

Success Factors and Development Priorities of a KKN Information System: DeLone-McLean, PLS-SEM, and IPMA

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Abstract

Kuliah Kerja Nyata (KKN) requires Indonesian university students to submit attendance records and daily activity logs throughout their community service, often from villages with limited internet connectivity. This study developed a web-based KKN information system using the prototyping method, examined the factors associated with its success, and formulated development priorities. The evaluation integrated the DeLone-McLean information systems success model with task-technology fit (TTF). Survey data from 193 users (183 students and 10 field supervisors) were analyzed using partial least squares structural equation modeling (PLS-SEM), importance-performance map analysis (IPMA), and the Kruskal-Wallis test. TTF was the strongest predictor of user satisfaction ($\beta = 0.542$, $p < 0.001$). Satisfaction and TTF jointly explained 74.4% of the variance in effective use, whereas effective use and satisfaction explained 78.4% of the variance in net benefits. IPMA identified TTF, satisfaction, and effective use as the constructs with the highest importance. Lower perceived internet quality was associated with lower perceived access speed ($p = 0.002$) but not with satisfaction or net benefits. A load test on the production server handled up to 50 concurrent users without errors. The proposed development priorities are analytical recommendations that remain to be validated through subsequent implementation.

Keywords: DeLone-McLean; IPMA; KKN information system; PLS-SEM; task-technology fit

1. INTRODUCTION

Kuliah Kerja Nyata (KKN) is a community service program that university students in Indonesia are required to complete. Through KKN, students live and work with village communities for a defined period. During the program, students carry out work plans with local residents and report to field supervisors (DPL) and the organizing committee. Such community engagement constitutes an important part of the societal role of universities [1]. Behind these field activities lies a considerable administrative workload that spans registration, group assignment, attendance, daily activity logs, supervision, and final reporting. Many universities have moved KKN administration to web-based information systems. However, a KKN system differs from typical academic systems. Attendance and daily logs are submitted every day, so the system is used continuously throughout the program and is frequently accessed by many students at the same time. Most students rely on mobile phones, and many KKN sites are located in villages with weak internet signals, while internet access quality is associated with user satisfaction in online services [2]. A KKN system must therefore be lightweight, remain responsive under concurrent use, and be easy to understand. The researchers' prior experience in building multi-role web systems with Laravel and Filament [3] and in optimizing systems for resource-constrained devices [4] informed the development of the system examined in this study.

Several studies have evaluated KKN information systems in Indonesia. Handayani and Saputera applied the technology acceptance model (TAM) to examine how perceived ease of use and usefulness relate to the use of an online KKN system [5]. Tiwi and Khaira assessed a KKN management information system using the HOT-FIT framework [6]. Ananda et al. combined HEART metrics with importance-performance analysis to assess the user experience of a KKN system [7], while Adelia et al. measured user satisfaction with an E-KKN registration system [8]. Fitriani et al. integrated EUCS, DeLone-McLean, and self-efficacy in a lecturer research and community service system [9].

Nugraha et al. designed the user interface of a KKL and KKN management system, although their work remained at the design stage and was not deployed [10]. These studies were selected because they evaluate or design KKN or community service information systems at Indonesian universities. Table 1 compares them.

Table 1. Comparison with previous studies

Study	Object	Method	Respondents	Addresses system design	Analyzes internet quality	Sets development priorities
Handayani and Saputera [5]	Online KKN system	TAM, multiple linear regression	100 students	No	No	No
Tiwi and Khaira [6]	management information system	HOT-FIT, PLS-SEM	100 students	No	No	No
Fitriani et al. [9]	Lecturer research and community service system	EUCLS, DeLone-McLean, PLS-SEM	89 lecturers	No	No	No
Ananda et al. [7]	KKN system	HEART, IPA	98 students	No	No	Yes, item level
Adelia et al. [8]	E-KKN registration	TAM, multiple linear regression	30 students	No	No	No
Nugraha et al. [10]	KKL and KKN UI/UX design	UCD, heuristic evaluation	1 expert and 10 users	Yes, interface design only	No	No
This study	Deployed KKN system covering all stages	DeLone-McLean with TTF, PLS-SEM, IPMA, Kruskal-Wallis	183 students and 10 DPL	Yes, deployed system	Yes	Yes, construct level

As Table 1 shows, the reviewed studies largely measured user perceptions, covered only a single stage such as registration, or did not reach a deployed system. Among the studies reviewed here, none combines how the system was designed, how it was made lightweight for rural use, which factors are associated with its success, which areas should be prioritized for development, and how evaluations differ by internet quality at the site. This combination constitutes the contribution of the present study.

To evaluate system success, this study adopts the DeLone-McLean model, which posits that system quality, information quality, and service quality are related to use, user satisfaction, and net benefits [11], [12]. The model has been widely applied to educational systems, including student information systems [13], digital libraries [14], Moodle [15], and learning management systems [16], [17], [18]. In Indonesia, quality and satisfaction models have also been used to evaluate public service applications, mobile applications, and digital banking services [19], [20], [21]. In the e-government context, satisfaction is associated with continuance intention [22].

This study adds two quality dimensions that are characteristic of KKN systems. UI/UX captures the experience of interacting with the interface, such as the clarity of icons, task flows, and comfort on mobile phones [7], [10]. It differs from system quality, which captures technical performance such as speed and stability. Dashboard quality captures the summaries and visualizations on the landing page of each role, whereas information quality captures the content of information throughout the system. Because all five quality dimensions are evaluated from the user experience of the same system, their boundaries may overlap. This possibility is examined explicitly through HTMT and VIF.

KKN systems are also mandatory. Students may access the system frequently because they are required to, not because it genuinely supports their work. This study therefore incorporates task-technology fit (TTF), defined as the degree to which system features match the tasks users must perform [23]. Use is assessed as effective use, that is, use that helps users attain their task goals [24]. Combining TTF with information systems success models helps explain satisfaction and success in digital learning in higher education [25], [26].

This study consists of two parts. The first part describes how the system was designed with the prototyping method and how it was optimized to remain lightweight. The second part evaluates the system with three objectives: (1) to examine the associations among quality factors, TTF, satisfaction, effective use, and net benefits using PLS-SEM, (2) to identify construct-level development priorities based on

importance-performance map analysis (IPMA), and (3) to compare user evaluations across levels of internet quality at KKN sites using the Kruskal-Wallis test.

2. MATERIALS AND METHODS

2.1. Research Design

The study was conducted in two phases, as shown in Figure 1. Phase A involved designing and building the system using the prototyping method. Phase B involved evaluating the system through a user survey after the system had been used throughout the KKN period, complemented by a load test on the production server.

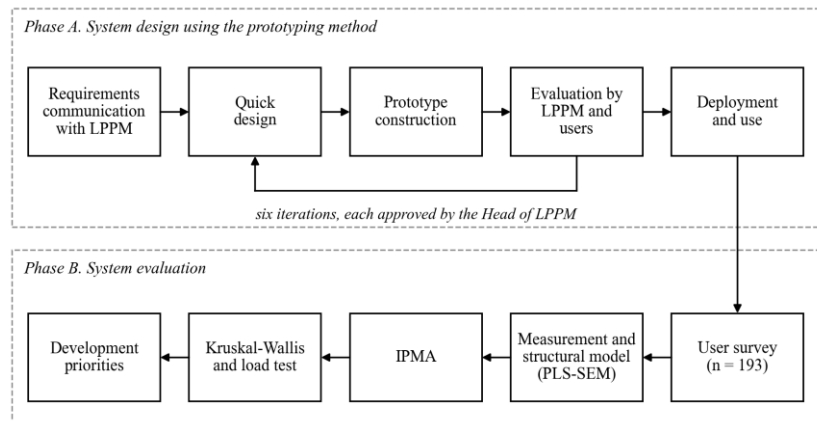


Figure 1. Research stages

2.2. System Design Using the Prototyping Method

The system under study is a web-based KKN information system used in the 2026 KKN program of Universitas Widya Nusantara. The prototyping method was chosen because many KKN requirements became clear only when administrators could view and try the system directly [27]. Development proceeded in six iterations, as summarized in Table 2. The participants were the Head of the Institute for Research and Community Service (LPPM), who is responsible for KKN, staff of the Academic and Student Affairs Bureau (BAAK), DPL, and KKN students. The criterion for proceeding to the next iteration was approval by the Head of LPPM that the workflow and interface complied with KKN regulations.

Table 2. Prototype development iterations

Iteration	Participants	Activities and feedback	Outcome
1	Head of LPPM	Oral discussion of the KKN workflow, document requirements, groups, attendance, daily logs, supervision, reports, and grading	Requirements list and division into three panels
2	Head of LPPM	User interface mockups for each panel Trial of the administrator panel and configuration of registration	Interface design approved
3	Head of LPPM and BAAK staff	requirements (payment receipt, student ID card, health certificate, academic transcript)	Document requirements configurable by administrators
4	All 35 DPL during DPL training	Supervision dates needed to be editable	Major revision of the supervision interface and workflow
5	All KKN students (374) during the KKN briefing	Trial of the student workflow, no change requests	No interface revision
6	Students, DPL, and committee during KKN	New field requirements	Seminar presentation upload per village, all-day attendance, attendance correction by group leaders and DPL, larger supervision photo limit

2.3. System Architecture and Technology Stack

The system architecture is shown in Figure 2. The system was built with PHP 8.3, Laravel 13, and Filament 4 running on Livewire. All three panels operate in single page application (SPA) mode, so that navigation reloads only the changed parts of a page. Access rights are assigned by role. The application is deployed on a virtual private server with 2 vCPUs and 8 GB of RAM shared with other applications, using Nginx and PHP-FPM, Opcache, MariaDB as the database, Redis for sessions and caching, and private file storage for documents and photos.

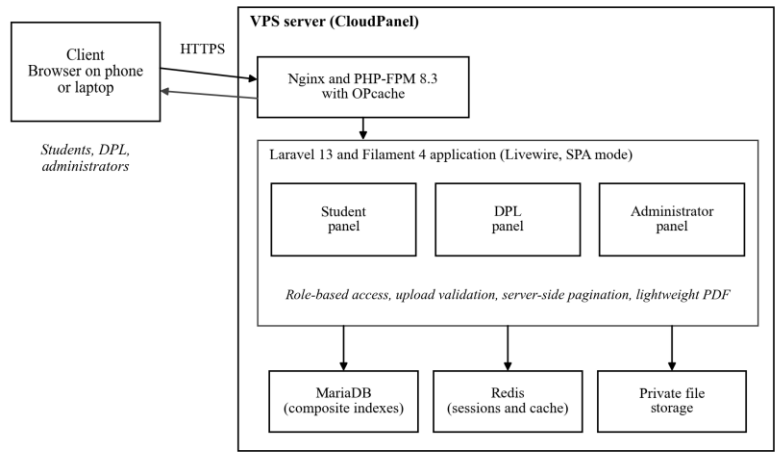


Figure 2. System architecture and technology stack

2.4. Performance Optimization for Low-Bandwidth Use

The optimizations applied to keep the system lightweight are summarized in Table 3. These measurements were obtained in the development environment (MacBook Pro M4, 16 GB RAM) with a copy of the production database and serve only to compare conditions before and after each change, not to describe production performance. Query counts were measured with the Laravel query logger, and database indexes were selected based on the output of the EXPLAIN command. Frequently changing data, such as document status, attendance, reports, and grades, were excluded from long-term caching so that users always see the latest status. Daily log photos were limited to 1 MB, and every upload is stored within a single database transaction, which prevents partially saved records when a connection drops.

Table 3. Performance optimizations and measured results

System component	Optimization	Before	After
Student dashboard	Documents and reports retrieved in a single query	15 queries, 11.58 ms	10 queries, 3.41 ms
Administrator dashboard	User and group counts combined	5 queries, 21.36 ms	3 queries, 10.94 ms
DPL grading page	Eager loading of related data	10 queries	2 queries
DPL report, supervision, and log pages	Eager loading of related data	3 to 4 queries	2 queries
Site settings	Cached and invalidated on update	10 queries	3 queries
Attendance and daily log history	Composite indexes selected with EXPLAIN	scan with filesort	direct index access
Data tables	Server-side pagination (15 rows per page)	all records loaded	loaded per page
Front-end assets (CSS and JS)	Production build with self-hosted fonts	approximately 168 KB	52 KB
Attendance summary PDF	Built-in PDF fonts	965 KB, 0.61 s	89 KB, 0.39 s

Production performance under concurrent access was tested with k6 on 2 October 2026 from a laptop over Wi-Fi, following common web application load-testing practice [28]. The test requested only three student pages (dashboard, daily attendance, and daily logs) with a test account and did not write any data. The load was increased stepwise to 10, 25, and 50 concurrent users, each held for one minute with a think time of 1 to 3 seconds between requests, with a total duration of 5 minutes. Requests were sent without HTTP compression, so each page was received in full (approximately 160 KB on average), which is heavier

than for browsers that receive compressed responses. At the time of testing, the production database contained one KKN period of data, including approximately 9,800 attendance records and 5,600 daily logs.

2.5. Population, Participants, and Data Collection

The population comprised all system users in the 2026 KKN program, namely 374 students in 35 groups and 35 DPL. Three administrator accounts were excluded because their holders managed the system. The online questionnaire was distributed to the entire population through a system announcement and the WhatsApp groups of students and DPL from 17 August to 2 September 2026. The first page explained the purpose of the study and stated that participation was voluntary and anonymous and would not affect KKN grades or DPL honoraria. A total of 193 users gave consent and completed the questionnaire, comprising 183 students (48.9%) and 10 DPL (28.6%), for an overall response rate of 47.2%. All items were mandatory, so there were no missing data. The questionnaire also asked about the device used most often, internet quality at the KKN site, frequency of use, and one open-ended question on the most helpful feature and the most needed improvement. Responses from students and DPL were pooled because both groups used the same system for interrelated tasks, namely attendance, daily logs, supervision, and reporting. Measurement invariance across roles could not be tested because only 10 DPL responded. Instead, the model was re-estimated with students only.

2.6. Instrument and Research Model

The questionnaire contained 46 statement items (indicators) measured on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Items were adapted from the sources listed in Table 4 and tailored to KKN tasks such as submitting attendance, checking status, and uploading documentation. Dashboard quality items were developed by the authors because no established instrument exists for KKN system dashboards. The questionnaire was written directly in Indonesian, so no translation was required. Content validity was reviewed with the Head of LPPM, after which the items were examined by two lecturers from the KKN monitoring and evaluation team who did not serve as DPL. Both reviewers judged the items to be clear and appropriate, so no wording changes were made. No pilot test with prospective respondents was conducted. The complete list of 46 items and their sources is provided as supplementary material.

Table 4. Constructs, number of indicators, sample indicators, and sources

Construct	Code	Items	Sample indicator (translated)	Source
System quality	SQ	5	The system can be accessed quickly when I need it	[11], [12]
Information quality	IQ	5	Attendance, document, and report status are displayed clearly	[11], [12]
Service quality	SVQ	5	Help is available when I encounter a problem	[12]
UI/UX	UX	8	The system interface is comfortable to use on a mobile phone	[7], [10]
Dashboard quality	DQ	5	The data summary on the dashboard is easy to understand	Developed by the authors
Task-technology fit	TTF	4	The system features match the needs of my KKN activities	[23]
User satisfaction	US	4	Overall, I am satisfied with my experience of using the system	[11], [12]
Effective use	EU	4	The system helps me complete my obligations on time	[24]
Net benefits	NB	6	The system saves time in completing KKN administration	[12]

The research model is shown in Figure 3. Five quality factors (system quality, information quality, service quality, UI/UX, and dashboard quality) and TTF were hypothesized to be positively associated with user satisfaction (H1 to H6). Satisfaction and TTF were hypothesized to be positively associated with effective use (H7 and H8). Effective use, satisfaction, and TTF were hypothesized to be positively associated with net benefits (H9 to H11). Net benefits refer to the benefits perceived by users, such as time savings, better-organized activities, and easier coordination.

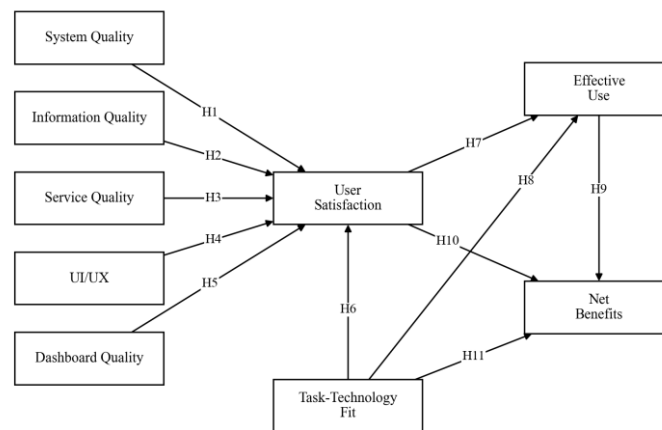


Figure 3. Research model and hypotheses

2.7. Data Analysis

The first analysis was PLS-SEM, chosen because it suits models with many constructs and does not require normally distributed data [29], [30], [31]. All nine constructs were modeled reflectively because each item is a manifestation of the same underlying evaluation, so the items are expected to be highly correlated and interchangeable. Estimation used the PLS algorithm with Mode A outer estimation, the path weighting scheme, standardized indicators, and a stop criterion of 10^{-7} with at most 300 iterations. Significance was tested with 5,000 percentile bootstrap samples (seed 42), and a hypothesis was supported when the 95% confidence interval excluded zero. Computations were performed in Python 3.11 with NumPy 2.4.4, pandas 3.0.2, and SciPy 1.17.1. The analysis code is provided as supplementary material.

The thresholds were loadings of at least 0.708, Cronbach's alpha and composite reliability (CR) between 0.70 and 0.95, average variance extracted (AVE) of at least 0.50, and HTMT below 0.85, or below 0.90 for conceptually similar constructs [29], [32]. For pairs exceeding the threshold, the bootstrap confidence interval of HTMT was examined to determine whether its upper bound was below 1 [32], [33]. Predictor VIF was assessed for each path with a critical threshold of 5 [29]. A non-significant path was interpreted as the absence of a unique association after controlling for the other predictors, not as evidence that the construct is unimportant. Using the inverse square root method, a path of 0.20 requires at least 155 respondents at the 5% level with 80% power [34], so 193 respondents are sufficient to detect paths of 0.179.

Because all constructs were measured with one questionnaire, common method bias was mitigated procedurally through anonymous participation and the assurance that responses would not affect grades [35]. It was also assessed statistically with full collinearity VIF for all constructs [36] and the share of variance explained by a single factor [35]. Robustness was examined by re-estimating the model in three subsamples, namely excluding respondents with uniform response patterns, excluding respondents whose response standard deviation was below 0.25, and students only. A uniform response pattern was defined as giving the same value to all 46 items. This criterion was set after data collection, so the primary analysis retained all respondents. The second analysis was IPMA with net benefits as the target construct [37]. Each item score was rescaled to a 0 to 100 range, and construct performance was computed as the weighted mean of the rescaled scores using normalized unstandardized outer weights. Importance is the unstandardized total effect on net benefits. Importance is therefore a model-derived measure of association, and the resulting priorities serve as decision support rather than demonstrated improvement effects.

The third analysis was the Kruskal-Wallis test, used to compare scores across levels of internet quality at the KKN site [38]. Respondents were grouped into good (very good and good), fair, and poor (poor and very poor) internet quality. Effect sizes were computed as epsilon squared ($\epsilon^2 = H/(n - 1)$) [39]. For every significant result, Mann-Whitney tests with Bonferroni correction identified which pairs differed. Open-ended responses were coded inductively by the first author. A list of themes was developed after reading all responses, and each response was assigned one or more theme codes. Consistency was checked by the second author, who reread all coded responses.

3. RESULTS

3.1. System Interface and Load Test

The system interface on mobile phones and laptops is shown in Figure 4. The top row (a to d) presents the mobile view, and the two bottom rows (e to h) present the laptop view. On mobile devices, the sidebar collapses into a hamburger menu and page content is arranged in a single column. The load test generated 2,415 requests (7.9 requests per second), all of which returned HTTP status 200, giving an error rate of 0%. The overall median response time was 783.5 ms with a p95 of 3,910.2 ms, and the median server waiting time was 367.9 ms. At 10 concurrent users, the median response time was 374.3 ms (p95 1,058.4 ms). At 25 users, the median was 569.8 ms (p95 1,383.8 ms). At 50 users, the median rose to 1,416.3 ms (p95 5,060.8 ms). The daily attendance page was the slowest, with a median of 1,528.1 ms and a p95 of 5,000.1 ms.

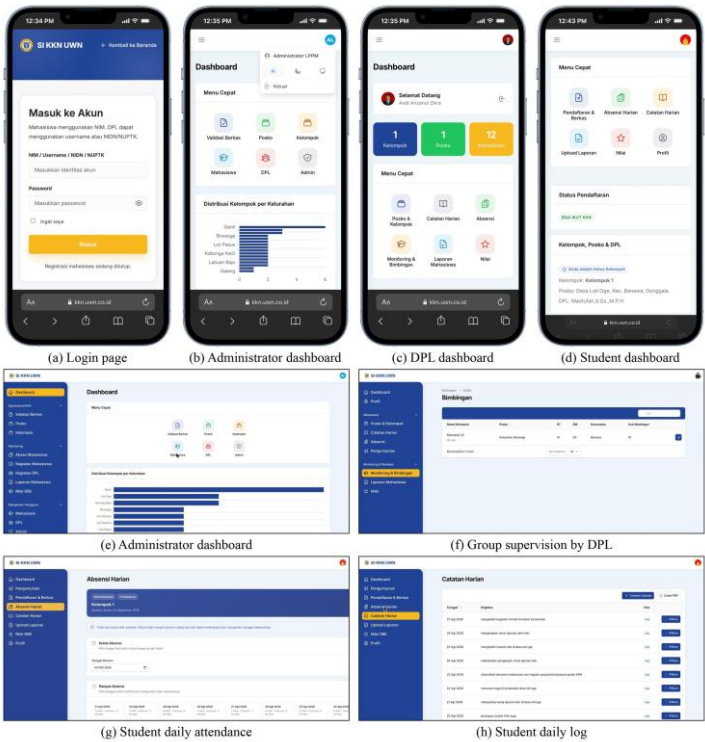


Figure 4. System interface on mobile phones (a to d) and laptops (e to h)

3.2. Respondent Profile

The respondent profile is presented in Table 5. Most respondents (91.2%) accessed the system primarily through mobile phones. Nearly all used the system regularly, with 45.6% using it daily and 48.7% several times a week. In total, 42.5% of respondents rated the internet quality at their KKN site as only fair or poor.

Table 5. Respondent profile (n = 193)

Characteristic	Category	Count	Percentage
Role	Student	183	94.8%
	DPL	10	5.2%
Primary device	Mobile phone	176	91.2%
	Laptop or computer	15	7.8%
	Tablet	2	1.0%
Internet quality at site	Good (very good and good)	111	57.5%
	Fair	55	28.5%
	Poor (poor and very poor)	27	14.0%
Frequency of use	Daily	88	45.6%
	Several times a week	94	48.7%
	Once a week	9	4.7%

Characteristic	Category	Count	Percentage
	Rarely	2	1.0%

3.3. Measurement Model Assessment

The measurement model results are reported in Table 6. Loadings ranged from 0.872 to 0.976, AVE from 0.796 to 0.936, Cronbach's alpha from 0.936 to 0.981, and CR from 0.951 to 0.985. Convergent reliability was established, but several values above 0.95 indicate that items within a construct were highly similar in meaning. At the item level, the three lowest scores concerned the availability of help (3.896), the speed of problem resolution (3.943), and system access speed (3.959).

Table 6. Mean scores, validity, and reliability

Construct	Mean	SD	Loadings	Alpha	CR	AVE
System quality	4.007	0.568	0.872-0.932	0.936	0.951	0.796
Information quality	4.062	0.544	0.893-0.942	0.950	0.962	0.834
Service quality	3.956	0.597	0.893-0.960	0.961	0.970	0.867
UI/UX	4.027	0.555	0.873-0.940	0.972	0.976	0.837
Dashboard quality	4.017	0.613	0.940-0.970	0.975	0.980	0.908
Task-technology fit	4.073	0.606	0.963-0.976	0.977	0.983	0.936
User satisfaction	4.038	0.586	0.942-0.957	0.965	0.974	0.904
Effective use	4.016	0.604	0.942-0.969	0.969	0.977	0.916
Net benefits	4.008	0.614	0.919-0.973	0.981	0.985	0.915

HTMT values ranged from 0.613 to 0.918. Of the 36 construct pairs, 27 fell below 0.85, eight fell between 0.85 and 0.90, and one exceeded 0.90, namely satisfaction and TTF (0.918). Discriminant validity between satisfaction and TTF is therefore not established under the 0.90 criterion. The bootstrap confidence interval of this HTMT was 0.867 to 0.962. Its upper bound lies below 1, so the two constructs remain statistically distinguishable although they are very close. When each TTF and satisfaction item was removed in turn, HTMT remained between 0.912 and 0.924 and the path from TTF to satisfaction remained between 0.518 and 0.559. The overlap is therefore not attributable to a single item, and no item was removed.

The common method assessment yielded full collinearity VIF values of 3.40 to 8.07, above the 3.3 threshold [36], and a single factor explained 68.7% of the item variance. Common method variance therefore cannot be ruled out. This variance stemmed mainly from respondents with uniform response patterns. In the subsample with a response standard deviation of at least 0.25, the single-factor share fell to 47.2% and the maximum HTMT to 0.843, with the same hypothesis results (Table 8).

3.4. Structural Model and Hypothesis Testing

The hypothesis testing results are presented in Table 7. The model explained 85.5% of the variance in user satisfaction, 74.4% in effective use, and 78.4% in net benefits [29].

Table 7. Hypothesis testing results with 5,000 bootstrap samples

H	Path	β	t	p	95% CI	f ²	VIF	Supported
H1	SQ → US	0.117	1.795	0.073	−0.014 to 0.246	0.029	3.273	No
H2	IQ → US	0.105	1.085	0.278	−0.075 to 0.308	0.013	6.104	No
H3	SVQ → US	−0.054	−0.930	0.352	−0.164 to 0.068	0.006	3.630	No
H4	UX → US	0.110	1.290	0.197	−0.055 to 0.288	0.020	4.212	No
H5	DQ → US	0.188	1.922	0.055	−0.008 to 0.369	0.046	5.362	No
H6	TTF → US	0.542	5.881	< 0.001	0.357 to 0.720	0.608	3.345	Yes
H7	US → EU	0.428	3.426	0.001	0.174 to 0.667	0.148	4.861	Yes
H8	TTF → EU	0.459	3.933	< 0.001	0.239 to 0.700	0.170	4.861	Yes
H9	EU → NB	0.377	2.472	0.013	0.158 to 0.759	0.168	3.912	Yes
H10	US → NB	0.379	2.994	0.003	0.120 to 0.611	0.119	5.578	Yes
H11	TTF → NB	0.175	1.383	0.167	−0.086 to 0.410	0.025	5.686	No

Note: R² US = 0.855, R² EU = 0.744, R² NB = 0.784. CI = 95% bootstrap confidence interval. VIF is computed among the predictors of each equation, critical threshold 5. Construct codes follow Table 4.

Of the eleven hypotheses, five were supported (H6 to H10) and six were not supported (H1 to H5 and H11). TTF was the strongest predictor of satisfaction ($\beta = 0.542$, $t = 5.881$, $p < 0.001$, $f^2 = 0.608$). This value is a standardized path coefficient, not a causal effect. Satisfaction ($\beta = 0.428$) and TTF ($\beta = 0.459$) were both associated with effective use. Effective use ($\beta = 0.377$) and satisfaction ($\beta = 0.379$) were in turn

associated with net benefits. The direct path from TTF to net benefits was not significant ($\beta = 0.175$), but its total effect was large and significant (0.641, 95% CI 0.475 to 0.790). The difference arises from indirect paths through satisfaction ($0.542 \times 0.379 = 0.205$), through effective use ($0.459 \times 0.377 = 0.173$), and through satisfaction followed by effective use (0.087). The association between TTF and net benefits thus operates mainly through indirect pathways rather than as a direct determinant.

Predictor VIF for satisfaction reached 6.104 for information quality and 5.362 for dashboard quality, above the critical threshold of 5. This collinearity can inflate standard errors and destabilize the coefficients of the five quality factors. In an alternative model, the five quality factors were combined into a single overall quality score (VIF 2.966). Overall quality was then positively associated with satisfaction ($\beta = 0.402$, 95% CI 0.252 to 0.552), TTF remained strong ($\beta = 0.564$, 95% CI 0.392 to 0.737), and R^2 for satisfaction was 0.849. The non-support of H1 to H5 therefore reflects overlap among the quality dimensions rather than the absence of an association between quality and satisfaction.

The robustness results are shown in Table 8. In total, 63 respondents (32.6%) gave uniform responses, namely 42 who answered 4, 11 who answered 5, and 10 who answered 3 to all items. This group did not differ from the other respondents in role, internet quality, device, frequency of use, or mean scores on any of the nine constructs (all $p > 0.05$). In all three subsamples, the supported and unsupported hypotheses were identical to those in the full sample. The subsample results are not regarded as more valid than the primary analysis, but they show that the conclusions do not depend on uniform responders or on DPL responses.

Table 8. Robustness of the model across subsamples

Sample	n	TTF → US	R ² US	R ² EU	R ² NB	Max. HTMT	Single factor
All respondents	193	0.542	0.855	0.744	0.784	0.918	68.7%
Excluding uniform patterns	130	0.553	0.789	0.644	0.699	0.881	57.1%
Response SD ≥ 0.25	100	0.567	0.725	0.568	0.617	0.843	47.2%
Students only	183	0.540	0.866	0.747	0.793	0.922	68.8%

Note: in all four samples, H6 to H10 were supported and H1 to H5 and H11 were not supported (5,000 bootstrap samples). Single factor is the share of item variance explained by one factor.

3.5. Importance-Performance Map Analysis

The IPMA results are presented in Table 9 and Figure 5. The dashed lines in Figure 5 indicate the mean importance (0.233) and mean performance (75.62). The three constructs with the highest importance were TTF (0.648), satisfaction (0.566), and effective use (0.383). Within the model, a one-point increase in TTF performance is associated with a 0.648-point increase in net benefits. The performance of these three constructs ranged from 75.39 to 76.81.

Table 9. IPMA results with net benefits as the target construct

Construct	Importance	Performance
Task-technology fit	0.648	76.81
User satisfaction	0.566	75.94
Effective use	0.383	75.39
Dashboard quality	0.102	75.43
System quality	0.068	75.22
UI/UX	0.066	75.68
Information quality	0.064	76.54
Service quality	-0.030	73.93

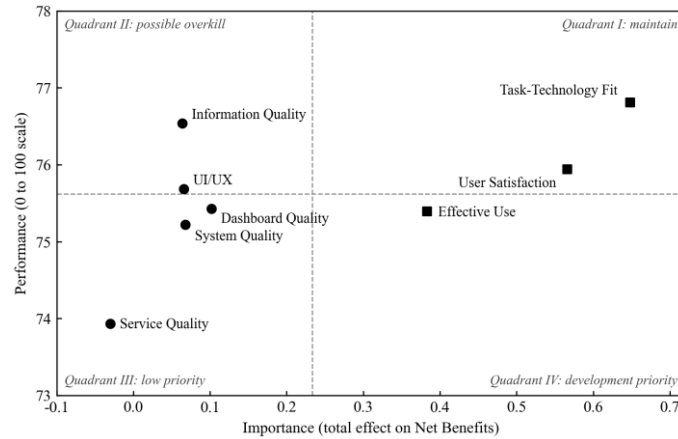


Figure 5. Importance-performance map with net benefits as the target construct

Effective use fell into the priority quadrant because its importance was above average while its performance was below average. TTF and satisfaction fell into the maintain quadrant. Service quality had the lowest performance (73.93), but its importance for net benefits was small.

3.6. Evaluations by Internet Quality at the KKN Site

The Kruskal-Wallis results are presented in Table 10. Among the nine constructs, only system quality differed across internet quality groups ($H = 11.036$, $p = 0.004$, $\epsilon^2 = 0.057$). At the item level, differences appeared in access speed ($H = 12.237$, $p = 0.002$, $\epsilon^2 = 0.064$) and system stability ($H = 6.482$, $p = 0.039$, $\epsilon^2 = 0.034$). All three effect sizes are small. Post hoc tests showed that the good internet group rated system quality higher than the fair (Bonferroni-adjusted $p = 0.041$) and poor groups (Bonferroni-adjusted $p = 0.017$). The same pattern appeared for access speed (Bonferroni-adjusted $p = 0.026$ and 0.011). For system stability, no pair differed after Bonferroni correction (good and poor $p = 0.083$, good and fair $p = 0.277$, fair and poor $p = 0.872$).

Table 10. Kruskal-Wallis test results by internet quality

Construct	Good	Fair	Poor	H	p	ϵ^2
System quality	4.101	3.909	3.822	11.036	0.004	0.057
Item SQ2: access speed	4.099	3.818	3.667	12.237	0.002	0.064
Item SQ3: system stability	4.090	3.927	3.704	6.482	0.039	0.034
Information quality	4.139	3.946	3.985	5.272	0.072	0.027
Service quality	4.032	3.916	3.726	4.643	0.098	0.024
UI/UX	4.107	3.886	3.986	5.561	0.062	0.029
Dashboard quality	4.092	3.905	3.933	3.941	0.139	0.021
Task-technology fit	4.115	4.032	3.982	0.978	0.613	0.005
User satisfaction	4.079	3.968	4.009	0.878	0.645	0.005
Effective use	4.077	3.900	4.000	2.564	0.278	0.013
Net benefits	4.042	3.954	3.975	0.668	0.716	0.003

Note: p values in bold are significant at $\alpha = 0.05$. Group sizes: good 111, fair 55, poor 27. $\epsilon^2 = H/(n - 1)$.

Satisfaction ($p = 0.645$), effective use ($p = 0.277$), net benefits ($p = 0.716$), and TTF ($p = 0.613$) did not differ across internet quality groups. Among users with poor internet, only 63.0% agreed that the system could be accessed quickly, below the 77.2% observed across all respondents.

3.7. User Feedback

Of the 193 open-ended responses, 64 stated that the system was already adequate or needed no improvement and 36 were blank or uninformative, leaving 93 analyzable responses. The themes in these 93 responses are shown in Table 11. Theme counts are not mutually exclusive and do not represent proportions of the whole sample.

Table 11. Themes in open-ended responses (93 analyzable responses)

Group	Theme	Responses
Most helpful features	Daily attendance	26
	Daily logs	24

Group	Theme	Responses
Suggested improvements	Document and report upload	23
	Information, announcements, and dashboard	12
	Supervision and monitoring	8
	Photo size limit and manual compression	15
	Slow or unstable access	10
	Network at the site	4
	Member-level attendance or report entry	3
	User guides or consultation	3

Note: one response may be assigned to more than one theme.

The features most frequently cited as helpful were attendance, daily logs, and document or report upload. The most common complaint concerned the 1 MB photo limit, which required students to compress photos manually before uploading. The second most common complaint was slow or unstable access during peak hours.

4. DISCUSSION

4.1. Task-Technology Fit and Satisfaction

The main empirical finding is that TTF was the strongest predictor of satisfaction and that its association with net benefits operated mainly through satisfaction and effective use. One interpretation is that KKN daily tasks are well defined, so a system that facilitates these tasks tends to be rated as satisfying and beneficial. TTF was positively associated with satisfaction, consistent with studies that integrated TTF with information systems success models [25], [26] and with findings that satisfaction links system quality to benefits in educational systems [15], [16], [17]. Because the data are cross-sectional, however, the direction of these associations cannot be established. The non-support of H1 to H5 does not imply that system quality, information quality, service quality, UI/UX, and dashboard quality are unimportant. The empirical findings are the high VIF and HTMT values and the significant association of overall quality in the alternative model. A plausible but untested interpretation is that users evaluated the quality dimensions as a single overall impression. The individual coefficients of the quality factors are therefore not interpreted as a ranking of importance. This result differs from earlier KKN studies that identified ease of use and usefulness as the main factors [5], [6], because the present study evaluated the system across all KKN stages rather than only registration [8].

4.2. System Evaluations under Different Internet Quality

The measured evidence is that satisfaction, effective use, net benefits, and TTF did not differ across the good, fair, and poor internet groups, whereas system quality and access speed differed with small effect sizes. Because internet quality was self-reported, these results reflect associations rather than objectively measured performance under weak networks. Measures such as SPA mode, server-side pagination, and upload size limits may have contributed, but this contribution was not tested in a controlled experiment. The load test showed that the production server handled up to 50 concurrent users without errors, but response times increased clearly at 50 users, especially on the daily attendance page. Together with the lower access speed scores under poor internet and 10 complaints about slow access at peak hours, access speed remains the weakest aspect of the system.

4.3. System Development Priorities

The proposals in Table 12 were derived from IPMA, the Kruskal-Wallis results, the load test, and the open-ended responses, and were separated into independently testable interventions with evaluation metrics. The link between the photo-size complaints and TTF is inferential, so these proposals are evidence-informed design recommendations that require evaluation before and after implementation [7].

Table 12. Proposed interventions and evaluation metrics

No.	Intervention	Evidence	Evaluation metrics
1	Automatic photo compression on the phone before upload	TTF has the highest importance in IPMA (0.648). 15 responses mention the 1 MB photo limit.	Upload success rate, transferred file size, upload time, TTF score
2	Member-level submission of attendance or reports	3 responses request member access when the group leader is away.	Share of reports submitted on time, TTF and effective use scores

No.	Intervention	Evidence	Evaluation metrics
3	Faster daily attendance page under high load	Median 1,416.3 ms and p95 5,060.8 ms at 50 users. Lower access speed score under poor internet ($p = 0.002$). Service quality has the lowest performance (73.93). The help availability item has the lowest score (3.896).	Median and p95 response time, error rate, transferred bytes per page, access speed score
4	Short guides or help videos in each menu		Number of help requests, service quality score

4.4. Limitations

This study has several limitations. First, the data came from one university and one KKN period. Second, discriminant validity between satisfaction and TTF was not established under the HTMT 0.90 criterion, and VIF among the quality factors reached 6.104, so the satisfaction path coefficients should be interpreted with caution. Third, all constructs were measured with one questionnaire, and the full collinearity and single-factor assessments indicate that common method variance cannot be ruled out. Fourth, 32.6% of respondents gave uniform responses. Their exclusion was decided after data collection and was used only as a robustness check. Fifth, only 10 DPL responded, so measurement invariance across roles could not be tested. Sixth, the items were not pilot-tested with prospective respondents before the survey. Seventh, internet quality was self-reported rather than measured. Eighth, the optimization measurements were obtained in the development environment, while the production load test was conducted with k6 after the KKN period and without HTTP compression.

5. CONCLUSION

This study developed a web-based KKN information system using the prototyping method and evaluated it with the DeLone-McLean model, TTF, PLS-SEM, and IPMA. In the context of one university and one KKN period, the model identified TTF as the strongest predictor of user satisfaction, and the association between TTF and net benefits operated mainly through satisfaction and effective use. Satisfaction, effective use, net benefits, and TTF did not differ by self-reported internet quality, whereas perceived access speed did. The load test showed that the server handled up to 50 concurrent users without errors, with response times increasing at the highest load. These results should be read in light of the closeness between satisfaction and TTF, collinearity among the quality factors, and common method variance. The proposed developments still require validation through objective network and server measurements and evaluation before and after implementation.

AUTHOR CONTRIBUTIONS

Andi Anzanul Zikra: conceptualization, methodology, software, formal analysis, data curation, writing (original draft), and visualization. Afiyah Rifkha Rahmika: methodology, validation, and writing (review and editing). Rahmat Yanuary: investigation, validation, and writing (review and editing). Komala Sari: investigation, resources, and writing (review and editing). I Gusti Ayu Ivana: validation, investigation, and writing (review and editing). All authors have read and approved the final manuscript.

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DATA AVAILABILITY STATEMENT

The data supporting the findings of this study are available from the corresponding author upon reasonable request. The analysis code and the complete list of questionnaire items are provided as supplementary material.

CONFLICT OF INTEREST

The authors declare no conflict of interest in the research, authorship, or publication of this article.

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