



Development of NARA biodegradable journaling books as a circular economy-based solution for sustainable lifestyle transformation and social empowerment

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ABSTRACT

Background: Sustainability challenges have prompted higher education institutions to reconsider intensive paper consumption that contributes to waste and carbon emissions. Prior studies show that student behavior can be influenced through sustainable product design, yet affordable and functional eco-friendly academic products remain limited. Meanwhile, corn husk waste is underutilized despite its potential as a biodegradable material. This study aims to develop and evaluate a biodegradable journaling product made from recycled paper and corn husks as a circular economy-based solution supporting sustainable lifestyles and social empowerment. **Methods:** This study employed an applied product development approach integrated with the Voice of Customer (VoC) method. Product development included material selection, prototype design, and the incorporation of circular economy principles. User data were collected through an online structured questionnaire distributed to university students in the Special Region of Yogyakarta, Indonesia. Quantitative data were analyzed using descriptive statistics, while qualitative responses were thematically analyzed to capture user perceptions regarding functionality, sustainability attributes, and social value. **Findings:** The VoC analysis shows that users prioritize motivational and environmental insights (47.4%), habit tracking features (41.2%), and digital synchronization through reminders or QR-based systems (36.8%). These findings indicate that sustainable journaling products are more effective when cognitive motivation, behavioral monitoring, and digital convenience are integrated. The results support behavioral design theory, which suggests that sustainable behavior adoption is strengthened through the combination of inspiration, accountability, and usability. **Conclusion:** This study demonstrates that agricultural waste and literature-based content can be transformed into a user-centered and sustainable academic product through structured product development and VoC integration. **Novelty/Originality of this article:** This research uniquely integrates biodegradable material innovation, behavioral journaling design, and user-centered product development within a circular economy framework while incorporating social empowerment at the farmer level.

KEYWORDS: circular economy; product development; voice of customer.

1. Introduction

The increasing urgency of global sustainability issues has prompted various sectors to reorient their production and consumption patterns towards more environmentally friendly practices (Abonguie et al., 2025; Shi et al., 2026; Tanderup et al., 2025). The higher education sector has a strategic role to play in this process, given that students are not only active consumers but also agents of social change who have the potential to internalize and

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disseminate sustainability values (Chen et al., 2026; Gomes et al., 2025; Hussain et al., 2025; Wirtu et al., 2025). However, consumption practices on campus are still dominated by a linear economic model, particularly in the use of paper-based products such as notebooks and stationery, which contribute significantly to waste generation and pressure on natural resources (Acquah et al., 2024; Cao et al., 2025; Esmaeeli & Sarrafzadeh, 2023; Kokhuis et al., 2025). Currently, higher education institutions generate a considerable volume of paper waste each year, in line with their high levels of academic and administrative activity (Fiedler, 2025; Gursoy Haksevenler et al., 2022; Harter et al., 2025; Hezardastan & Shmelev, 2025). Most of this paper waste ends up in landfills without optimal recycling processes, thereby exacerbating environmental problems and increasing the carbon footprint of the education sector (Liu et al., 2025; Sahoo et al., 2025; Zhang et al., 2026). This situation is paradoxical, given that the increasing environmental awareness among students has not been fully matched by the availability of environmentally friendly, affordable, and functional alternative products to support daily academic activities. Integrating Sustainable Consumption Theory (SCT) can help explain this gap, suggesting that high environmental values do not automatically translate into green purchasing unless products are perceived as functional and accessible.

On the other hand, Indonesia, as an agricultural country, produces a large amount of agricultural biomass waste, one of which comes from corn husks (Chiang et al., 2026; Thøgersen & Zhang, 2025). Corn husk waste is generally not optimally utilized and is often burned or discarded, which not only causes waste of resources but also causes carbon emissions and environmental pollution (Du & Yuan, 2024; Park & Her, 2026). In fact, corn husks have the potential to be processed into biodegradable materials, including as alternative paper raw materials through a simple material engineering process (Chang et al., 2025; Susetyo et al., 2025). The utilization of this waste opens up opportunities for the development of sustainable products in line with the principles of the circular economy (Harris & Wu, 2025; Talebzadehhosseini et al., 2025). In this context, Innovation Diffusion Theory provides a framework for how such materials can be adopted by the mass market through attributes like relative advantage and trialability. Furthermore, compared to other biodegradable sources like sugarcane bagasse or rice straw, corn husk offers a unique balance of high cellulose content and local abundance, making it a superior candidate for user-centered material engineering. These environmental issues also intersect with socio-economic issues, particularly at the farmer level (He et al., 2025; Pålsson & Olsson, 2025). Most farmers are still at the bottom of the agricultural value chain and have limited access to post-harvest technology and waste utilization innovations (Abera et al., 2025; Pereira et al., 2025). As a result, agricultural waste, which should have economic added value, becomes an environmental burden without providing financial benefits to farmers (Chen et al., 2026; Tariq et al., 2025). The integration of farmers into a circular economy scheme based on the upcycling of agricultural waste has the potential to be a solution to increase income while strengthening rural economic resilience.

2. Methods

2.1 Data objectives

This study employed an applied product development research design integrated with a Voice of Customer (VoC) approach to address the research objective of developing and evaluating the NARA biodegradable journaling book as a circular economy-based solution for sustainable lifestyle transformation and social empowerment (Serrano-García et al., 2025; Sorcaru et al., 2025). Ontologically, this research is grounded in a pragmatic perspective, assuming that sustainability challenges can be addressed through tangible product innovation informed directly by user needs and perceptions. Epistemologically, the study adopts a post-positivist orientation, combining empirical user data with contextual interpretation to inform product development decisions. The research design consisted of two main stages. The first stage focused on product development, including material

selection, prototype design, and integration of circular economy principles (MacNeil, 2025; Sorcaru et al., 2025). The second stage applied the Voice of Customer (VoC) approach to capture user needs, expectations, and perceptions regarding functionality, sustainability attributes, and social value of the product (Landa-Oregi et al., 2026; Li et al., 2025). The VoC approach was selected to ensure that the product development process was user-centered and aligned with actual consumer requirements rather than designer assumptions.

2.2 Data collection and analysis

The research was conducted at the Special Region of Yogyakarta, Indonesia, selected due to its active academic environment, diverse student population, and relevance as a representative higher education institution with high paper consumption intensity. The location also aligns with the target users of the NARA product, namely university students. The study employed purposive sampling, targeting 300 active university students who constitute the primary consumer base for academic stationery.

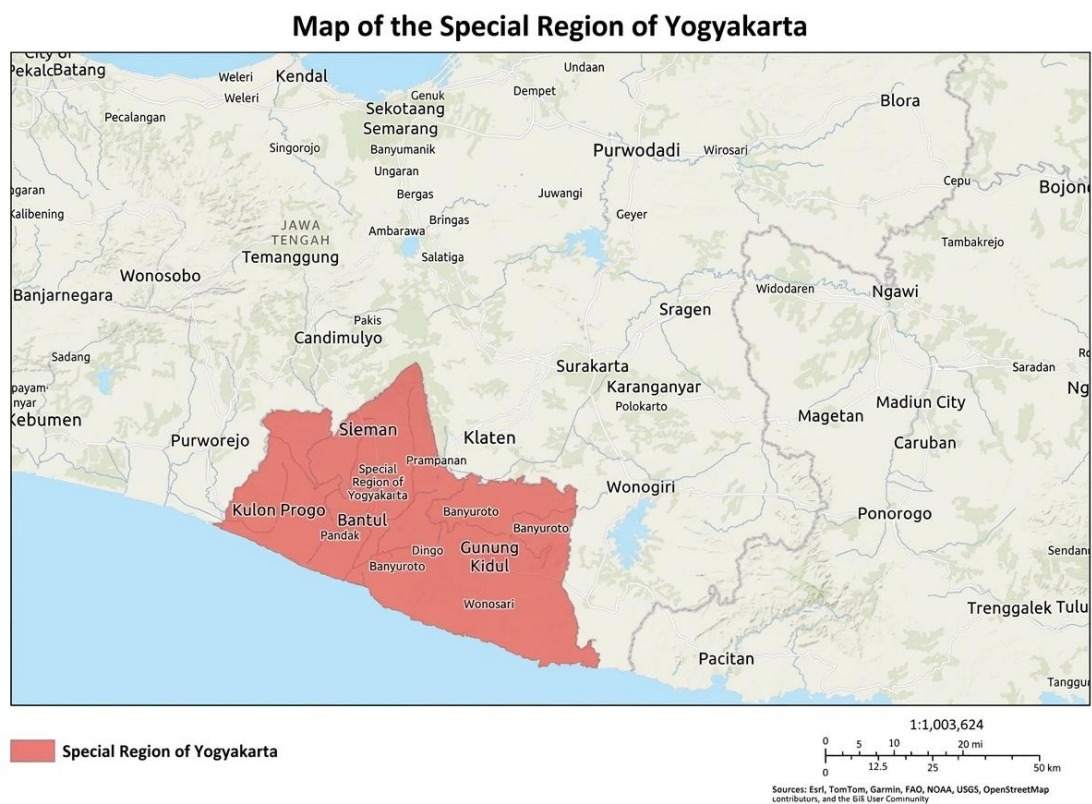


Fig. 1. Research base location

This strategy ensured that respondents possessed relevant experience with the product category, thereby increasing the validity of the Voice of Customer data. Data collection was carried out between March and September 2025, a period chosen to coincide with the active academic semester to ensure adequate respondent participation. The production of prototype materials using corn husk waste involved collaboration with local agricultural communities in the Yogyakarta region, where corn husk residues are readily available. Data collection was conducted using a structured questionnaire consisting of closed-ended questions measured on a Likert scale to capture quantitative perceptions, along with limited open-ended questions to gather qualitative feedback. These quantitative measures were operationalized into three core constructs: Functionality (assessing ink absorption, paper durability, and writing comfort), Sustainability Attributes (evaluating the use of corn husk waste and biodegradability), and Social Value (measuring the perceived impact on local farmer empowerment and circular economy contribution). Each construct

was measured using a 5-point Likert scale to ensure granular data capture. The questionnaire was distributed online to ensure accessibility and anonymity. The instrument was subjected to expert judgment for face validity before distribution to ensure clarity. Furthermore, the qualitative feedback from open-ended questions was analyzed using thematic analysis, involving a systematic process of data familiarization, initial coding, and theme development to extract deeper insights into user motivations and barriers to adopting bio-based products. Quantitative data were analyzed using descriptive statistical analysis to identify trends in user perceptions and acceptance of the NARA product. Qualitative responses from open-ended questions were analyzed, involving categorization and thematic grouping to extract recurring insights related to sustainability awareness and perceived social impact.

3. Results and Discussion

3.1 Voice of customer

The Voice of Customer (VoC) analysis was conducted to systematically capture user priorities regarding feature inclusion in the NARA biodegradable journaling product, with the overarching objective of ensuring that product development decisions were firmly grounded in actual user expectations, lived experiences, and daily usage patterns. In the context of sustainable product innovation, VoC plays a critical role in bridging the gap between designer assumptions and real-world user needs, particularly when the product is intended not only as a functional object but also as a behavioral intervention tool. By embedding user voices directly into the design process, the VoC approach helps ensure that sustainability-oriented products such as NARA do not remain symbolic artifacts but instead become practical instruments that meaningfully support lifestyle change and long-term engagement. The VoC study employed a multiple-response questionnaire distributed to student respondents, allowing participants to select more than one preferred feature. This methodological choice reflects a recognition of the inherently multifunctional nature of journaling products. Unlike single-purpose tools, journals are often used simultaneously for reflection, planning, emotional regulation, habit formation, and motivational reinforcement. Allowing multiple responses acknowledges that users do not experience journaling as a linear or isolated activity, but rather as an integrated practice embedded within broader cognitive and behavioral routines. From a methodological standpoint, the multiple-response format enables a richer capture of user expectations by accommodating overlapping needs rather than forcing respondents into mutually exclusive choices. As a result, the data generated provides more nuanced insights into how users cognitively, emotionally, and behaviorally interact with journaling tools, particularly within the emerging context of sustainable lifestyle adoption among young adults. The VoC results, as summarized in Table 1, reveal distinct patterns in user preferences that carry significant implications for product development and feature prioritization.

Table 1. Voice of customer (VoC)

Voice of customer	Percentage (%)
Quotes and environmental insight	47.4
Habit tracker	41.2
Reminder and digital synchronization	36.8
Free journaling pages	31.6
Weekly reflection	15.8

One of the most prominent findings from the VoC analysis is the strong preference for motivational quotes and environmental insight content, selected by 47.4% of respondents. This result indicates that users expect the journaling product to play an active and educative role in shaping values, reinforcing sustainability awareness, and sustaining motivation over time, rather than merely serving as a passive medium for writing. The preference suggests

that users perceive journals not only as tools for self-expression, but also as cognitive companions that can guide thought patterns and reinforce purpose-driven behavior. In the context of sustainability-oriented design, this finding is particularly important, as it aligns with behavioral change theories that emphasize the role of continuous cognitive reinforcement in sustaining pro-environmental actions. Motivational and environmental insights function as micro-interventions that embed sustainability narratives into everyday routines. By encountering short, emotionally resonant messages during daily journaling activities, users are repeatedly reminded of the broader environmental and social significance of their individual actions. This form of subtle, repeated exposure helps translate abstract sustainability concepts, such as circular economy principles or environmental responsibility into personally meaningful reflections. From a VoC perspective, the demand for such content indicates that users value products that support identity formation as environmentally conscious individuals. The journal, therefore, is not merely a tool for recording activities, but also a medium through which values are internalized and reaffirmed.

Closely related to the motivational dimension is the high demand for a habit tracker feature, selected by 41.2% of respondents. This finding reflects users' strong need for concrete mechanisms that enable them to monitor, evaluate, and regulate their daily behaviors over time. While motivational content addresses the cognitive and affective dimensions of sustainability, habit tracking fulfills the behavioral execution component by transforming intentions into observable and measurable actions. From a VoC standpoint, this preference highlights users' desire for structure, clarity, and feedback in their self-improvement efforts. Habit trackers allow users to visualize progress, identify behavioral patterns, and maintain consistency, all of which are essential elements in habit formation theory. The combination of motivational content and habit tracking reveals a critical VoC insight, namely users seek a balance between inspiration and accountability. Motivation alone may spark initial interest, but without a mechanism to track behavior, its impact is often short-lived. Conversely, habit tracking without motivational reinforcement may feel mechanical or burdensome. The coexistence of these preferences suggests that users expect journaling products to support both emotional engagement and disciplined execution. Habit trackers provide tangible feedback loops that reinforce positive behavior through visual cues and progress indicators, thereby strengthening the likelihood of sustained engagement. In the context of sustainable lifestyle adoption, this dual approach is particularly effective, as it aligns personal motivation with observable behavioral outcomes.

Another significant finding emerges from the preference for reminder and digital synchronization features, selected by 36.8% of respondents. This result underscores users' expectation for seamless integration between physical products and digital ecosystems. As university students increasingly rely on digital platforms to manage academic schedules, personal goals, and social interactions, purely analog products may be perceived as incomplete or disconnected from daily workflows. From a VoC perspective, the demand for QR-based synchronization and digital reminders represents a desire for continuity, accessibility, and convenience. Users want their journaling practices to extend beyond the physical notebook and interact dynamically with digital tools they already use. Digital synchronization enables users to receive reminders, log progress digitally, and maintain behavioral consistency even when the physical journal is not immediately accessible. This hybrid approach enhances usability without eliminating the tactile and reflective benefits of physical journaling. Importantly, the VoC data suggests that users do not view digital integration as a replacement for analog journaling, but rather as a complementary system that enhances functionality. This insight is critical for product development, as it supports the design of a hybrid physical-digital experience that aligns with contemporary user habits while preserving the emotional and reflective depth associated with handwritten journaling.

In contrast to structured and system-driven features, the demand for free journaling pages that selected by 31.6% of respondents, thus introduces an important counterbalance within the VoC findings. While users value structure, tracking, and reminders, they also

emphasize the importance of unstructured space for personal expression, emotional processing, and creative reflection. This preference suggests that users resist overly rigid systems that constrain individuality or impose predefined categories on personal experiences. From a VoC interpretation, free journaling pages serve as a critical space for autonomy, allowing users to write spontaneously, explore emotions, and articulate thoughts that may not fit neatly into habit trackers or predefined prompts. The inclusion of free journaling pages supports emotional flexibility and personalization, which are key factors in long-term user engagement. Journaling is often deeply personal, and excessive structure may reduce its perceived authenticity or emotional safety. By providing unstructured pages alongside structured features, the product accommodates diverse journaling styles and fluctuating emotional needs. This hybrid system allows users to alternate between disciplined behavior monitoring and open-ended reflection, thereby enhancing overall usability and emotional comfort. From a product development standpoint, this VoC insight underscores the importance of designing for emotional autonomy as well as behavioral guidance.

Weekly reflection features received the lowest level of selection at 15.8%, yet this result should not be interpreted as a lack of relevance or value. Instead, it reflects users' preference for features that are perceived as low-effort, flexible, and immediately actionable. Weekly reflection typically requires higher cognitive investment, sustained attention, and dedicated time, which may be perceived as burdensome within the context of students' busy academic schedules. From a VoC perspective, this lower preference highlights the importance of perceived effort in feature adoption. Users may recognize the theoretical value of weekly reflection but prioritize features that fit more seamlessly into daily routines. When analyzed alongside the higher demand for habit tracking and reminders, this finding suggests that users prioritize daily micro-actions over periodic deep reflection. Rather than engaging in structured weekly evaluations, users appear to favor incremental, low-friction interactions that can be completed quickly and consistently. This insight has important implications for feature positioning. Weekly reflection should not be eliminated, but rather reframed as an optional, supportive feature that users can engage with voluntarily when time and motivation permit. By positioning weekly reflection as flexible rather than mandatory, the product can preserve reflective depth without creating perceived barriers to use.

Overall, the VoC findings demonstrate that users prioritize journaling features that support behavioral reinforcement, motivational engagement, and digital convenience, while still valuing creative freedom and optional reflective depth. The interaction between these preferences reveals that effective sustainable product design must integrate cognitive, behavioral, and emotional dimensions within a single, cohesive user experience. Journaling products that emphasize only one dimension, such as motivation without structure or tracking without emotional engagement, are less likely to achieve sustained adoption or meaningful impact. For the development of the NARA biodegradable journaling product, we translated these VoC insights directly into design priorities.

Motivational content and habit tracking emerged as core features because they strongly align with user expectations and play a central role in supporting behavior change. Digital synchronization was positioned as an enabling system that enhances usability and continuity without overshadowing the physical journaling experience. Free journaling pages and weekly reflection were treated as complementary features that provide emotional flexibility and reflective depth while remaining optional and user-driven. By grounding feature prioritization in VoC data, the final product configuration aligns closely with real user expectations and daily practices. This VoC-driven approach increases the likelihood that NARA will be perceived not merely as an eco-friendly stationery product, but as a meaningful tool for sustainable lifestyle transformation and social empowerment. In the broader context of circular economy-oriented design, integrating user voices ensures that sustainability is not imposed as an abstract ideal but embedded organically within everyday behaviors, cognitive routines, and emotional experiences. This integration also strengthens NARA's practical relevance by connecting sustainability-oriented features to users' established routines and behavioral needs. Consequently, the product design reflects

a user-centered pathway in which environmental responsibility, personal reflection, and sustainable behavior are developed as interconnected elements of everyday practice.

3.2 NARA product development

The NARA product follows a user-centered development approach that prioritizes alignment among knowledge content, system structure, and user interaction. This approach is grounded in the understanding that effective digital products—particularly those intended for educational, reflective, or behavioral support purposes—must not only deliver information but also structure that information in a way that is cognitively accessible, contextually meaningful, and behaviorally actionable. In the case of NARA, the product is not conceptualized merely as a digital artifact, but as an integrated knowledge system that translates conceptual understanding into practical user engagement. Therefore, the development process emphasizes coherence between what users learn, how information is organized, and how users interact with the system. At the conceptual stage, NARA was designed by positioning the NARA book as the product's central knowledge foundation, or core knowledge asset. The book serves as the authoritative source that defines the identity, purpose, and intellectual direction of the NARA system. It contains the conceptual narrative, thematic orientation, and informational scope that shape the product's value proposition. Rather than treating the book as a static reference, the development process interprets it as a structured knowledge repository from which digital functionalities and interaction mechanisms can be derived. This positioning ensures that the digital product remains anchored in a well-defined conceptual framework, avoiding fragmentation or loss of meaning during the transition from analog to digital form.

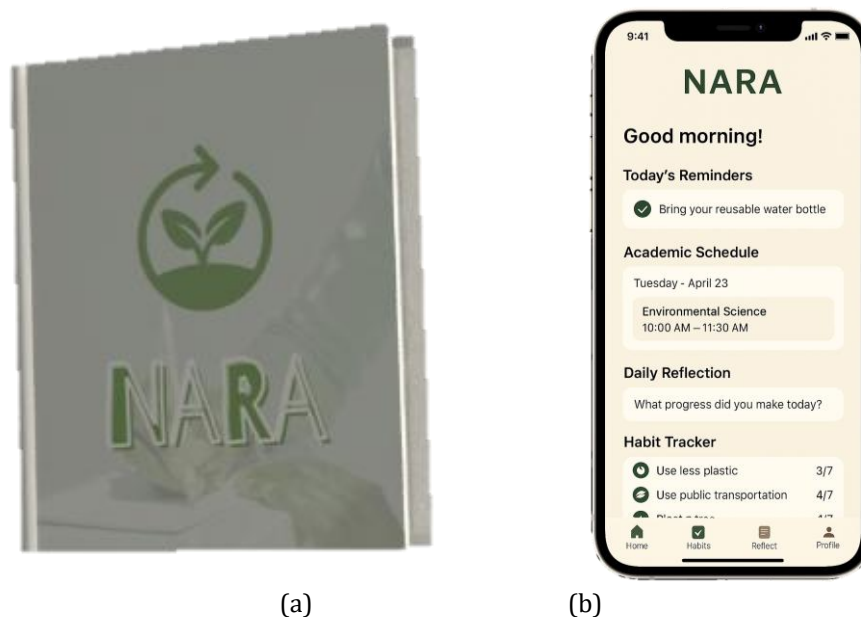


Fig. 2. (a) NARA journal; (b) NARA digital platform

The initial development stage involves a systematic analytical review of the book's content to identify key themes, essential information units, and logical relationships between topics. This analysis goes beyond surface-level content extraction and focuses on understanding the internal structure of the knowledge presented in the book. Concepts are decomposed into smaller informational components, such as definitions, explanations, examples, and contextual narratives, which can later be recomposed within a digital interface. By mapping relationships between these components, the development team establishes a conceptual hierarchy that reflects how knowledge is constructed and understood, rather than how it is merely written. This step is critical in ensuring that the digital product preserves the intellectual depth and coherence of the original material.

Importantly, the development process does not aim to simply digitize textual material or replicate the book's linear format in a digital environment. Instead, the focus lies on restructuring and contextualizing content so that it can be effectively consumed in a digital format, where user attention spans, interaction patterns, and navigational behaviors differ significantly from traditional reading. Digital users often engage with content in a non-linear manner, seeking specific information, skimming sections, or navigating between related topics based on immediate needs. Recognizing this, the NARA development approach transforms linear narratives into modular content units that can be accessed flexibly while still maintaining conceptual continuity. This restructuring allows the product to accommodate diverse user entry points without sacrificing informational integrity. This conceptual adaptation ensures that the core values, educational intent, and informational richness of the NARA book are preserved while being translated into a form that aligns with digital user expectations. The book remains the ideological backbone of the product, but its content is reinterpreted through a user-centered lens that emphasizes clarity, relevance, and usability. As a result, NARA is positioned not merely as a digital version of a book, but as a knowledge-driven system that enables users to interact with content in ways that support comprehension, reflection, and application.

Following the conceptual structuring of content, the next stage of product development involves translating the refined knowledge structure into a user interface (UI) and user experience (UX) design. This stage represents a critical transformation point where abstract knowledge is operationalized into tangible interaction elements. The UI/UX design serves as a functional bridge that connects complex informational content with user interaction capabilities, ensuring that users can navigate, interpret, and utilize knowledge without experiencing cognitive friction. In this context, UI/UX is not treated as a purely aesthetic layer, but as an integral system component that shapes how knowledge is accessed and understood. The development of information architecture forms the foundation of the UI/UX design process. Content derived from the NARA book is organized into hierarchical layers, enabling users to access essential information at a surface level while retaining the option to explore deeper explanations through progressive disclosure. This layered structure is designed to accommodate varying levels of user familiarity and engagement. New users can interact with high-level concepts without being overwhelmed, while more experienced users can delve into detailed content as needed.

From a cognitive perspective, this approach reduces information overload and supports efficient information processing by aligning content presentation with human attention and memory constraints. Visual consistency and layout clarity are emphasized to support user comprehension and interaction continuity. Consistent use of visual elements such as typography, spacing, color schemes, and iconography helps users develop mental models of the system, allowing them to predict where information is located and how interactions function. Clear navigational cues, such as menu structures, visual hierarchies, and interactive indicators, guide users through the system and minimize disorientation. By reducing the cognitive effort required to navigate the interface, the UI/UX design enables users to focus on content understanding rather than system mechanics. In this sense, the UI/UX design acts as a strategic enabler that enhances accessibility, clarity, and usability. It transforms complex conceptual material into an experience that feels intuitive and manageable, even for users encountering the content for the first time. The design does not merely present information, but actively shapes the way users engage with it, influencing comprehension, retention, and perceived value. This aligns with user-centered design principles, which emphasize designing systems that adapt to user needs and behaviors rather than forcing users to adapt to rigid system structures.

The product development process is conducted iteratively, with continuous alignment between content structure and anticipated user interaction patterns. Iteration allows the development team to evaluate coherence between informational logic and interaction flow at each stage of design. Rather than finalizing the interface in a single step, design elements are progressively refined based on internal consistency checks and scenario-based evaluations. This approach is particularly important in contexts where full-scale user

testing may be limited, as it enables designers to anticipate potential usability issues through systematic reasoning and simulation. Each UI/UX component is designed based on potential user scenarios that reflect realistic use cases. These scenarios include activities such as searching for specific information, understanding conceptual explanations, navigating between related topics, and revisiting previously accessed content. By grounding design decisions in user scenarios, the development process ensures that interface elements support actual user goals rather than abstract design preferences. Interaction flows are constructed to minimize unnecessary steps, maintain logical continuity, and support efficient task completion. This scenario-driven approach strengthens the design's functional relevance and improves overall usability. Design elements such as page structure, iconography, typography, and interaction feedback reflect the logical organization established during the content analysis stage.

For example, visual hierarchies mirror conceptual hierarchies, and navigation pathways reflect thematic relationships between topics. Typography choices support readability across different content densities, while icons function as visual signifiers that reinforce meaning and reduce reliance on text. Interaction feedback, such as visual responses to user actions, helps users understand system behavior and reinforces a sense of control. Together, these elements create a cohesive interface that aligns visual design with informational logic. Iterative refinement allows the design to evolve in response to ongoing evaluations of clarity, consistency, and alignment with user-centered principles. Even without direct user testing, coherence checks between content presentation and interaction logic help identify mismatches, redundancies, or potential points of confusion. This reflective design process supports the development of a product that is not only visually coherent but also functionally robust and conceptually sound. By continuously revisiting design decisions, the development process maintains flexibility and adaptability, which are essential qualities in knowledge-based digital products.

In summary, the NARA product development process integrates literature-based knowledge with digital design principles to produce a coherent, functional, and user-oriented product. The NARA book serves as the authoritative knowledge source that defines the system's conceptual foundation and thematic direction. Meanwhile, the UI/UX design acts as a transformation mechanism, translating static, text-based content into an interactive digital experience tailored to user needs and behaviors. This integration ensures that knowledge is not merely presented but actively mediated through design to support engagement and comprehension. Despite the limited availability of development artifacts, such as extensive prototypes or user testing data, the structured and iterative development approach provides a clear methodological foundation. By emphasizing content analysis, information architecture, scenario-based design, and iterative refinement, the NARA development process ensures clarity of purpose, design consistency, and relevance to user needs. As a result, NARA is positioned not only as an informational resource, but also as a practical digital tool that supports learning, reflection, and meaningful interaction. This approach enhances the effectiveness and applicability of the NARA product within its intended context, reinforcing its role as a user-centered, knowledge-driven system.

3.3 Outcome and impact

The primary outcome of the NARA product development is the successful transformation of a literature-based knowledge source into a functional digital product supported by a structured and coherent UI/UX design. This transformation represents a fundamental shift in how knowledge is delivered and experienced by users. Initially, the NARA book functioned as a static informational medium, where content was accessed through linear reading and required sustained cognitive effort to navigate complex themes. Through the product development process, this static medium evolved into an interactive digital platform that enables users to access, explore, and interpret information more efficiently and flexibly. This outcome demonstrates that the integration of structured knowledge assets with thoughtful digital interface design can significantly enhance usability

and applicability without diminishing the conceptual depth or intellectual integrity of the original content. This success is rooted in the User-Centered Design (UCD) framework, where the UI/UX was not merely an aesthetic choice but a result of translating user cognitive patterns into digital affordances. By prioritizing the user's mental model, the transition from paper to digital maintains functional familiarity while enhancing accessibility.

One of the most critical outcomes is preserving the book's conceptual value throughout the digitization and transformation process. Rather than simplifying or fragmenting the original content to fit a digital format, the development approach maintained the core narrative, thematic coherence, and informational richness of the NARA book. The structured UI/UX design functions as a mediation layer that translates complexity into accessibility, allowing users to engage with sophisticated concepts through intuitive interaction pathways. This outcome matters especially for knowledge-based products, where depth often conflicts with usability. The NARA product shows that careful alignment between content structure and interface logic can minimize this trade-off. The structured navigation and visual hierarchy embedded in the UI/UX design enable users to engage with information progressively. Users are not immediately confronted with dense blocks of text or excessive detail; instead, they can begin with high-level concepts and gradually explore deeper layers of information as needed. This progressive disclosure approach supports cognitive processing by aligning information presentation with users' attention capacity and learning pace. As a result, comprehension improves, and barriers commonly associated with text-heavy or conceptually dense materials decrease. From a learning perspective, this outcome supports more effective knowledge absorption, as users can construct understanding incrementally rather than through forced linear exposure.

From a product perspective, NARA delivers a tangible outcome in the form of improved information accessibility and user engagement. Compared to traditional book-based consumption, the digital format enables faster information retrieval, clearer content segmentation, and more intuitive interaction. Users are no longer required to navigate information sequentially from beginning to end but can instead access specific topics based on immediate needs, interests, or contextual relevance. This non-linear access model reflects contemporary patterns of information consumption, particularly among digitally literate users who expect flexibility and control in their interaction with content. Consequently, NARA supports a shift in how knowledge-based products are consumed, emphasizing efficiency, personalization, and user autonomy. In line with Innovation Diffusion Theory, the NARA digital platform exhibits a high relative advantage over traditional books through its non-linear navigation and rapid information retrieval. These attributes, combined with low interface complexity, accelerate adoption among digitally literate students seeking efficient knowledge-sharing tools. Enhanced accessibility also translates into improved functional usability. By structuring content into clearly defined modules and categories, the product reduces the cognitive load associated with searching and interpreting information. Users can quickly locate relevant sections, understand relationships between concepts, and navigate between related topics without losing contextual orientation. This outcome is particularly relevant for users who engage with the product intermittently rather than continuously, as it lets them re-enter the knowledge space without rereading extensive prior material. In this way, NARA accommodates diverse usage patterns, ranging from quick reference to deeper exploratory learning.

Beyond usability, NARA's digital transformation also boosts user engagement by encouraging active interaction rather than passive consumption. The interface design invites users to explore content through navigation choices, layered explanations, and visual cues that guide attention. This interactive dimension increases the likelihood that users will spend more time engaging with the material and return to the product over time. As engagement increases, so does the potential for deeper understanding and meaningful application of the knowledge presented. Thus, the primary outcome of the NARA product development is not merely functional digitization, but the creation of an environment that supports sustained and purposeful interaction with knowledge. In terms of broader impact,

NARA contributes to the field of digital product development by showing how content-driven products can be developed effectively even with limited technical and financial resources. NARA's development approach shows that meaningful digital products do not necessarily depend on advanced system architectures, complex algorithms, or extensive datasets. Instead, product quality depends on the strategic alignment between content structure and user experience design. This insight challenges the assumption that digital innovation is inherently resource-intensive and highlights the value of design thinking and content analysis as foundational development tools. This impact is particularly relevant for small-scale developers, academic initiatives, and early-stage digital products, where resource constraints often limit development scope. In such contexts, developers may lack access to large development teams, sophisticated infrastructure, or prolonged user testing cycles. The NARA case shows that by prioritizing clarity of purpose, structured knowledge organization, and user-centered interface design, developers can still build functional, impactful digital products. As a result, NARA provides a replicable and adaptable model for transforming literature-based content into user-oriented digital platforms without excessive technical complexity.

Furthermore, NARA demonstrates the importance of viewing content as an active design component rather than a static input. The impact of the product lies not only in the digital interface itself, but in the way, knowledge is curated, structured, and contextualized for user interaction. This perspective encourages developers to invest effort in understanding the internal logic of their content and translating it into interface elements that support comprehension and navigation. By doing so, NARA contributes to a broader understanding of how content-driven digital products can achieve effectiveness through thoughtful design rather than technological sophistication alone. The potential long-term impact of NARA extends to knowledge dissemination and learning efficiency across diverse user groups. By presenting structured information through an accessible digital interface, the product lowers entry barriers for users who may find traditional learning materials less engaging, intimidating, or difficult to navigate. This includes users with limited time, varying levels of prior knowledge, or preferences for non-linear learning pathways. As a result, NARA supports more inclusive access to knowledge by accommodating different learning styles and engagement capacities. In educational contexts, NARA can function as a supplementary learning tool that enhances understanding through flexible access and structured presentation. Students can use the platform to review concepts, clarify specific topics, or explore connections between ideas without the constraints of linear reading. In professional or community-based contexts, the product can support efficient knowledge transfer by enabling users to quickly access relevant information and apply it within practical settings. This adaptability increases the product's relevance across multiple domains, amplifying its overall impact.

Another important dimension of impact relates to sustained use and long-term value. The alignment between content clarity and interface usability enhances the likelihood that users will continue to engage with the product over time. When users perceive a digital product as intuitive, efficient, and meaningful, they are more likely to integrate it into their regular routines. This sustained engagement increases the product's cumulative impact, as repeated exposure to knowledge reinforces understanding and supports deeper learning. In contrast, poorly structured digital products often spark initial curiosity, then quickly lose users. NARA's design approach mitigates this risk by prioritizing coherence, usability, and relevance. From a strategic perspective, NARA's outcomes and impacts highlight the role of digital products as mediators between knowledge and behavior. While the product itself does not enforce specific actions, it creates an environment that supports informed decision-making and reflective engagement. By making knowledge more accessible and navigable, NARA empowers users to interact with information on their own terms, fostering agency and ownership over the learning process. This empowerment is critical to the effectiveness of knowledge-based systems, particularly those intended to support personal development or behavioral change.

4. Conclusions

This study concludes that effective product development does not depend solely on advanced technical implementation but can be achieved through the strategic integration of knowledge assets and user-centered design principles. By using the NARA journal as the foundational knowledge source and translating its conceptual structure into a coherent UI/UX design, the study demonstrates that content-driven products can be systematically developed into functional digital concepts. This finding highlights the significance of information architecture and experience design as core components of product development, particularly in the early stages where technical resources may be limited. The main contribution of this research is demonstrating a product development approach that bridges literature-based content and digital interface design within a unified framework.

Rather than reiterating design outputs, the study offers insight into how structured development processes can transform knowledge into user-oriented value. This approach advances science by expanding understanding of user-centered product development beyond conventional software-centric models, offering an alternative pathway for innovation in educational and knowledge-based products. This study addresses the growing need for interdisciplinary methods that connect design, knowledge management, and product development. The conclusions emphasize that this work's originality lies in its methodological contribution, showing that rigorous product development analysis can be conducted using limited but strategically leveraged artifacts. As such, the study offers both theoretical and practical value, supporting future research and development efforts in digital product innovation, particularly in contexts characterized by resource constraints and knowledge-intensive content.

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Author Contribution

Conceptualization, A.A.S.; Methodology, A.A.S., and F.A.P.; Data Curation, F.A.P.; Formal Analysis, A.A.S., and F.A.P.; Resources, M.I.B.; Writing–Original Draft Preparation, A.A.S.; Writing – Review & Editing, A.A.S., and M.I.B.; Visualization, F.A.P.; Project Administration, A.A.S.; Supervision, M.I.B.

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Ethical Review Board Statement

The ethical review board waived ethical review and approval for this study due to its minimal-risk nature. The research involved anonymous questionnaire-based data collection, did not include sensitive personal information, and posed no risk to participants' health, safety, or privacy.

Informed Consent Statement

We obtained informed consent from all subjects involved in the study. Participation was voluntary, and respondents were informed of the study's purpose, the anonymity of their responses, and the confidentiality of the data collected before completing the questionnaire.

Data Availability Statement

The data presented in this study are not publicly available due to privacy and ethical considerations but are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflict of interest.

Declaration of Generative AI Use

During the preparation of this work, the authors used ChatGPT and DeepL solely to assist in language refinement and academic writing. The tool was not used for data analysis or interpretation. After using this tool, the authors reviewed and edited the content as needed and took full responsibility for the publication's content.

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