated in several sectors.

Some of time-critical weather alert apps [7], investigate the UI design principles of mobile Al-Quran apps for senior citizens [8], the design and usability quality metrics evaluation of chromatin immunoprecipitation combined with sequencing (ChIP-seq) web tools [9], a new prototype design for a smartwatch UI [10], the development of a mobile-based UI that makes it easier for farmers to view the data [11], redesigning food delivery application [12], and development of Marine tourism [13]. In the education sector [14]–[16], among others design and development of a simple content management system for learning called the EMasters [17], PAUD monitoring application [18]. In the health sector there are several studies [19]–[21], including developed of the healthy phone is a mobile medical emergency call apps that can help people with hearing impaired when in emergency situations [22].

Several methods were used in the research, including agile development using scrum model integration with UX design process [23]–[27]. The expert (heuristics) was used as a reference for making the UI designs improvement [28]–[30], and UX was evaluated using the user experience questionnaire (UEQ) [31]–[33]. The UEQ, a quantitative tool, can be used to measure the experience that users feel. UEQ is a simple, reliable, and valid method for adding a subjective quality rating to the results of other evaluations [34], [35]. The combination of expert (heuristics) methods and UEQ tool is a novelty in this study, especially in the development of responsive system i.e., adapted to small screens of mobile devices such as laptops, tablets, and smartphones. This paper presents the design and development approach of mobile application of batik 4.0. The existing limitations of the current batik 4.0 web application stem from its design, which is optimized for desktop computers and lacks a simple and user-friendly interface suitable for mobile devices. Due to increase usage of mobile application among mobile phone users, existing batik 4.0 web applications have moved to mobile based applications to cater for increasing numbers of mobile users. Batik 4.0 following online business principles, similar to e-commerce. E-commerce is a transaction activity carried out by consumers with electronic devices connected to the internet [36], [37].

Batik is an Indonesian product that is used all over the world. One of the uniqueness of batik is the production process with specific motifs that are already standard and contemporary, as well as custom batik designs which continues to grow [38], [39]. Online customizations create additional profits and competitive advantages for manufacturing enterprises [40]–[42]. In this customized product, payment processing is critical to any online business and e-commerce [43]. Current condition the payment system, which is still limited currently, payments are typically made only once at the beginning. Therefore, it is essential to enhance the payment strategy's design to enhance the customization experience for batik products. This objective precisely underlies the primary motivation for this paper.

The novelty of this study is simplifying the ordering process for potential customers who want to acquire custom batik design. Ease of transactions, namely cash and down payments (DP) systems where users can make advance payments, so that users are relieved in terms of payment transactions. This research led to the creation of the batik 4.0 mobile, which is a development of the existing batik 4.0 website. Batik 4.0 is software in the form of computer-aided design (CAD) custom batik design and integration of written batik computerized numerical control (CNC) machine used in the production processes. It can quickly produce in high-quality batik designs in a shorter amount of time by using the input of batik characters, features, algorithms, and graphical displays.

2. METHOD

This mobile UI of batik 4.0 was created using UCD approach. UCD places the user at the center of system development, shown in Figure 1. UCD covered by ISO 9241-210: 2010 [4], describes requirements of human-centred design principles and activities that are related to the usage of computer systems.

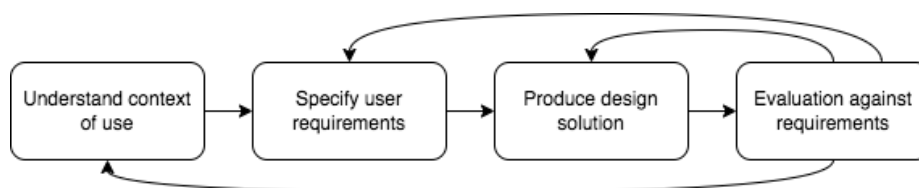


Figure 1. UCD method's stages of design [44]

2.1. Data materials

This paper discusses the creation of a mobile application for batik 4.0. This study comprised 44 respondents, which is consistent with the guidelines from “Usability” by. An expert review heuristic method to review and verify the design of batik 4.0 mobile. The study data was shown in Table 1.

Table 1. Study data

No	Section	Description
1.	Object	Batik 4.0 mobile (development of web browser desktop)
2.	Method	UCD
3.	Instrument	a) Qualitative expert feedback according to heuristics basic principles by Nielsen (2020) b) Quantitative UX testing UEQ-S
4.	Respondent	3 experts review heuristic (UI design, navigation, and interactivity) 44 respondents who are active in using online transactions on mobile
5.	Tools	Figma program to produce a low-level prototype and a high-level prototype Draw. IO for creating diagrams and flowcharts Google forms for questionnaire creation and data collection

2.2. Instruments

In the development phase, we employed an expert review heuristic method to review and verify the design of batik 4.0 mobile. Performing heuristic evaluations in the designs is crucial for gathering insights on usability issues and enhancing interactions and UX to a greater extent. Experts with experienced interface design to review the UI design, navigation, and interactivity, according to the basic principles of heuristics by Nielsen [45] as shown in Table 2.

Items in the short version of the UEQ employ a 7-point Likert scale and includes just eight items, the range of the scales is between -3 (horribly bad) and +3 (extremely good). UX test results using the UEQ-S tool are shown in Table 3. Subsequently, they are processed using the Short_UEQ_Data_Analysis_Tool provided by researchers [34], [46], [47].

Table 2. Basic principles of heuristics by Nielsen [45]

No.	Broad heuristik	No.	Broad heuristik
#1	Visibility of system status	#6	Recognition rather than recall
#2	Match between system and the real world	#7	Flexibility and efficiency of use
#3	User control and freedom	#8	Aesthetic and minimalist design
#4	Consistency and standards	#9	Help users recognize, diagnose, and recover from errors
#5	Error prevention	#10	Help and documentation

Table 3. Items of the short version of the UEQ [46]

Negative	Scale	Positive
obstructive	o o o o o o o o	supportive
complicated	o o o o o o o o	easy
inefficient	o o o o o o o o	efficient
confusing	o o o o o o o o	clear
boring	o o o o o o o o	exciting
not interesting	o o o o o o o o	interesting
conventional	o o o o o o o o	inventive
usual	o o o o o o o o	leading edge

2.3. Procedures

The standard concerns with ways to enhance human-system interaction through usage of interactive computer systems. In the iterative process of design, implementation, and evaluation, several phases are repeated until reaching the final stage where the design solution aligns with user requirements [44]. There are four steps conducted, outlined as follows:

2.3.1. Understand context of use (identification)

First, in the preliminary investigation phase, a review of the literature was done to identify the current situation and issues related to a batik mobile e-commerce, payment system, and customer’s behaviour. The literature analysis is important to ensure that all possible perspectives were considered before designing the prototype. An analytical data analysis of an existing batik 4.0 website was performed to gain

insight into UI/UX, usability, and performance. Explore how the system works so that there are no errors in making changes from website to mobile.

2.3.2. Specify user requirements

In the requirement gathering and analysis phase, user survey, interview, and comparative analysis have been done to get user requirement for designing the application that concentrate on user layout, user flows, and testing with actual users to gather early feedback. The next stage is collecting the required elements such as features and color and appearance designs that can help the process of making a mobile UI design. In the design requirements, the majority of respondents agreed that, for a mobile batik 4.0, the application should be interactive, easy to use, user friendly, and has an appealing interface, payment transactions features, and simple steps for ordering.

2.3.3. Produce design solution (prototyping)

The following step entails developing low-fidelity prototypes or wireframes. Wireframes serves as a blueprint or framework for the layout, structure, and functionality of digital products. Then make high-fidelity prototypes of the potential solutions. This step with finished visual designs and interactions, and thoroughly test these prototypes with consumers. Utilizing the created wireframe, use the online Figma.

2.3.4. Evaluation against requirement (heuristic evaluation and UEQ)

This stage involves testing the system design strategy to determine whether it can adequately address the needs of the user. To find user issues and UI interaction challenges, UX testing is used with low-level or high-level prototypes. To find potential issues, do heuristic analysis of the current UI using predetermined design principles. In this stage, testing are conducted on UI experts and users using UEQ to gather feedback for system development.

3. RESULTS AND DISCUSSION

3.1. User requirement specification

Based off the results of interviews and observations with the respondents of this study, it was found that there are several interface requirements for order processing and payment in batik 4.0 mobile custom batik products, including:

- Payment system for custom products with DP or paid off immediately.
- Has an automation feature for calculating shipping cost and checking payments.
- There is an express checkout feature, price validation/correction is carried out at the final stage so that the order is immediately entered the queue.
- Order tracking feature for both the stages of the production process and the expedition shipping process.
- Notifications about payment invoices and order status.
- Provide ratings and assess the performance of services.
- It has a simple yet informative display so it doesn't take much time to load the interface.
- The order process flow is short and simple, making it easier for users to use.

3.2. Bussiness process payment (user flows)

In general, the process of making orders in the marketplace system is shown in Figure 2. The process includes product selection, checkout, address selection, shipping expeditions, payment systems until the process is complete. In this conventional process, payments are typically made only once at the beginning. This payment model contrasts with more contemporary or alternative approaches, where payment structures may be more varied, allowing for installment payments or other flexible arrangements throughout the duration of the engagement.

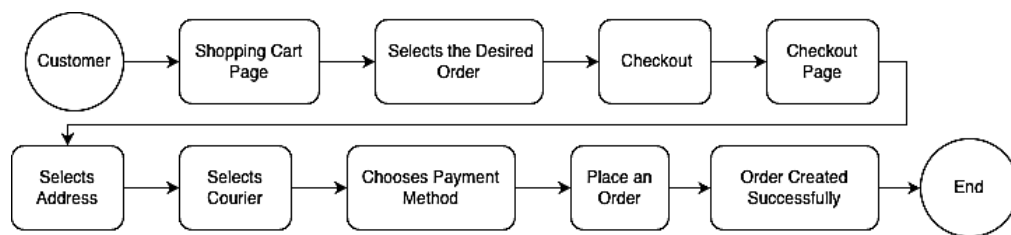


Figure 2. Place an order e-commerce system workflow

The adherence to a single upfront payment in the conventional method may have implications for financial planning, budgeting, and cash flow management for both parties involved in the transaction or contract. The adoption of a more dynamic down payment system can be considered. As a solution, payments could be structured in multiple stages with an initial down payment as the first step. Therefore, necessary to refine its design strategy to improve the batik customization experience.

To clarify the above solution, researcher created a user flow. The user flow serves to understand the sequence of activities that users can perform when using the advance/down payment method. User flows help of identify opportunities to improve UX, as illustrated in Figure 3. The type of conventional payment provided for users in the e-commerce/marketplace system is a paid system (cash 100%), as illustrated in Figure 3(a). In the batik 4.0 mobile, an advance payment prototype was made, where customers can make payments in stages (%), as illustrated in Figure 3(b). This advance payment system will certainly help customers because custom design batik requires a process to make it. Figure 3(c) show innovation mobile payment system workflow (payment bill).

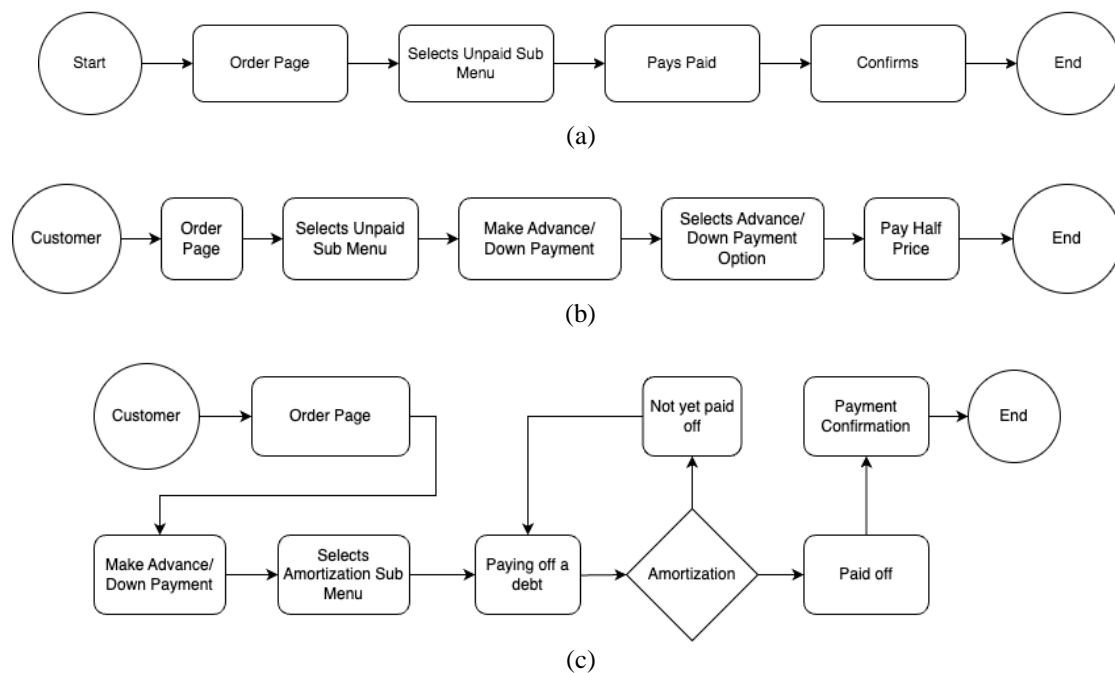


Figure 3. Payment system workflow; (a) conventional mobile payment (cash payment), (b) innovation mobile payment, and (c) innovation mobile payment (payment bill)

3.3. Low fidelity UI design

The wireframe (low fidelity UI design) was made by considering the previous steps. By closely considering the previous steps, the wireframe serves as a tangible and structured blueprint, laying the foundation for the subsequent phases of the UI design, with a focus on UX and interface aesthetics. The wireframe consists of: login page, homepage, design results, cart, order, and profile menu.

3.3.1. Login page

The login page contains 3 sections, the first page displays the logo, then enter the login page and there will be a button to go to the register menu. There is nothing different from the pages on the batik 4.0 website. This stability in design elements could be attributed to a desire for continuity or a deliberate effort to prioritize user familiarity and consistency within the application's interface.

3.3.2. Homepage

There are no modifications to the batik 4.0 mobile UI design's home page. The absence of notable adjustments suggests a deliberate decision to maintain the existing layout, features, or components on the home screen. A strategic choice to preserve a user-friendly experience by avoiding unnecessary disruptions or complexities that might arise from frequent alterations to the home page.

3.3.3. Design results menu

It appears like Figure 4 on the batik 4.0 website. The batik generator method can currently not be utilized on smartphones, but you can make your own batik designs using the design results menu. The sole design option available on the mobile UI is the design results page, which displays a selection of designs created by customers using the web.

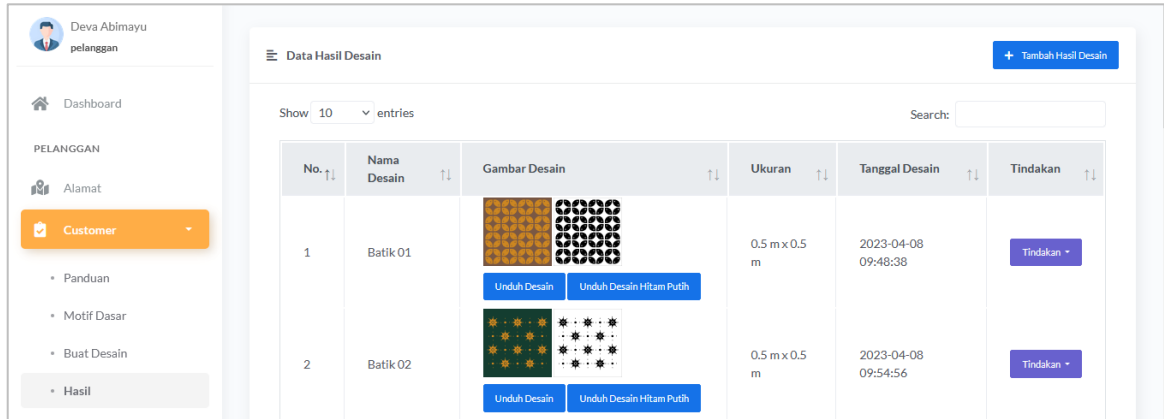


Figure 4. Design results menu-existing customer page

3.3.4. Cart menu

On the cart menu, the design doesn't really change the user flow, which has the same appearance as the basket page on the website. Changes that change the user flow are found in the checkout menu that will appear when a customer selects an item to buy, as shown in Figure 5. These changes are strategically implemented to streamline the UX during the critical phase of completing a purchase, aiming to optimize efficiency and user satisfaction at the checkout stage.



Figure 5. Wireframe of design results, order cart, and profile menu

3.3.5. Order menu

The phases of the batik product's processing are shown on the order menu. There will be unpaid stages, processed stages, packaged stages, sent stages, finished stages, and canceled stages in this menu. As may be seen in Figure 5, the customer's products will thereafter be displayed in detail.

3.3.6. Profile menu

The customer's personal information is shown in the profile menu. This profile menu also includes the page for satisfied customers, which was created on a different page. To help clients learn more about the batik 4.0 mobile, it will also be furnished with general information and references.

3.4. High fidelity UI design

The next step is the building of a high-fidelity prototype with the following outcomes when the low prototyping is finished. This advanced prototype will encompass a higher level of detail, incorporating realistic graphics, precise interactions, and a more accurate depiction of the final product. Additionally, the high-fidelity prototype serves as a valuable tool for user testing and feedback, facilitating a more comprehensive evaluation of the UI before the final implementation phase.

3.4.1. Login page

Login page prototype displays the Butimo logo as a splash screen before displaying the login menu in order to emphasize that Butimo is the proprietor of batik 4.0. The Butimo logo, text fields for password and email, and a login button are all included on the login menu. To access the register menu, click the register text button. The login menu and the register menu look very similar.

3.4.2. Homepage

The homepage prototype includes the customer's name along with their status, as shown in Figure 6. Banners are used to advertise products. Cards (rectangular modules) are made from data such transaction lists, pending orders, design findings, running orders, and include notification. These notifications are strategically incorporated to alert users about specific events, updates, or actions related to their account and ongoing transactions.

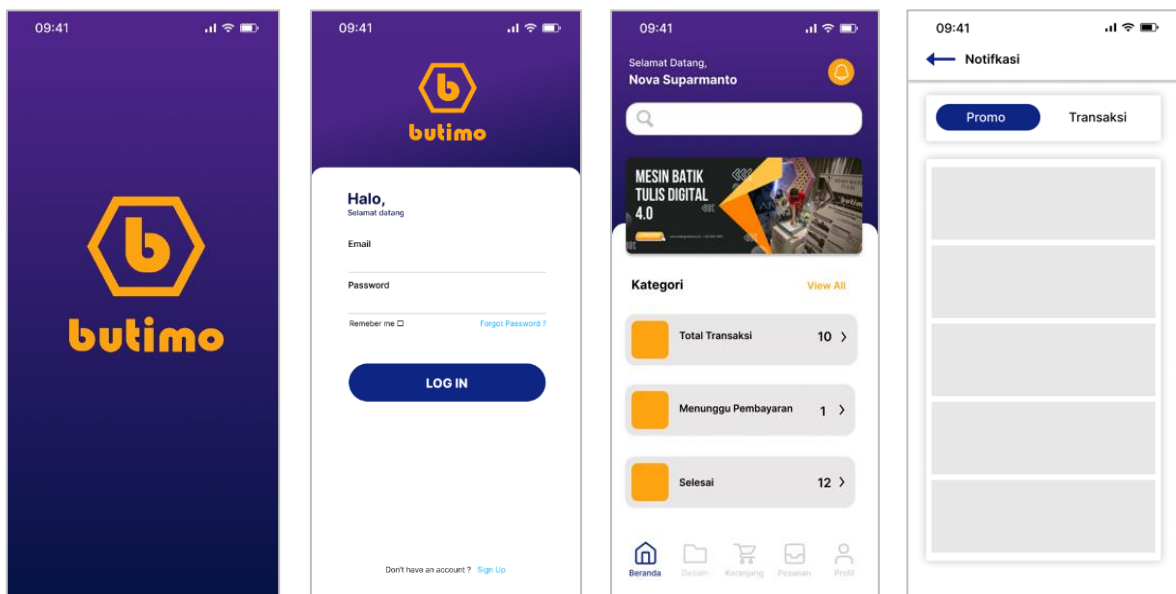


Figure 6. High fidelity splash screen, login page, homepage, and notification

3.4.3. Design menu

When the user selects the design menu, the prototype shown in Figure 7. The prototype shows cards with in-depth descriptions about batik patterns, a search function, and an add button. The design used to create the content of this batik product was created using the website's batik generator. In this prototype, the card may be scrolled to the bottom to reveal the final product of the design. A button that, when touched, will display a pop-up in the shape of a component outlining the order to be made is located on the content card portion of the batik motif. There are radio buttons to choose the material, color, and color technique in this pop-up window, includes a quantity button that allows you to specify how many orders to place. The order information pop-up prototype includes parts for a radio button for the order details and a text button that says "Masukkan Keranjang" to add an order to the cart.

3.4.4. Shopping cart menu

When a user clicks the navigation bar's cart button, the following shows. There are many features, like checkout buttons, price displays on the selected item, quantity and ellipsis buttons on the batik detail cards. The item information and product costs will increase when the user clicks the checkbox button. The user will see a delete button after selecting the ellipsis button. The orders in the shopping cart will be erased when the user clicks the trash can-shaped button, as shown in Figure 7.

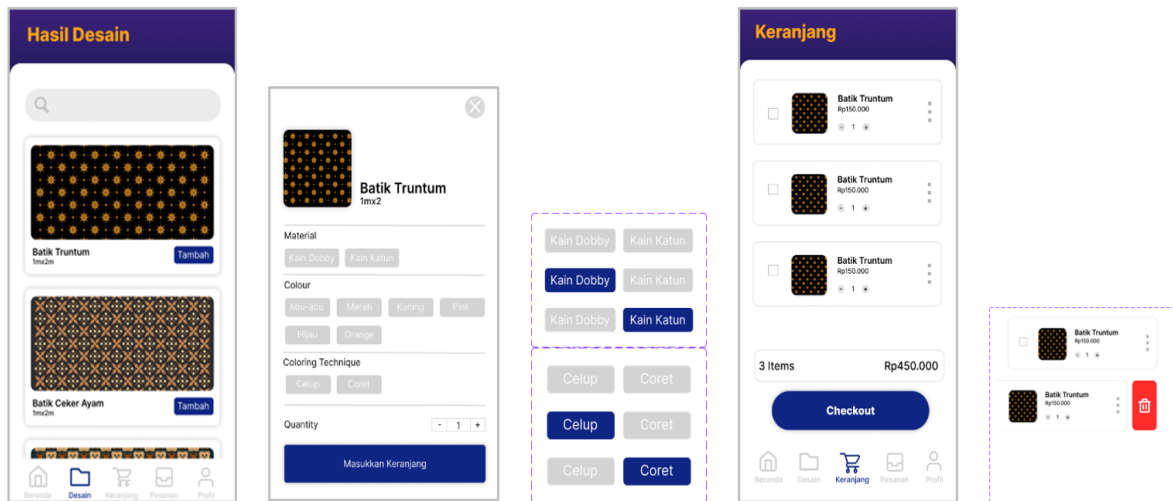


Figure 7. Design menu, order detail pop-up, technique color, shopping cart menu, and delete menu

3.4.5. Checkout

When the user presses the checkout button, a prototype will appear like Figure 8. There are several display features such as addresses, product, shipping couriers, payment methods, order detail, total price, and "Pay" button. Users will be directed to complete data: choosing an address, courier, and payment method. The data that has been entered will be entered on the order detail card in the form of payment details for the ordered product. The accumulated price will be displayed in the total price text. User can press the back button, if doesn't want to continue ordering, then will return to the shopping cart.

- Select address: this prototype will appear when the user presses the button on the shipping address in the previous checkout menu. It will display address data that has been previously entered. Users can select an address by pressing one of the available radio buttons. If the user does not have an address, then the user can add a new address by pressing the add address text button. If the user has chosen the address to go to, then the user can return to the checkout page to complete other data. If users want to edit the address previously entered, the user can press the pencil icon to go to the change address prototype.
- Delivery courier: when the user presses the delivery button a pop-up of delivery options will appear. Users choose which courier to use. There will be a price description and product delivery time, which will later be included in the order details.
- Payment method: this prototype will display several types of payments that are used to accept transactions from customers. When the user has selected and pressed the payment method to be used, the user will return to the checkout menu.

3.4.6. Payment system

The payment system prototype will appear in Figure 9, when the user has completed the data on the checkout menu and pressed the pay button.

- Confirmation payment: when the user presses the pay button on the checkout menu, confirmation payment prototype will appear. The virtual account number or nominal to be paid can be copied using the copy icon on the payment method card, making it simpler for users to input data during payment operations. Users will have the option of direct payments or down payments in the payment prototype.
- Order details: the order details option will appear when the user views the information on the payment method card. The user (buyer) must confirm that the order has been received by clicking the done button, which also serves as a confirmation of the purchase price that must be paid.

- Tracking: the track button will be active when the payment has been completed. Tracking prototype will display a shipping card containing the receipt number and other details, product tracking. In this prototype, the user can monitor the position and location of the ordered product.

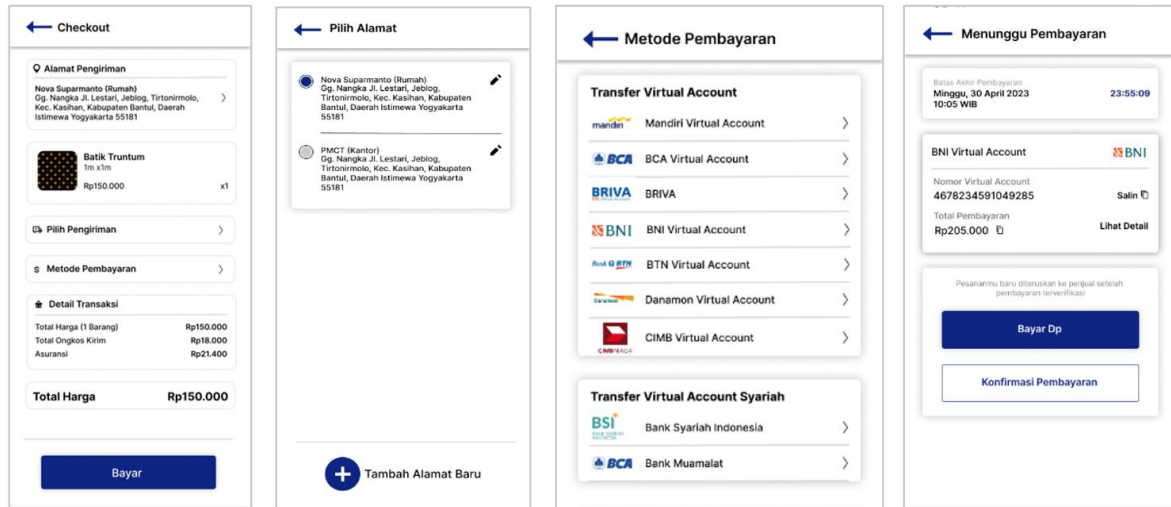


Figure 8. High fidelity of checkout, select address, payment methods, and confirmation payment

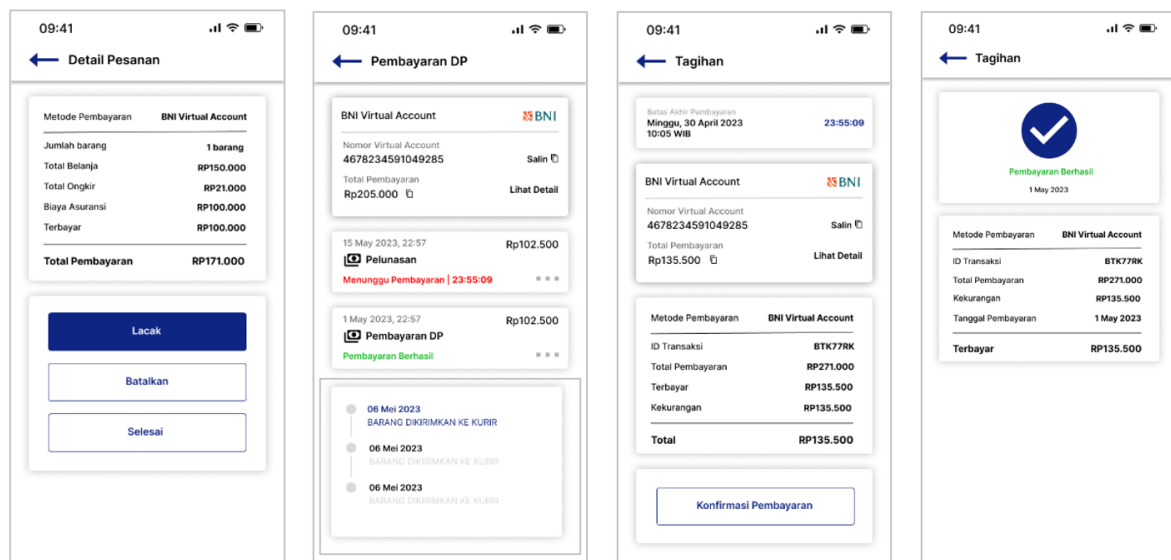


Figure 9. High fidelity of order details, tracking, paid billing, payments, and billing

3.4.7. DP menu

As illustrated in Figure 9, the created mobile UI includes a system that allows users to make down payments, which relieves them of the burden of handling payment transactions.

- DP payment: a prototype of the user's chosen DP payment will appear when they pick and press it from the waiting for payment menu. The user of this prototype will be able to see the inadequacies and payments that have been made; there is also an impending deadline for payments.
- Billing: includes the due date, payment details, underpayment card, and a payment confirmation button will appear when the user presses the billing card.
- Paid billing: a paid billing prototype will appear when the user taps the paid bill card. This prototype show payment time card, detail card, and underpayment card.

3.4.8. Order menu

Prototype order menu as in Figure 10 will be displayed after the customer presses the order menu in the menu bar. In this order menu, any product description process changes will be displayed. Users can do tracking by pressing and selecting the button you want to display. The processes contained in the order menu include: unpaid, processed, packed, shipped, completed, and cancelled. In each process, a product detail card will be displayed in what part of the process. If a product is being packed, product details will appear when the customer presses the packed button. The order button component was made to only display 4 processes so that horizontal scrolling was made on this order button component. Prototype production sub menu will be displayed after the user presses the produced button. This prototype displays the details of the product purchased and the details button.

3.4.9. Profile menu

Profile menu prototype in Figure 10 appears when the user presses and selects menu profile on the menu bar. This prototype displays profile text, identity cards, address cards, general information cards, and preference cards. This profile menu was made by developing from a wireframe. Users can manage personal data through this menu. This prototype is divided into 4 data sections, data that can be processed as follows.

- Personal data: this prototype displays data from the fields during account registration. In the personal data menu, the user can change the name, email, number and password in the available text fields. After the user replaces one of the data, the user can press the confirmation button to send the data to be updated.
- Address: users can process address data on this prototype.
- General information: on the general information card in shown in Table 4, there will be options that users can press to display information related to batik 4.0 mobile.
- Preferences: on the preferences card there will be an option where the user is presented with the option to choose language or logout. a) select language: when the user presses the language select preference a pop-up will appear select language. In this prototype, users can choose Indonesian or English. b) logout: when user presses logout preference it will show login prototype. So, the user exits the mobile app.

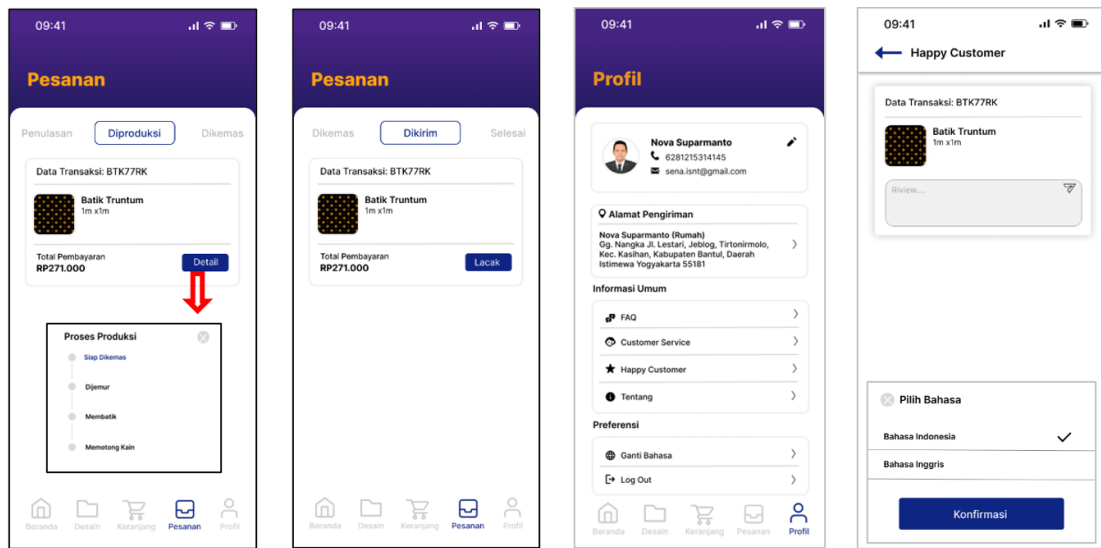


Figure 10. Prototype of production process, delivered, profile, happy customer, and select language pop-up

Table 4. General information features

No	Menu	Description
1.	Frequently asked questions (FAQ)	FAQ prototype will show up when the user clicks on the general FAQ content. A list of groups of FAQ and the responses to those questions will appear in this FAQ prototype. Users can click one of the various FAQs to be sent to the answer page.
2.	Customer service	User will be taken to the WhatsApp page when they click generic customer service information. Customers can connect with customer support by using the WhatsApp app.
3.	Happy customers	The products that have successfully transaction procedure are included in the prototype of the delighted customer. Users can remark on the things they have purchased on this page of happy customers, piquing the curiosity of other users.
4.	About	The batik 4.0 mobile's specifications are described in the about prototype's text.

3.5. Usability testing result (prototype validation)

In the validation phase, we employed an expert review heuristic method to review and verify the design of batik 4.0 mobile. Experts with experienced interface design to review the UI design, navigation, and interactivity, according to the basic principles of Heuristics by Nielsen [45] as shown in Table 2. The experts found problems with the payment process, where the advance payment system could not work properly. The findings of the expert on the heuristic problem are shown in Table 5.

Table 5. Usability problems finding by expert

No.	Problems	Heuristics principles
1.	Added "Change" option of the ellipse button, so that the use of the ellipse button is appropriate.	#8
2.	Added validation pop-up every option selection and payment.	#1, #5, #9
3.	The order of appearance (hierarchy) of the "Pay Now" button is at the top or higher than the advance/down payment.	#1
4.	DP payment button changed to down pay payment.	#4
5.	Added the "Lunas" or "Repayment" button option to pay down payment bills.	#2
6.	Added pop-up for user ratings.	
7.	The use of words on several pages is still mixed with Indonesian and English.	#4

Based on the findings in Table 5, the next step is to improve UI batik 4.0 mobile as follows.

- Added "Ubah" or "Change" option to the contents of the ellipse button, so that the use of the ellipse button is appropriate. When the user presses the button in the form of a trash can, the order in the cart will be deleted. Meanwhile, when the user presses the edit button, an order details pop-up will appear so that the user can make changes to the order details.
- Added validation pop-up of option selection and payment. In the prototype waiting for this payment, when the customer selects one of the three buttons provided, a confirmation pop-up will appear Figure 11.
- The order of appearance (hierarchy) of the "Pay Now" button is at the top or higher than the advance/down payment. This is because 100% cash payments are prioritized through the "Sudah Bayar" or "Already Paid" button, then the next is the "Bayar Uang Muka" or "Pay Advance" button in Figure 11.
- The DP button is changed to pay down payment. In the pending prototype, the user will be able to choose direct payment, advance payment, or order cancellation, as shown in Figure 11.
- Added the "Lunasi" or "Repayment" button option to pay down payment bills, as shown in Figure 12. When the customer chooses to pay in advance, the user can go to the prototype of the payment submenu in the order menu. Customers can press the pay off button to go to the down payment page. When the user selects and presses pay off on the redemption submenu, a prototype of the DP payment will be displayed. There are payment detail cards, billing cards, and paid cards. The user will find out the deficiencies and payments that have been made. There is a deadline for users to make payments immediately.
- Added pop-up for user ratings. The track button will be active when the payment has been completed. After the customer receives the order, the customer can press the button to indicate that the order has been received. This prototype displays the details of the product purchased and the value button to provide an assessment of the orders that have been placed. In this pop-up, customer can provide input or evaluate the goods they have received. Feedback will later be entered into the happy customer in the profile menu in the general information section see in Figure 12.
- The use of words on several pages is still mixed with Indonesian and English. Some of the words that have been changed include: login, register, add button, and other words, shown in Figure 13.

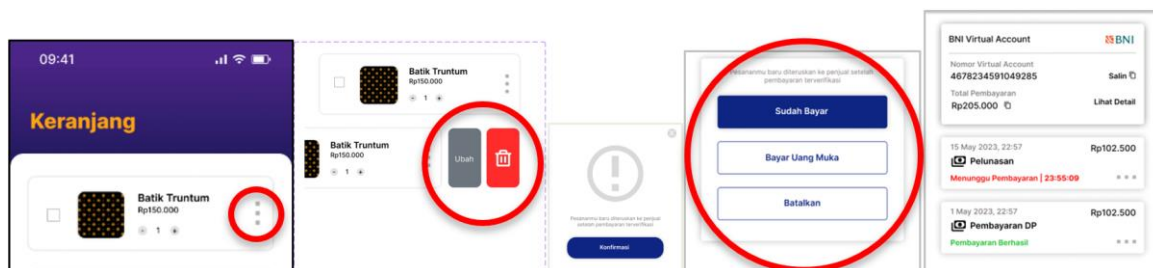


Figure 11. High fidelity of cart menu, ellipse button components, UI confirmation pop-ups, and waiting for payment (hierarchy)

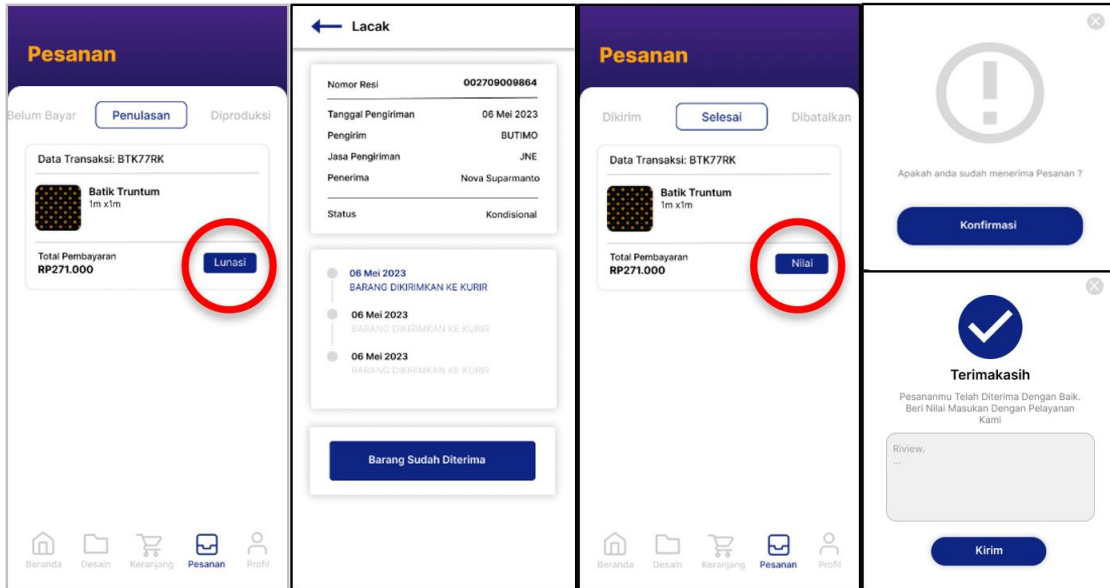


Figure 12. High fidelity of tracking, received goods, completed, and rating pop-up



Figure 13. Consistent changes in the use of words in language

3.6. UEQ

After being repaired, UX testing was carried out with the UEQ-S tool, involving 44 respondents who are active in using online transactions on mobile. A short version, called UEQ-S, includes just eight items, four from the pragmatic scale’s efficiency, perspicuity, dependability (blue colors), and four from the hedonic scale’s stimulation and novelty (yellow colors). UEQ-S is available for scenarios requiring very short completion times. It contains only two scales for the pragmatic quality (the first four items in the list below) and hedonic quality (the last four items in the list below), but it provides an overall UX score Schrepp *et al.* [34]. UX test results using the UEQ-S tool are shown in Table 6.

Table 6. Batik 4.0 mobile UEQ-S results

Item	Mean	Std. Dev.	Negative	Positive	Scale
1	2.0	0.8	obstructive	supportive	Pragmatic quality
2	1.9	1.0	complicated	easy	Pragmatic quality
3	1.8	0.9	inefficient	efficient	Pragmatic quality
4	2.1	0.8	confusing	clear	Pragmatic quality
5	1.6	0.9	boring	exciting	Pragmatic quality
6	1.8	0.9	not interesting	interesting	Pragmatic quality
7	1.9	0.8	conventional	inventive	Pragmatic quality
8	1.6	0.9	usual	leading edge	Pragmatic quality

Figure 14 shows the results of the questionnaire responses on the batik 4.0 mobile are all positive UX (according to the handbook a value falls into the positive range if it is >0.8). The benchmark provides, per scale, a grouping into five categories (excellent, good, above average, below average, and bad). Each category is linked to a percentile of products from the benchmark data set.

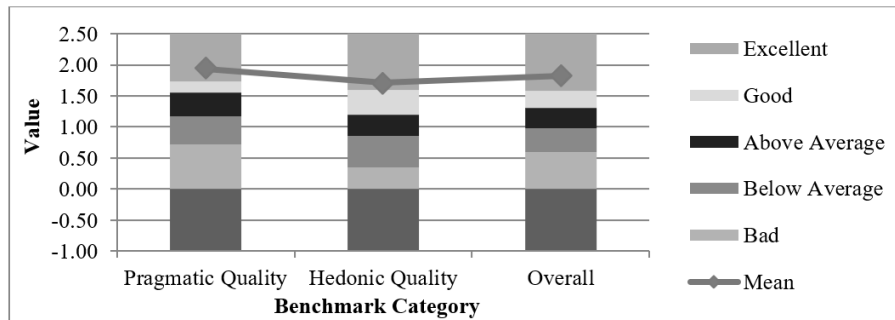


Figure 14. Batik 4.0 mobile benchmark

Based on the UEQ-S benchmark diagram, the batik 4.0 mobile is included in the “excellent” category. If a product falls, according to the benchmark, into the category excellent, this means it is amongst the 10% of the best products. If it falls into the category above average, 25% of the products from the benchmark data set have better results, and 50% have worse results for this scale. The benchmark for the short version was derived from the benchmark of the full version Hinderks *et al.* [47]. The value of each UEQ-S item can be seen in Table 7, where the average on the overall scale is 1,824. The comparison of the results for the evaluated product with the data in the benchmark allows conclusions about the relative quality of the evaluated product compared to other products.

Table 7. Short UEQ scales

Scale	Mean	Comparison to benchmark	Interpretation
Pragmatic quality	1.9375	Excellent	In the range of the 10% best results
Hedonic quality	1.7102273	Excellent	
Overall	1.82	Excellent	

4. CONCLUSION

The paper, describing the case of UI design and development of application called the mobile batik 4.0, presents an iterative process of UCD. The design project was carried out to give customers the opportunity to access the batik 4.0 website in mobile form. The process begins with rapid prototyping and pilot testing of the first design. The second design is made according to the users’ feedback and the implementation follows. To evaluate developed UI design, a comprehensive approach using qualitative expert feedback and quantitative UX testing UEQ-S were carried out. In the prototype validation phase, UI validation took place towards the end of the prototype lifecycle. The UI experts went through the application and the instruments to evaluate the content, the flow, the look and feel, functionalities, and the interaction aspect. In the interface validation phase, three experts with at least five years of work experience in UI/UX design area validated the prototype. They reviewed the prototype based on the basic principles of heuristics by Nielsen. The experts responded positively towards the application, found heuristic problems, and suggested for further improve the prototype on its usability and interface design aspects. Improvements were made to the UI batik 4.0 mobile design in response to advice from specialists who were divided into the ordering and payment procedures, resulting in a more intricate yet easily usable user flow. The addition of a pay button, or the pay-off button will make it easier for customers to proceed with ordering batik in batik 4.0. The expert’s have led to improvements in the advance/DP procedure. For instance, there is a hierarchy of direct payment buttons with increasing priority, advance payment client validation, and the availability of buttons to settle ongoing advance payments. According to the obtained results, the evaluation framework confirmed to be suitable for iterative process of UCD of batik 4.0 mobile. The study shows that usability evaluation can be successfully applied in design process in a quick and cost-effective manner. Quantitative results show that UX score using UEQ-S reached a “excellent” category. In addition, the framework can be further adjusted and refined to fulfil the requirements of batik 4.0 mobile developed for the purpose of purchasing and payment thus contributing to the researchers and practitioners in the field of design and development of UI mobile and online business. This research can contribute by combining the two methods used to solve problems, UEQ-S (quantitative) and heuristics (qualitative) methods, so that the results are expected to enrich the results of this research. In future research, the batik generator can be refined so that it can be specifically designed for mobile devices.

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