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ENHANCING USER ENGAGEMENT IN DESA DIGITAL INDONESIA (DDI) KMS THROUGH GAMIFICATION DIGITAL NUDGES

Dzakiyyah Hasbi Hutauruk[1], **Yani Nurhadryani**[2], **Rina Mardiana**[3]

[1,2]Department of Cumputer Science, IPB University, Indonesia
[3]Department of Communication Science and Community Development, IPB University, Indonesia

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ABSTRACT

This study examined how digital nudges integrated with gamification could improve user engagement in Desa Digital Indonesia (DDI) KMS. Using a user-centered design approach, the research was conducted in two iterative cycles involving user testing and interviews with 5 and 20 participants from rural backgrounds. An iterative process involving two design cycles was conducted, including user analysis, prototype development, and evaluation. The initial evaluation involved five participants and revealed that leaderboard and badge features were generally acceptable but less effective in collaborative contexts. Based on these findings, the design was refined by introducing collaborative elements and small incentives, including achievement titles and promotional rewards. The second evaluation showed improved user acceptance, with all participants preferring the new design, and the incentive-based feature receiving the highest positive rating (90%). The findings indicate that combining competitive, collaborative, and incentive-based nudges leads to more effective and contextually relevant user engagement in rural systems.

Corresponding Author:
Yani Nurhadryani,
Department of Computer Science
IPB University
Email: yani_nurhadryani@apps.ipb.ac.id

1. INTRODUCTION

The Desa Digital Indonesia Knowledge Management System (KMS DDI) is a collaborative platform designed to accelerate the dissemination of digital innovation and village-related information. Its primary objective is to enhance access to digital knowledge and advance the smart village concept. The system targets three main user

groups, namely innovators, village stakeholders, and the general public [1] [2] [3]. Its role is increasingly critical, as equitable access to information constitutes a key driver of inclusive rural development [4].

Within the broader framework of digital transformation, rural communities require knowledge management systems that extend beyond information provision to foster interaction and knowledge exchange among users. Therefore, KMS DDI should operate not merely as an information repository but as a dynamic platform that facilitates collaboration and active user participation. This perspective aligns with Alavi and Leidner [5], who argue that effective knowledge management systems must integrate knowledge storage with social interaction to enable the exchange of tacit knowledge.

Despite its potential, the current implementation of KMS DDI demonstrates notable limitations in fostering user engagement. Although the platform incorporates knowledge-sharing features, their utilization remains minimal and largely passive. This condition is shaped influenced by disparities in digital literacy among rural users, limited prior experience with digital systems, and low perceived usefulness of the platform. As a result, the system has yet to achieve its intended function as an effective medium for knowledge exchange.

These challenges highlight the need for interventions that can more effectively stimulate user participation. One promising approach is the application of digital nudges, subtle techniques designed to influence user behavior without constraining freedom of choice [6], [7]. Empirical evidence indicates that digital nudges enhance usability, accessibility, and decision-making quality by leveraging behavioral principles such as default effects (status quo bias), popularity cues (social norms), alerts, gamification, and interface modifications [8], [9].

Digital nudges have been successfully applied across diverse domains, including social, environmental, health, business, and performance contexts [10]. They can be categorized into several types, such as decision information, decision structure, decision assistance, and social influence [11]. Ensuring an appropriate alignment between context needs and selected nudge mechanism is essential to maximize effectiveness implementation.

Previous studies demonstrate that digital nudges can effectively influence user behavior. For instance, Jung et al. [12] reported that a target-based nudge embedded in an energy-saving application reduced energy consumption by up to 4%, illustrating how well-designed nudges can enhance engagement and promote behavioral change.

In practice, digital nudges are frequently integrated with other persuasive strategies, such as gamification, to amplify their impact. The combination of nudging and gamification has been shown to drive behavioral change more effectively than either approach alone [13]. Gamification employs game elements, including points, badges, and leaderboards to strengthen user motivation and engagement [14]. By fostering enjoyment and sustained involvement, gamification generates positive psychological outcomes that directly support behavioral change [15].

Through mechanisms such as leaderboards, reward systems, and achievement badges, gamification creates immersive experiences that encourage active participation. Its effectiveness in enhancing motivation and engagement has been widely documented across diverse domains, including education education [16], project performance [17], transportation [18], and smart cities [19]. In certain contexts, gamification has even outperformed other persuasive techniques, including nudging [20]. Nonetheless, its success remains highly contigent upon contextual factors and other user characteristics [21].

Although numerous studies have demonstrated the effectiveness of gamification-based digital nudges in shaping user behavior and engagement within digital systems, approximately half of these studies (50%) remain concentrated in the education sector, followed by health applications [22]. In such contexts, users typically possess higher levels of digital literacy and clearer usage objectives, enabling behavioral intervention mechanisms to operate more directly. By contrast, the application of similar approaches in knowledge management systems (KMS), particularly in rural settings, remains limited [23]. Rural KMS environments are often characterized by heterogenous digital literacy, unstable intrinsic motivation, and low perceived value of digital platforms. Consequently, strategies proven effective in other domains cannot be directly transferred to rural KMS without contextual adaptation [24].

Moreover, research in Indonesia investigating design-based approaches, such as user-centered design (UCD), to integrate digital nudges and gamification within KMS remains scarce Such integration is critical to ensure that interventions are not only technically robust but also tailored to the needs, capabilities, and behavioral characteristics of end users [25].

Addressing these gaps, the present study proposes an enhanced design of KMS DDI that incorporates digital nudges and gamification through a user-centered design (UCD) framework to strengthen user engagement in rural communities [26]. An initial evaluation is conducted to generate preliminary insights into the effectiveness of the proposed design [27]. This study is expected to contribute to the broader application of gamification-based digital nudges in rural knowledge management systems, thereby advancing inclusive digital transformation [28].

2. RESEARCH METHOD

This study employs a user-centered design (UCD) approach with an iterative design process to develop and evaluate the integration of digital nudges and gamification within the KMS DDI platform. The UCD framework was selected to ensure that the resulting design is closely aligned with user needs and characteristics, particularly those of rural communities as the primary beneficiaries [29].

The research methodology is structured around the framework with adaptations to accommodate an iterative, user-driven design cycle. The study consists of two main iterations, each comprising three stages: user analysis, digital nudge design, and evaluation. The first iteration focuses on producing an initial prototype, while the second iteration refines the design based on user feedback and evaluates its effectiveness with a broader participation group [30]. The overall research flow is presented in Figure 1.

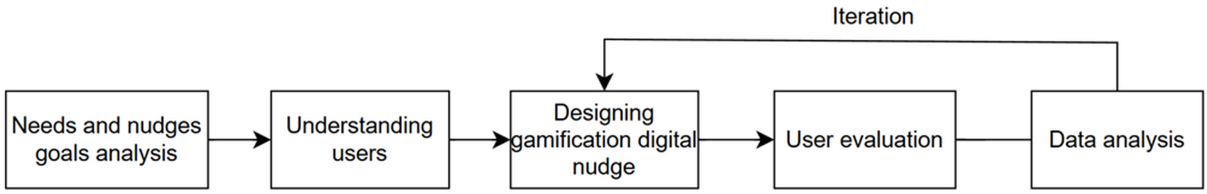

Figure 1: Research Flow

2.1 Needs and nudges goals analysis

This stage is designed to identify system requirements and define the objectives of implementing digital nudges within KMS DDI. The analysis is guided by the overarching goal of the platform: to foster its use as a medium for knowledge exchange and the adoption of digital innovations in rural communities.

The process involves structured discussions with key stakeholders to elicit user needs, clarify system objectives, and explore relevant scenarios for nudge application. The outcomes of this stage provide the foundation for selecting and designing appropriate digital nudge and gamification strategies that are contextually aligned with the system environment and the behavioral characteristics of its users.

2.2 Understanding Users

This stage is conducted to gain a comprehensive understanding of the characteristics, needs, and behavioral tendencies of rural communities as the primary users of KMS DDI. The analysis is informed by findings from the initial development of the platform as well as relevant literature on rural user behavior.

The focus includes examining users' goals in utilizing the system, their decision-making processes in accessing and applying information, and as cognitive factors such as heuristics and biases that may shape user choices [22]. In addition, the analysis considers users' perceptions of digital innovation, prior experience with technology, and motivational drivers for engaging with KMS platforms. These insights serve as the foundation for designing digital nudge and gamification mechanisms that are appropriately tailored to the rural context.

2.3 Designing Digital Nudge

The design of the nudge approach is developed based on system requirements and insights from relevant literature, particularly the frameworks proposed by Thaler et al. [24] and Bhatt-Seetharaman [25], while also accounting for user heuristics and behavioral biases. The proposed strategies are operationalized through gamification, serving as practical application of digital nudges. This integration enables the use of interactive elements such as ranking systems, reward mechanisms, and achievement badges, to strengthen user motivation and engagement [26].

The designed approach is subsequently mapped into interface components and translated into user interactions within the system. The design process is conducted iteratively: an initial prototype is created for evaluation, refined based on user feedback, and further developed into a high-fidelity prototype. The final prototype is produced using Figma, in alignment with the established KMS DDI design system.

2.4 User Evaluation

Evaluation is conducted to assess the suitability of the design for user characteristics and to identify potential improvements. User testing involves participants who meet the following criteria:

a. Living in rural areas or actively involved in village-related activities,

b. Using smartphone devices, and

c. Aged between 20 and 50 years.

The evaluation is conducted in two phases. The first phase involves five participants and is designed to obtain initial feedback on the proposed nudge design through think-aloud observations and semi-structured interviews. This method captures participants' real-time perceptions and cognitive processes during system interaction [27], [28]. The second phase expands the evaluation to 20 participants, comprising 13 rural residents and 7students originating from rural areas. This composition ensures that the assessment reflects the relevance of the design to rural needs while also incorporating perspectives from users with higher levels of digital literacy. In this phase, participants compare two design versions through user testing and provide feedback via interviews and Likert-scale questionnaires to assess the perceived effectiveness of the design.

The questionnaire consists of five evaluation items, covering: (Q1) the attractiveness of the ranking system, (Q2) the usefulness of the ranking system for recommending innovations, (Q3) the motivational effectiveness of leaderboard and badge features, (Q4) the motivational effect of title-based features, and (Q5) the effectiveness of incentive-based digital nudges in the form of free promotional advertisements.

2.5 Data analysis

The collected data are analyzed using both qualitative and quantitative approaches. Interview data are analyzed using thematic analysis, which aims to identify patterns or emerging themes from the data through interpretation of initially unstructured information [29]. In summary, key takeaways are derived to represent the main insights related to the digital nudge design.

Meanwhile, questionnaire data are analyzed descriptively by examining the distribution of responses and the proportion of positive responses (scale 6-7, corresponding to "agree" and "strongly agree") to assess user perceptions and preferences toward the design. This approach provides a comprehensive understanding of user responses and supports further design refinement.

$$\text{Positive Response } (\%) = \frac{f_6 + f_7}{n} \times 100\% \tag{1}$$

f_6 and f_7 represent the frequencies of responses at scale 6 ("agree") and scale 7 ("strongly agree"), respectively, while ndenotes the total number of respondents.

3. RESULT AND ANALYSIS

3.1 Needs and nudges goals analysis

The results of the needs analysis indicate that KMS DDI is designed as a platform that supports the exchange of digital innovation information in rural areas, while also encouraging user engagement in the innovation adoption process. However, the current system interface is still primarily focused on information presentation and lacks elements that actively promote user engagement. Therefore, it is necessary to design digital nudges to encourage more active user engagement, taking into account both system objectives and user needs. This condition can be observed in Figure 2.

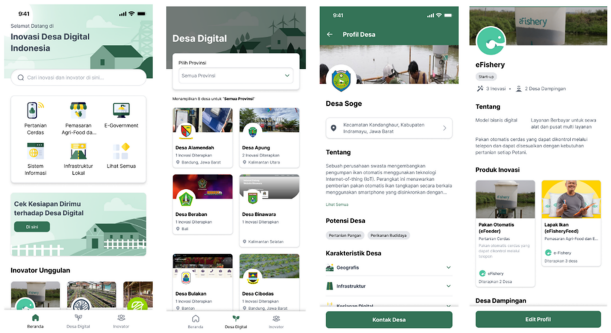

Figure 2: The KMS DDI interface currently focuses primarily on information presentation

Based on the analysis, four main system objectives were identified: (1) to facilitate the exchange of village innovation information, (2) to encourage interaction among users, (3) to increase village participation in adopting digital innovations, and (4) to support system sustainability through funding mechanisms.

Accordingly, specific objectives for implementing digital nudges were formulated, including: (1) encouraging users to access digital innovation information, (2) guiding users to explore village and innovator profiles, (3) motivating users to claim innovations that have been implemented, and (4) increasing the number of users registering on the platform.

Furthermore, the analysis indicates that digital nudges should be strategically placed at key interaction points within the user journey. These include the initial stage when users access the platform, the stage of exploring innovation-related information, and the stage when users access digital village profiles.

At the initial stage, users often do not have clear goals; therefore, stimuli are needed to capture attention and encourage exploration. During the exploration stage, interventions focus on maintaining engagement and guiding users toward desired actions. Meanwhile, at the village profile stage, interventions aim to strengthen perceived value by presenting real examples of innovation implementation, thereby encouraging users from other villages to adopt digital innovations.

3.2 Understanding User

The analysis results indicate that users have two primary goals when using the system: (1) to obtain information related to digital innovations and digital villages as references, and (2) to use the platform as a medium for promotion and collaboration among villages. In addition, users also need to see tangible evidence of successful innovation implementation as a basis for decision-making.

In the decision-making process, rural users tend not to rely entirely on complex rational considerations but are instead influenced by heuristics, or simple rules of thumb, when evaluating choices. While heuristics simplify decision-making, they can also lead to cognitive biases that influence user behavior. Based on the analysis, several cognitive biases were identified as influencing user behavior:

a. Social norms: the tendency of users to follow behaviors commonly observed within their social environment, particularly when there are examples of other villages that have successfully implemented certain innovations.

b. Status quo bias: the tendency to maintain familiar and perceived safe conditions, which can hinder the adoption of new innovations.

c. Hyperbolic discounting: the tendency to prioritize immediate, short-term benefits over uncertain long-term benefits.

Furthermore, user decisions are strongly influenced by the presence of tangible evidence and social references when evaluating innovations. Users tend to be more attracted to information that demonstrates successful implementation.

3.3 Designing Digital Nudge

Based on the findings from the previous stage, approaches that leverage social influence are identified as particularly relevant for designing digital nudges. This relevance stems from characteristics that are strongly shaped by social norms and a preference for adopting practices already proven successful within their communities. Furthermore, the tendency to maintain familiar conditions (status quo bias) suggests that users are more likely to be influenced by concrete examples rather than independently exploring new innovations.

Accordingly, mechanisms of social influence, social comparison, and social proof were selected as the foundation for interventions aimed at enhancing user engagement and decision-making. These approaches have been shown to be effective in promoting behavior change in contexts where social ties are strong, such as rural communities [30]. In line with these considerations, gamification elements, specifically leaderboards and badges, were chosen as the practical implementation of digital nudges. Illustrations of the digital nudge design are presented in Figures 3.

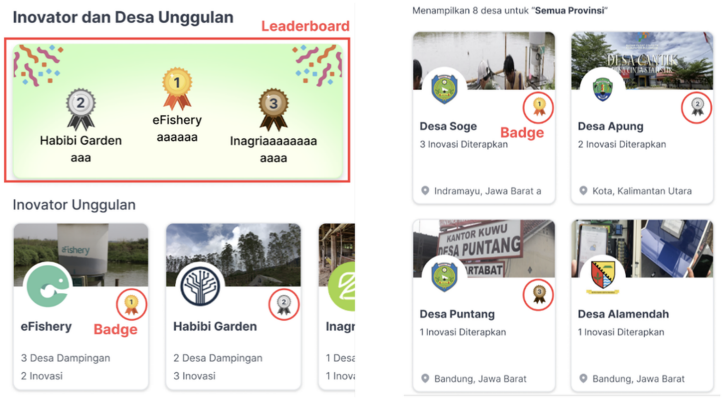

Figure 3: Digital nudge design display: (a) Leaderboard on the homepage; (b) Badge on village cards on the digital village page (note: the KMS using Indonesian language)

a. Leaderboard

The leaderboard displays rankings of villages and innovators based on their level of contribution to the system. Village rankings are determined by the number of adopted innovations, while innovator rankings are based on the number of villages they support. This feature implements social comparison, social proof, and social influence mechanisms by allowing users to observe and compare achievements among participants.

In the village context, the leaderboard provides a visual representation of innovation adoption levels, reinforcing the perception that innovations are widely used and encouraging other users to follow similar behavior. In the innovator context, the leaderboard functions as a reputation indicator based on innovation adoption levels, helping villages evaluate and select credible innovators.

b. Badge

Badges are awarded as a form of recognition to villages and innovators who achieve top rankings on the leaderboard. For villages, badges serve as a promotional tool that highlights their success in adopting digital innovations. For innovators, badges function as indicators of reputation and innovation quality. In addition, badges act as a reinforcement mechanism that can enhance user motivation to actively participate in the system.

3.4 User Evaluation (Iteration 1)

The first evaluation involved five participants with diverse demographic backgrounds, as presented in Table 1.

Table 1: Participant Demographics (Iteration 1)

Question	P1	P2	P3	P4	P5
Age	47	24	24	23	48
Gender	Male	Female	Male	Female	Male
Last Education	Elementary School	Bachelor's Degree	Bachelor's Degree	Bachelor's Degree	Bachelor's Degree
Occupation	Farmer and laborer	College student and freelancer	Secretary of BUMDES, village youth organization	Freelancer	Coffee farmer

Overall, all participants were able to use the system effectively and complete the exploration tasks without significant difficulties. This indicates that the interface design meets basic usability requirements and does not hinder user interaction. Moreover, all participants recognized the implemented digital nudge elements, particularly the leaderboard and badge features, suggesting that these components possess sufficient visibility within the system.

The evaluation, however, revealed notable differences in participant responses. The majority of participants (four out of five) provided positive feedback on the digital nudge design. The leaderboard feature was perceived as motivating through social comparison, encouraging users to evaluate their village's performance to others.

Information highlighting villages that had successfully adopted innovations functioned as social proof, reinforcing perceptions that digital innovations are beneficial and worth adopting.

The badge feature further strengthened this effect by offering symbolic rewards, enhancing users' sense of achievement and collective pride. Together, these elements fostered healthy competition and were seen as having the potential to accelerate innovation diffusion across villages. Some participants even associated these mechanisms with broader impacts, such as increased economic activity and job creation, indicating that digital nudges can influence not only individual behavior but also perceptions of system value.

Nevertheless, not all participants responded positively. One participant expressed skepticism regarding the relevance of competition-based digital nudgesin village contexts, which are often more collaborative than competitive. This participant argued that without tangible incentives, such as program support or direct benefits, leaderboard and badge features may have limited effectiveness in driving behavioral change.

These differing responses appear to be linked to variations in user characteristics, particularly in terms of digital literacy, involvement in village activities, and exposure to technology. Participants with greater technological familiarity and actively engagement in village initiatives tended to respond more positively, whereas those with limited exposure were more skeptical.

These findings suggest that the effectiveness of digital nudges is strongly influenced by the sociocultural context. In more traditional village settings, decision-making is often driven by needs and short-term benefits, reflecting hyperbolic discounting, where immediate gains are prioritized over uncertain long-term outcomes. Additionally, strong collaborative values within rural communities may reduce the effectiveness of competition-based approaches, meaning that social comparison mechanisms do not always align with prevailing social norms.

The evaluation also identified areas for design improvement, particularly regarding nudge visibility. Several participants recommended placing the leaderboard in a more prominent location, such as the homepage, to ensure immediate visibility upon system access. This underscores that, beyond selecting appropriate nudge mechanisms, visual implementation and element placement are also critical factors in determining intervention effectiveness.

Overall, the evaluation results indicate that gamification-based digital nudges hold significant potential to enhance user engagement and motivation. However, the approach is not yet fully inclusive and requires further adaptation to accommodate diverse user characteristics, particularly those with lower levels of technology adoption and stronger collaborative orientations.

These findings highlight the importance of context-sensitive design and reveal a gap between initial design assumptions and actual field conditions. Consequently, design refinement is necessary, not only by emphasizing competitive elements but also by incorporating more tangible incentives, improving element visibility, and exploring alternative nudge mechanisms that better align with the sociocultural realities rural communities. These insights form the basis for the next design iteration.

3.5 Digital Nudge Design Improvement

The design improvements were carried out based on findings from the user evaluation stage, which indicated that the initial design was not fully effective in encouraging sustained user engagement. Although leaderboard and badge features were able to attract attention and motivate some users, user interactions remained largely reactive, with users accessing the platform only when they had specific information needs, rather than being driven by system-induced exploration.

In addition, the competition-based approach implemented through leaderboards and badges was not fully aligned with the characteristics of some rural communities, which tend to prioritize collaboration, exhibit low competitive motivation, and focus more on short-term benefits. This condition highlights a mismatch between initial design assumptions and the sociocultural context of users. Based on these findings, three main needs were identified for the design improvement process:

1. The provision of more tangible incentives to strengthen user motivation
2. The adoption of approaches that better align with collaborative social values
3. The inclusion of varied digital nudges to encourage continuous user engagement with the platform.

To address these needs, additional digital nudge variations were developed while still adhering to previously identified heuristic/bias principles and social influence approaches. One of the implemented solutions was the introduction of title-based achievements. Unlike badges, which are competitive and hierarchical, titles are designed as a more inclusive form of recognition that does not pressure users to achieve top rankings. Examples include titles such as "Innovation Driver" and "Digital Advocate," which aim to build a positive image and strengthen village identity as agents of transformation.

These titles are displayed on village and innovator profile cards to enhance visibility and allow other users to observe these achievements. This mechanism leverages social proof and social influence, encouraging users to follow socially recognized practices without requiring direct competition.

Furthermore, to address the need for incentives, a dynamic banner feature was introduced on the homepage, providing free promotional space for top-performing villages and innovators based on leaderboard rankings. This incentive is designed as increased visibility rather than substantial material rewards, thereby maintaining the core principle of nudging as a subtle behavioral intervention.

Improvements were also made to the interface layout, particularly by increasing the visibility of the leaderboard through its placement in a more strategic area on the homepage. This ensures that nudge elements are immediately visible at the beginning of user interaction, enhancing their effectiveness as attention triggers and motivational cues. The updated title-based gamification nudge design is shown in Figure 4.

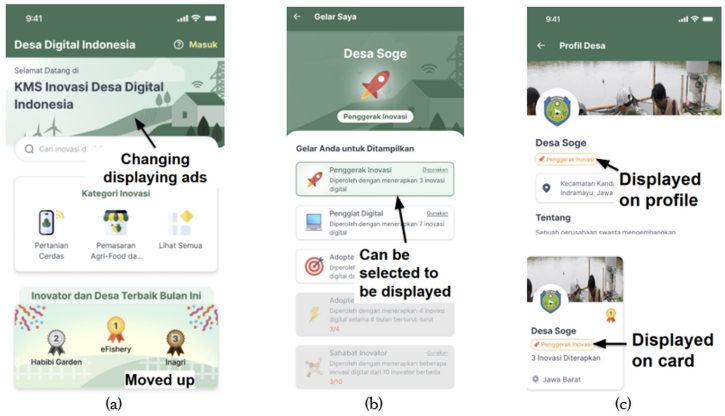

Figure 4: Digital nudge improvements: (a) Changes the position of the leaderboard and ads, (b) Title feature, (c) Titles on village details and village cards

3.6 User Evaluation (Iteration 2)

The second iteration evaluation was conducted to assess the effectiveness of the improved digital nudge design developed based on findings from the previous stage. The evaluation involved 20 participants with diverse demographic backgrounds. The majority were male (65%) and predominantly from Generation Z (60%), followed by Generation X (25%) and Millennials (15%). Educational backgrounds varied, with most participants holding a high school diploma (45%), followed by bachelor's degrees (35%) and junior high school education (20%). Most participants were from Sirnaresmi Village, which served as the primary testing location, as shown in Table 2.

Table 2: Participant Demographics (Iteration 2)

Variable	Choice	Total	Percentage
Gender	Male	13	65%
	Female	7	35%
Age	20–26 years (Gen Z)	12	60%
	27–42 years (Millennials)	5	25%
	43–58 years (Gen X)	3	15%
Education	Junior High School	4	20%
	Senior High School / Vocational	9	45%
	Bachelor's Degree	7	35%
Occupation	Non-village official	7	35%
	Village official / community empowerment staff	6	30%
	Student	7	35%

This demographic variation influenced participants' levels of knowledge regarding digital innovation and the concept of digital villages. Participants with higher education levels and active involvement in village activities tended to demonstrate better understanding, largely due to more frequent exposure to and interaction with technology. In contrast, participants with lower educational backgrounds and limited engagement in village activities

showed lower levels of technological exploration and, consequently, more limited understanding of digital innovation. This finding suggests that user segmentation in UX design for rural contexts should not rely solely on conventional demographic factors but also consider social roles and levels of community engagement.

Interestingly, although age is often associated with technological understanding, it was not the primary determining factor in this study. Some older participants (Generation X and Millennials) demonstrated strong understanding of digital innovation, particularly when they were actively involved in village activities. This indicates that social factors, such as community involvement and roles in local decision-making, have a stronger influence than age alone.

These findings suggest that readiness for adopting digital innovation in rural communities is shaped not only by demographic factors but also by a combination of digital literacy and social engagement. This insight is particularly important in the context of designing digital nudges, as it highlights the need for approaches that can accommodate varying levels of user understanding while also considering social roles in decision-making processes.

3.7 Evaluation Result

The evaluation results indicate that the revised design received more positive responses. No low ratings were observed across evaluation items, and all participants expressed a preference for the new design. This suggests that the design improvements successfully enhanced the overall user experience, particularly in terms of attractiveness, relevance, and motivational potential.

Quantitatively, differences in effectiveness were observed across digital nudge elements. As presented in Table 3, all nudge designs received ratings ranging from neutral to strongly agree in terms of perceived effectiveness. The distribution of responses also indicates varying levels of agreement across items.

Table 3: Results of the Questionnaire on Participants' Preferences for Digital Nudges

Question	Scale 1	Scale 2	Scale 3	Scale 4	Scale 5	Scale 6	Scale 7
Q1	0	0	0	2	5	4	9
Q2	0	0	0	0	7	8	5
Q3	0	0	0	1	5	5	9
Q4	0	0	0	2	3	8	7
Q5	0	0	0	1	1	5	13

To further examine these differences, the proportion of positive responses (scale 6-7) was calculated for each evaluation item. As shown in Table 4, incentive-based features specifically free promotional advertisements as rewards achieved the highest level of agreement (90%). These features were perceived as providing direct and tangible benefits, making them more effective in attracting user interest and encouraging sustained engagement. This finding aligns with the concept of hyperbolic discounting, where individuals prioritize immediate, tangible benefits over uncertain long-term gains.

Table 4: Quantitative Evaluation Results

No	Question	% Positive Responses (Scale 6–7)
1	Q1	65%
2	Q2	65%
3	Q3	70%
4	Q4	75%
5	Q5	90%

In addition, collaborative features such as titles also demonstrated a high level of acceptance (75%). These features were perceived as more aligned with the social characteristics of rural communities, as they provide recognition without imposing competitive pressure and more inclusive. Unlike hierarchical badges, titles offer flexible recognition that can be achieved through various forms of contribution, making them more compatible with the strong sense of community in rural environments.

Conversely, leaderboard and badge features showed moderate acceptance levels (65-70%). Although still perceived positively, their effectiveness was limited when not accompanied by clear incentives. This suggests that competition-based approaches are not universally effective, particularly in communities that prioritize collaboration over competition. However, their effectiveness improved when combined with incentive mechanisms, indicating

that competitive elements still play a role but require complementary support. This further reinforces the preference for more collaborative approaches in rural contexts.

3.8 Qualitative Findings

These quantitative findings are supported by qualitative analysis. Thematic analysis identified three key themes influencing user perceptions and preferences: (1) Preference for collaborative approaches, (2) The importance of tangible incentives, and (3) Shift from competitive to more inclusive mechanisms. A summary of the three thematic analysis findings is presented in the Table 5.

Table 5: Qualitative Findings (Thematic Analysis)

Theme	Description	Example Quote
Preference for collaborative design	The new design is preferred as it feels more collaborative and motivates users to revisit the system	"In my opinion, the new design can better motivate users to revisit the website and apply the innovations."
Role of tangible incentives	Advertising as a reward becomes a key driver due to its direct benefits and increased attractiveness	"The addition of ads as rewards is appealing. It can encourage villages to adopt innovations and guide users to explore featured villages."
Shift from competitive to collaborative	Title-based features are perceived as more inclusive than badges and reduce competitive pressure	"Titles make it less competitive and more aligned with the collaborative nature of village communities. It's also less discriminatory."

Participants generally perceived the revised design as more collaborative and more effective in motivating them to revisit the system. The advertising feature, introduced as a tangible incentive, emerged as a primary driver because it provides direct benefits, such as opportunities for village promotion, which were previously unavailable. Meanwhile, the title-based feature offerred personal satisfaction while fostering a sense of community, as recognition was not limit solely to top-ranked users.

Overall, the evaluation results indicate that the effectiveness of digital nudges is strongly influenced by the alignment between design mechanisms, users' intrinsic and extrinsic motivations, and their sociocultural characteristics. These findings reinforce the view that the success of behavior-based interventions is highly dependent on the implementation context, particularly in communities with strong social values such as rural societies.

This study also contributes to the understanding of social-based approaches in gamified digital nudge design. While social norm–based strategies remain relevant, their implementation requires careful adaptation. In this study, social proof and social influence mechanisms proved effective, but they performed best when combined with elements that encouraged collective participation rather than competitive pressure. By contrast, social comparison mechanisms were not consistently effective in communities with strong collective orientation, underscoring the limitations of competition-based gamification.

The findings further suggest that combining multiple types of digital nudges yields greater impact than applying a single approach in isolation. The integration of competitive elements (leaderboard), collaborative elements (titles), and incentive-based elements (advertising) enhanced attractiveness, relevance, and the potential for sustained user engagement. This supports a multi-strategy approach in persuasive technology, where complementary mechanisms strengthen intervention effectiveness.

From a practical perspective, this study highlights the importance of designing adaptive and context-aware digital nudges. In the case of KMS DDI, an approach that combines tangible incentives, collaborative mechanisms, and strategically reinforced competitive elements proved more effective in addressing diverse user characteristics. This is particularly important given the heterogeneity of rural communities in terms of digital literacy, motivation, and social values. Therefore, the combination of leaderboard and badge features with advertising incentives is recommended as a priority for initial implementation, which can then be complemented by title-based features to support sustained engagement.

However, this study has several limitations. The relatively small number of participants and the specific context of rural communities in Indonesia limit the generalizability of the findings. In addition, the evaluation primarily focuses on user perceptions and preferences, and therefore does not fully capture long-term behavioral changes. Future research is recommended to examine the impact of digital nudge implementation in real-world usage contexts and to involve a larger and more diverse sample of participants.

4. CONCLUSION

This study demonstrates that the implementation of gamification-based digital nudges in the KMS DDI platform has the potential to enhance user engagement and promote the adoption of digital innovations in rural communities. However, its effectiveness is not solely determined by the presence of nudge elements, but rather by the alignment between design mechanisms and users' sociocultural and motivational characteristics.

The evaluation results indicate that competition-based approaches, such as leaderboards and badges, are not consistently effective when applied independently in rural contexts characterized by strong collective values. In contrast, more collaborative and inclusive elements, such as achievement titles, along with tangible incentives like free promotional features, are more effective in sustaining user motivation and engagement. These findings suggest that, in rural settings, immediate and perceivable benefits play a more significant role in influencing user behavior than purely symbolic rewards.

Furthermore, this study finds that no single digital nudge mechanism is universally dominant. Instead, a combination of competitive, collaborative, and incentive-based elements yields more optimal outcomes than any single approach. This reinforces the importance of a multi-strategy approach in persuasive technology design, particularly for heterogeneous user groups.

From a theoretical perspective, this study contributes to the limited body of knowledge on digital nudge applications within knowledge management systems in rural contexts. The findings highlight that while social influence mechanisms remain relevant, they must be adapted into more contextual and not exclusively competition-driven forms.

Practically, this study provides insights for UX design in community-based systems, emphasizing the importance of developing adaptive digital nudges that align with social values, digital literacy levels, and users' practical needs. A design approach that integrates tangible incentives, collaborative mechanisms, and calibrated competitive elements is shown to better accommodate diverse user characteristics.

Nevertheless, this study is limited by the relatively small number of participants and the specific implementation context. Future research is recommended to evaluate the effectiveness of digital nudges in real-world deployments and to examine their long-term impact on user behavior. Additionally, further exploration of context-adaptive nudge mechanisms tailored to local conditions remains an important direction for future studies.

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