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Implementation of a Web-Based E-Commerce System with RajaOngkir and Midtrans for Gemstone Sales in Tunjungmuli Village

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Abstract

The advancement of internet technology has transformed global business through e-commerce. For agate gemstone craft MSMEs in Tunjungmuli Village, whose products possess high economic value due to their aesthetic appeal and rarity, adopting an information system is a strategic way to expand market reach. However, reliance on conventional marketing methods has limited sales growth and market accessibility. This Research and Development (R&D) study employed the ADDIE model to develop an e-commerce system integrated with product information, automatic shipping cost calculation through the RajaOngkir API, and the Midtrans payment gateway, while also evaluating its feasibility. The results show that the e-commerce platform was successfully developed. Evaluation using the Black Box Testing method yielded a system functionality score of 84.6%, which falls within the 81%–100% range and is categorized as Highly Feasible. The findings indicate that minor input-related issues do not affect transaction stability, making the system suitable for optimizing sales among agate gemstone artisans in Tunjungmuli Village.

Keywords: *Gemstone MSME, E-Commerce, ADDIE, RajaOngkir, Midtrans*

Abstrak

Kemajuan teknologi internet telah mentransformasi bisnis global melalui e-commerce. Bagi UMKM kerajinan batu akik Desa Tunjungmuli yang bernilai ekonomis tinggi berkat estetika dan kelangkaannya, adopsi sistem informasi menjadi instrumen strategis untuk memperluas pasar. Namun, ketergantungan pada pemasaran konvensional membuat volume penjualan belum optimal dan terbatas sekat geografis. Penelitian Research and Development (R&D) dengan model pengembangan ADDIE ini bertujuan membangun sistem e-commerce terintegrasi informasi produk batu akik, perhitungan ongkos kirim otomatis API RajaOngkir, dan payment gateway Midtrans, sekaligus mengukur tingkat kelayakan sistem tersebut. Hasil penelitian membuktikan bahwa platform e-commerce berhasil dikembangkan dengan hasil evaluasi menggunakan metode Black Box Testing menunjukkan persentase fungsionalitas sistem sebesar 84.6%, sehingga masuk dalam rentang 81%–100% dengan kategori Sangat Layak. Kebenaran ilmiah juga membuktikan bahwa kendala input sekunder tidak mengganggu stabilitas transaksi utama, sehingga sistem ini dapat diterapkan untuk mengoptimalkan penjualan para pengrajin batu akik Desa Tunjungmuli.

***Kata-kata kunci**: UMKM Batu Akik, E-Commerce, ADDIE, RajaOngkir, Midtrans*

1. Introduction

The advancement of internet technology has transformed global business through e-commerce as an online platform and interactive information medium that facilitates consumer decision-making [1]. For Micro, Small, and Medium Enterprises (MSMEs), the adoption of computer-based information systems serves as a strategic instrument that integrates people, procedures, and media to process data into valuable information [2], thereby reducing operational costs and enhancing global competitiveness [3]. Agate gemstones from Tunjungmuli Village, Karangmoncol District, Purbalingga Regency, Central Java Province, possess significant market potential due to their aesthetic appeal and rarity [4]. However, reliance on conventional marketing methods limits their market reach because of geographical barriers. Although previous studies have digitized SME transaction processes [5], conventional e-commerce development faces limitations when applied to agate gemstones due to buyers' skepticism regarding the physical authenticity of the stones, the low digital literacy of rural artisans, and the lack of integrated logistics cost calculation and automated payment modules.

To address these gaps, this study designed a dynamic e-commerce website based on PHP integrated with HTML [6] and a MySQL database [7], developed using Visual Studio Code [8] within a local XAMPP environment [9]. The primary distinction of this system lies in providing detailed physical specifications of gemstones to reduce buyer uncertainty, as well as implementing a third-party transaction system. This automated integration approach aligns with the efficient use of the JSON-based RajaOngkir API for domestic shipping cost calculations [10] and the adoption of the Midtrans payment gateway to provide secure real-time online payment services [11]. This study aims to examine the development process and evaluate the feasibility level of the agate gemstone e-commerce system in Tunjungmuli Village using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) development model [12][13], which has proven effective in identifying functional requirements in rural-scale environments [14]. The study is limited to locally sourced agate gemstones available in Tunjungmuli Village, where the system's functionality will be comprehensively evaluated using the Black Box Testing technique to ensure that all features, interfaces, and API integrations operate accurately [15][16].

2. Method

This study employed the Research and Development (R&D) method to design and develop a website-based e-commerce system as an effective solution to real-world problems encountered

in the field [17]. The operational workflow for developing this information system was guided by the ADDIE instructional model, which offers high adaptability, flexibility, and a structured framework to ensure the quality of development outcomes through evaluation at each stage of the process [18]. Chronologically, the problem-solving and system development procedures were carried out through the five phases of the ADDIE development model, as illustrated in Figure 1.

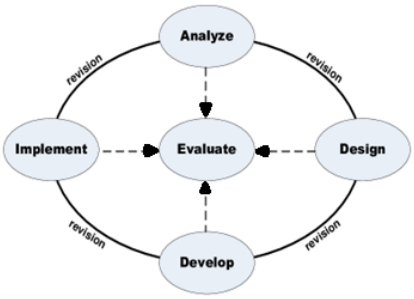

Figure 1. ADDIE Development Model

The system development process using the ADDIE model can be summarized in a continuous sequence of activities. The process began with the Analyze phase, which involved gathering the operational requirements of agate gemstone business actors in Tunjungmuli Village and identifying the website features needed. This was followed by the Design phase, where the database structure and system models were developed using Unified Modeling Language (UML), including Use Case Diagrams, Activity Diagrams, and Entity Relationship Diagrams. The Development phase then focused on implementing the system using PHP and MySQL, integrated with the RajaOngkir API and Midtrans payment gateway. Subsequently, the Implementation phase involved deploying the system on a server or hosting environment. Finally, the Evaluation phase was conducted to test system functionality using the Black Box Testing method and assess the system's feasibility prior to full-scale operation.

To ensure objectivity throughout each development phase, data were collected comprehensively through three primary instruments: structured interviews with agate gemstone artisans and sellers in Tunjungmuli Village, direct observation of business interaction processes and local technological readiness, and a literature review to establish the theoretical foundation for information system architecture and MSME digitalization. Furthermore, data analysis combined qualitative and quantitative descriptive approaches sequentially. Qualitative data obtained from field activities were reduced and transformed into technical representations, including database design and Unified Modeling Language (UML) models such as Use Case

Diagrams, Activity Diagrams, and Entity Relationship Diagrams. Meanwhile, quantitative evaluation of the developed website was conducted through external functionality testing using the Black Box Testing method, focusing on authentication features, product catalogs, transactions integrated with the RajaOngkir API and Midtrans payment gateway, and product management functions. The system success rate was calculated by comparing the number of successful test scenarios with the total number of testing scenarios using the formula presented in Equation (1) **[19]**.

$$\text{Success Percentage} = \frac{\text{Total Successful}}{\text{Total Test Cases}} \; x \; 100\% \; \ldots (1)$$

The quantitative percentage values obtained from the calculation were subsequently converted into standard validity criteria to determine the system's feasibility level. The feasibility level was classified into five categories, as presented in **Table 1 [20]**.

Table 1. System Feasibility Categories

No	Category	Percentage
1	Highly Feasible	81% – 100%
2	Feasible	61% – 80%
3	Moderately Feasible	41% – 60%
4	Not Feasible	21% – 40%
5	Highly Infeasible	< 20%

The interpretation of the converted data provided the basis for drawing comprehensive conclusions regarding the effectiveness and feasibility of the developed agate gemstone e-commerce platform and its suitability for implementation within the community.

3. Results and Discussion

3.1. Analyze Phase

The initial phase of this study was aimed at identifying objective problems and accurately mapping system requirements through a combination of qualitative and quantitative approaches. The research began by collecting operational information and website feature requirements directly from agate gemstone business actors in Tunjungmuli Village, Karangmoncol District, Purbalingga Regency, Central Java Province. Primary qualitative data were obtained through field observations and in-depth interviews with artisans, and subsequently refined through a data reduction process to eliminate information that was not

relevant to system development. This qualitative analysis identified three main clusters of operational issues: limited market reach due to conventional marketing methods, low trust among potential buyers from outside the region regarding the quality and physical characteristics of gemstones when purchasing remotely, and the limited use of technology by artisans in the sales process.

To strengthen the scientific basis of the system specifications, descriptive quantitative analysis was employed to assess the readiness of the local technological infrastructure and determine user requirements priorities. The integration of these two approaches resulted in a System Requirements Specification (SRS) document that defined access rights and functional system requirements for three primary actors: User (Registered Buyer), Guest (Visitor), and Admin (Seller), as summarized in **Table 2.**

Table 2. System Requirements Specification

Actor	Functional Requirements
User	Log in, register, and manage account dashboards. Browse the product catalog and view detailed agate gemstone specifications. Manage the shopping cart and perform checkout transactions. Calculate shipping costs automatically through the RajaOngkir API. Select digital payment methods through the Midtrans payment gateway. Monitor transaction history and track order status.
Guest	Browse the agate gemstone product catalog without logging in. Register a new user account.
Admin	Manage product data (add, edit, delete, and upload gemstone images). Monitor order data and verify payments automatically. Access sales reports and transaction history.

The website functionality specifications summarized in **Table 2** must be accommodated to address the identified limitations and research problems. The inclusion of a dynamic product catalog module equipped with detailed agate gemstone specifications was designed to enhance buyer interest and confidence. In addition, an intuitive shopping cart system, along with automated logistics transactions and payment gateway integration, was implemented to simplify business operations for artisans with limited digital literacy. The outcomes of this analysis phase served as the primary foundation and key parameters for designing the system architecture in the subsequent Design phase.

3.2. Design Phase

3.2.1. Use Case Diagram

The functional modeling of the agate gemstone e-commerce information system was analyzed using a Use Case Diagram to illustrate the interactions between external actors and the features provided by the system. The system involves three primary actors: Guest (unauthenticated visitor), User (registered buyer), and Admin (seller), as shown in **Figure 2**.

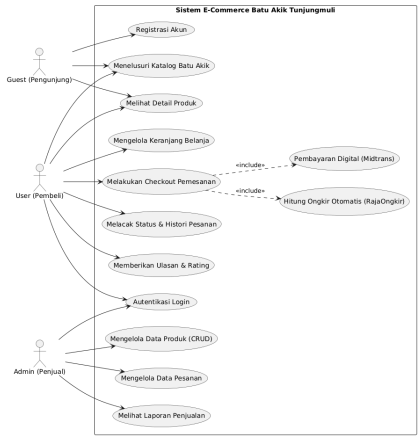

Figure 2. Use Case Diagram

The Guest actor has limited access rights, which are restricted to browsing the product catalog and viewing detailed physical specifications of agate gemstones. The User actor is granted full access to the purchasing process, including shipping cost calculation through the RajaOngkir API and payment processing via the Midtrans payment gateway integrated into the checkout process. Meanwhile, the Admin actor has complete control over product content management (Create, Read, Update, Delete/CRUD), order validation, and the monitoring of periodic sales reports.

3.2.2. Activity Diagram

The transactional activities and external system integrations of the agate gemstone e-commerce platform were modeled using an Activity Diagram to illustrate the workflow from product purchasing to payment completion. This workflow involves dynamic interactions among four entities: the Buyer, the Main System, the RajaOngkir API, and the Midtrans API, as shown in **Figure 3**.

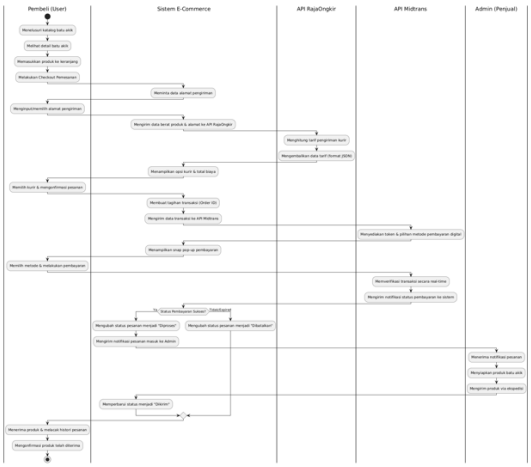

Figure 3. Activity Diagram

The process begins when the buyer proceeds to checkout the selected agate gemstone products. The system then sends the destination address to the RajaOngkir API server to generate shipping cost calculations automatically and in real time. After the buyer selects a preferred courier service, the system forwards the invoice data to the Midtrans payment gateway. Midtrans acts as a payment verifier, processing funds through various digital payment methods chosen by the customer. A successful payment notification sent instantly by Midtrans automatically updates the transaction status in the system database to "Processed," triggering the Admin actor on the seller's side to package and ship the product. The transaction is completed when the buyer confirms receipt of the delivered item.

3.3.3. Entity Relationship Diagram

The database architecture of the agate gemstone e-commerce system was designed using a relational approach consisting of 11 core tables. The relationships among entities were established to ensure the integrity of transaction data, product data, and user data. The inter-table relationships within the agate gemstone sales database are illustrated in **Figure 4.**

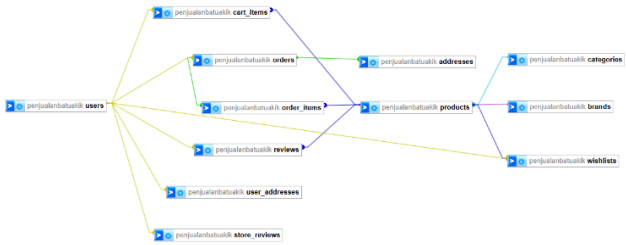

Figure 4. Entity Relationship Diagram

The relational database architecture of the system integrates three primary entity clusters. The first cluster consists of user entities (users), which maintain one-to-many relationships with the cart, order history, address, review, and wishlist tables. The second cluster represents

transaction-related entities, linking the orders table with the addresses table to support RajaOngkir API integration, as well as the order_items table to store detailed product information for each transaction. The third cluster comprises product-related entities, which dynamically organize product catalogs based on the categories and brands of artisans from Tunjungmuli Village into the products table, serving as the system's primary data repository.

3.4. Development Phase

The Development phase focused on translating the system requirements specifications and architectural designs into functional and deployable program code. The coding process was carried out in the Visual Studio Code environment using PHP as the server-side programming language and MySQL to implement the physical database structure, including the creation of the products table designed to store comprehensive information about agate gemstone products from Tunjungmuli Village.

A primary focus of this phase was the implementation of third-party API integrations. The logistics module was developed by integrating the RajaOngkir API to retrieve destination city ID parameters from the addresses table and generate automatic shipping cost calculations in JSON format. To establish a legitimate connection between the main system and the logistics server, authentication credentials in the form of an API Key obtained from a RajaOngkir account were configured within the program code, as shown in **Figure 5**.

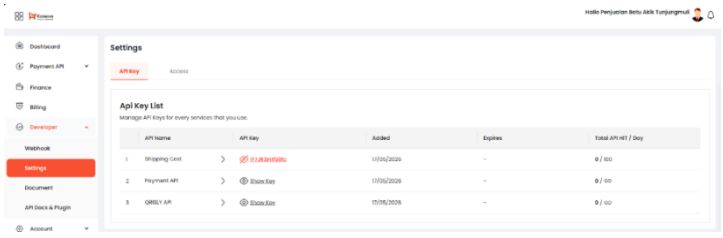

Figure 5. RajaOngkir API Key

Meanwhile, payment gateway automation was implemented by integrating Midtrans into the system's checkout script to transmit a unique combination of order_id and total purchase amount. The Midtrans server responds to this data by displaying a pop-up payment window that offers various digital payment methods, such as QRIS and Virtual Accounts. The security and authorization of remote transactions are ensured through the configuration of the Client Key and Server Key within the Midtrans developer dashboard, as shown in **Figure 6**.

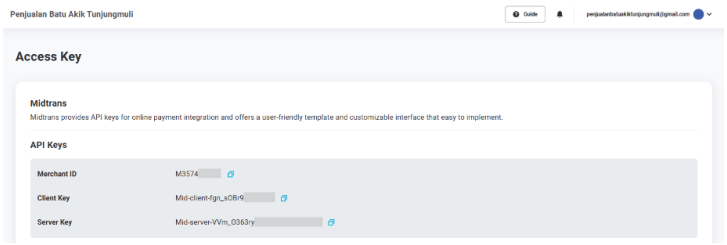

Figure 6. Midtrans API Key

The successful compilation of the program code, configuration of environmental parameters, and integration of the two third-party APIs resulted in a fully functional e-commerce website. The visual representation of the website's user interface (UI), developed as the final product of this phase, is presented and discussed in detail during the Implementation phase.

3.5. Implementation Phase

After all program code had been successfully developed during the Development phase, the system was deployed to a server and made publicly accessible through the Internet using a MySQL database. The implementation of the system resulted in a complete e-commerce platform featuring an interactive workflow that connects buyers and administrators. The implementation results of the website interface and the relationships among its pages are described as follows.

The user interaction cycle begins with the Home Page, as shown in **Figure 7.** This page serves as the main gateway, providing general information about agate gemstone products from Tunjungmuli Village. The Home Page is equipped with an interactive and persistent navigation bar (navbar) that directs users to other pages through the Artisans, Categories, Products, About Us, Contact Us, and Cart menus, as well as a dynamic Login button that changes into a profile shortcut once the user has been authenticated.

Figure 7. Home Page

To search for agate gemstone products, users can access the Product Catalog Page, as shown in **Figure 8**. This page dynamically connects user queries to the products table through

an interactive grid-based visualization. Users can refine their product searches using various filtering features, including sorting by the latest listings or price, filtering by gemstone category, selecting products from specific artisan profiles, and defining a desired price range.

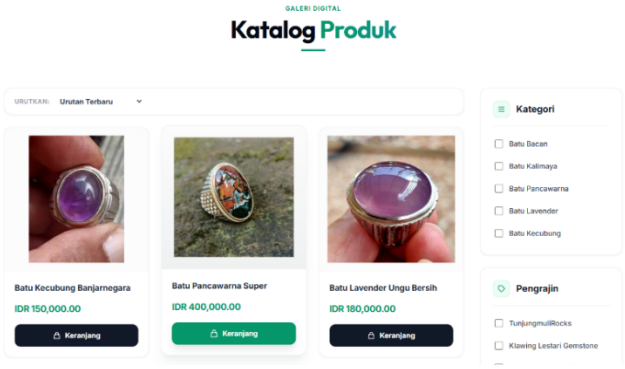

Figure 8. Product Catalog Page

When buyers select products and specify the desired quantities, the selected items are stored in the database and can be reviewed through the Cart Page, as shown in **Figure 9.** The Cart Page displays a list of selected products along with a shopping summary panel that presents the subtotal of the purchase.

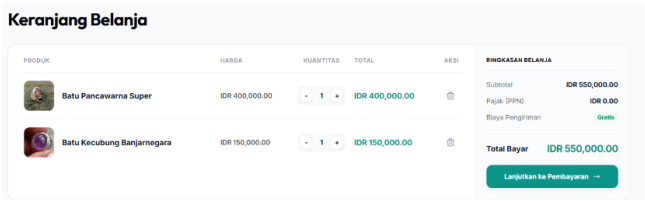

Figure 9. Shopping Cart Page

From the Shopping Cart Page, buyers are directed to the Checkout Page, as shown in **Figure 10**, to initiate the order fulfillment process. On the Checkout Page, buyers are required to select or enter a specific shipping address. The system then sends the address information to the RajaOngkir API server to retrieve and display available domestic courier services along with their shipping rates in real time. The Checkout Page also provides payment options, including Cash on Delivery (COD) and digital payment through Midtrans, before presenting the final order summary.

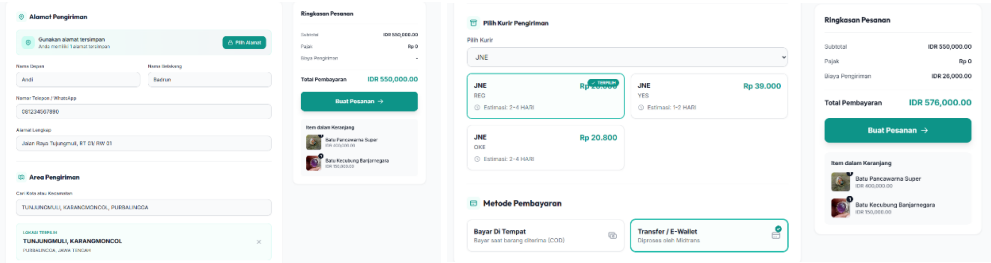

Figure 10. Checkout Page

If the Midtrans payment option is selected, buyers are redirected to the Invoice Details Page, as shown in **Figure 11**, which displays the final payment amount along with a Pay Now button. Clicking this button instantly launches the Midtrans Snap pop-up window on top of the main website page. Through this secure pop-up interface, customers can choose from various electronic payment methods, including QRIS, bank Virtual Accounts, and debit cards.

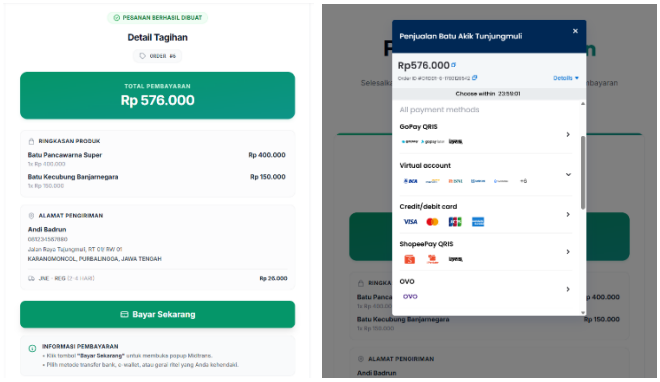

Figure 11. Invoice Details Page and Midtrans Pop-Up Payment Interface

After the payment authorization process is completed, the Midtrans server sends a real-time notification to the system, which immediately redirects the user to the Payment Success Page, as shown in **Figure 12** (left). This page displays an official digital invoice summary along with two navigation buttons: "Continue Shopping," which redirects users back to the product catalog, and "View My Orders," which links directly to the My Orders Page, as shown in **Figure 12** (right). Through the My Orders Page, buyers can monitor the status and history of all their active transactions.

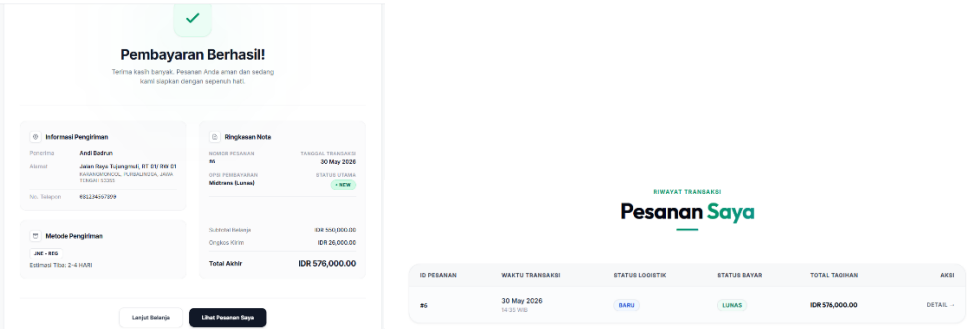

Figure 12. Payment Success Page (Left) and My Orders Page (Right)

Real-time status updates performed by the administrator dynamically modify the data representation displayed on the user's Order Details Page, as shown in **Figure 13**. On this page, buyers can view their order status as "Processing" with the payment status marked as "Paid." Once the agate gemstone has been delivered and the status on the administrator dashboard changes to "Shipped," the system displays a dedicated "Confirm Receipt" button on the buyer's

interface. When the buyer clicks this confirmation button, the system permanently updates the final transaction status in the database to "Completed," indicating that the e-commerce transaction cycle has been successfully concluded.

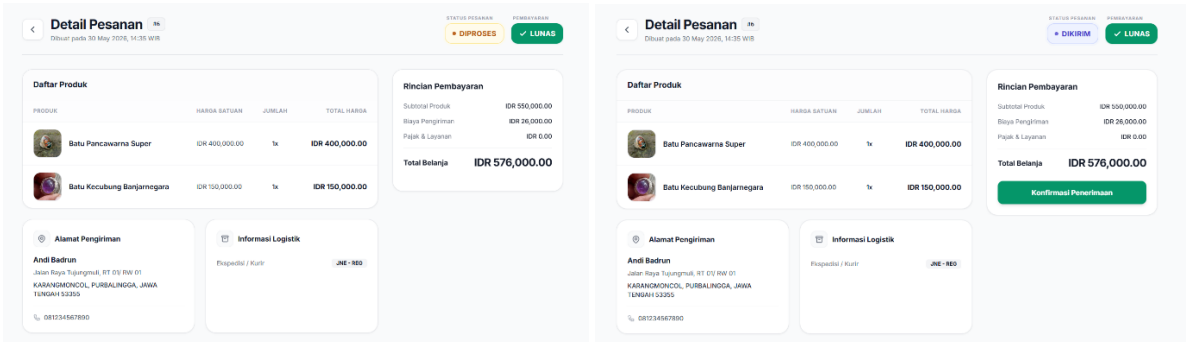

Figure 13. Order Details Page

3.6. Evaluation Phase

The Evaluation phase was conducted to assess the quality, reliability, and feasibility of the implemented system through external functional testing using the Black Box Testing method. The testing scenarios were systematically developed based on the functional requirements document and involved three primary actors: User (Buyer), Guest (Visitor), and Admin (Seller). This testing focused on validating the inputs and outputs of each critical feature to ensure that the system operated in accordance with the intended business logic. A summary of the functional testing results is presented in **Table 3.**

Table 3. Black Box Testing Result

No	Testing Scenario	Expected Result	Result
1	Browsing the Product Catalog Without Authentication	The system displays the agate gemstone product grid publicly.	Valid
2	New Account Registration	User data are stored in the users table, and the system redirects the user to the login page.	Valid
3	Login Authentication and Dashboard Management	Access rights are validated, and users are securely redirected to their account dashboard.	Valid
4	Viewing the Product Catalog and Agate Gemstone Details	Product specifications (gemstone patterns, origin, and dimensions) are displayed accurately.	Valid
5	Shopping Cart Management	Products are successfully added to or removed from the cart_items table.	Valid
6	Checkout Process and RajaOngkir API Integration	Shipping costs are automatically generated in JSON format based on the gemstone weight.	Valid

No	Testing Scenario	Expected Result	Result
7	Midtrans Payment Gateway Integration	The Midtrans Snap pop-up window successfully triggers digital payment options.	Valid
8	Monitoring Order History and Transaction Records	The buyer's transaction status is updated in real time after payment completion.	Valid
9	Input Validation	The system rejects data submission when the phone number field contains alphabetic characters.	Invalid
10	Product Data Management (CRUD)	The administrator can successfully add, edit, and delete agate gemstone product data.	Valid
11	Agate Gemstone Image Upload	The system restricts and rejects image files larger than 2 MB.	Invalid
12	Order Monitoring and Payment Automation	New order notifications are received, and payment verification is performed automatically.	Valid
13	Periodic Transaction Reporting	The system generates sales reports and financial transaction history summaries.	Valid

Based on the execution results of the 13 testing scenarios presented in **Table 3**, 11 scenarios were classified as valid, while 2 scenarios were classified as invalid. The first invalid case was identified in the user profile function (No. 9) due to the absence of input validation, allowing alphabetic characters to be entered into the phone number field, which should only accept numeric values. The second invalid case occurred in the product management function (No. 11), where the system was unable to save data when uploading high-resolution agate gemstone images exceeding 2 MB in size, due to the absence of an automatic image compression script on the server side.

Quantitatively, the functional feasibility level of the system was calculated using the success rate formula, as presented in **Equation (2).**

$$\text{Persentase Keberhasilan} = \frac{11}{13}\ x\ 100\% = 84.6\% \ldots (2)$$

Although several errors were identified in secondary input validation testing, all core transactional functions, including the RajaOngkir shipping automation module and the Midtrans payment gateway integration, operated successfully. Therefore, the final functionality score of 84.6% places the Tunjungmuli Village agate gemstone e-commerce platform within the 81%–100% range, corresponding to the Highly Feasible category. To maintain this level of feasibility and ensure optimal website performance, corrective actions in the form of form validation functions and server-side image compression scripts were scheduled for implementation prior

to deploying the system to MSME artisan partners engaged in agate gemstone production and sales.

4. Conclusion

The series of ADDIE model phases successfully achieved the research objectives by delivering an adaptive e-commerce platform for agate gemstone MSMEs in Tunjungmuli Village, integrating detailed product information, the RajaOngkir API, and the Midtrans payment gateway. The Black Box Testing evaluation yielded a functionality score of 84.6%, placing the system within the 81%–100% range and categorizing it as Highly Feasible. The findings further demonstrated that the identified secondary issues did not affect the stability of the system's core transactional functions. This study contributes to the advancement of knowledge in integrated information systems utilizing third-party APIs for local MSMEs. Future research is recommended to implement stricter phone number input validation mechanisms and server-side automatic image compression features to support the processing of higher-resolution agate gemstone image uploads.

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