The use of ADDIE model to re-create academic information systems to improve user satisfaction

J Marzal¹, E Saputra¹, T Suratno¹, Mauladi¹, Saharudin², E Elisa³

¹Program Studi Sistem Informasi, Universitas Jambi
²Program Studi Pendidikan Bahasa Inggris, Universitas Jambi
³Program Studi Teknik Mesin, Universitas Pendidikan Ganesha

*Corresponding Author: jefri.marzal@unja.ac.id

Abstract. User satisfaction is something that needs to be improved to realize the success of an information system. This study aims to redesign and recreate academic information systems in order to increase user satisfaction. The model used in application development is ADDIE because it has enough space in accommodating user participation, building trust in new applications through the data migration process, and changing culture through a limited set of applications. Meanwhile, user satisfaction is explored with the success of information systems model by DeLone and McLean (2003). The results of this study indicate that the ADDIE is an effective model in recreating academic information systems to increase user satisfaction. There is an increase in the influence of system quality, information quality, and service quality factors on user satisfaction from 65% in the legacy SIAKAD to 81% in the new SIAKAD. Meanwhile, user satisfaction significantly increased, namely an average of 17.7 in the legacy SIAKAD to 19.22 in the new SIAKAD.

1. Introduction

Computer application is a computer-based information system that is owned by an organization to run all or part of the business processes of that organization. Organizations such as tertiary institutions have many computer applications, including academic information systems, which are defined as an information system that records and processes business activities in the academic field, such as recording lectures, student, course, and data reporting.

Academic applications used by a tertiary institution could be different from other tertiary institutions. This difference is due to different academic business processes. It can be said that academic applications reflect the culture and academic process of a college that has been embedded and run by its users, namely lecturers, academic staff, and students.

The University of Jambi Academic Information System application is abbreviated SIAKAD. It is a web-based application that has been running since 2012. This five-years utilization time indicates users are familiar with this application. In general, this system has been used by students for registration and viewing study results. Lecturers use this application to upload lecture grades and scores. Meanwhile academic staff input course data, monitor lectures, and class schedules.

In this era of competition, organizations struggle to improve their competition by increasing productivity, innovation, quality and flexibility of service at the individual and organizational level [1]. With the demand to provide quality higher education governance, periodic academic information system success is measured [2]. One method of measurement can use the DeLeon and McLean models whose
parameters are system quality, information quality and service quality in relation to user satisfaction [3]. User satisfaction is one of the keys to the success of an information system which highlights the importance of understanding and satisfying user needs [4]. User satisfaction is defined as the user's belief that an information system has met their information needs [5]. Determining user satisfaction is very significant because it is an indicator of an information system's performance and effectiveness [6].

One of the development models used in the development of Information and Communication Technology (ICT) products is the ADDIE model, which stands for Analysis, Design, Development, Implementation, Evaluation. This model has been widely used in the development of ICT-based learning media [13]. This model has enough space to accommodate user participation, build trust in new applications, and change culture through a limited set of applications. By considering the success of this model in the development of ICT-based media, the authors adopted this model to rebuild the academic information system to improve user satisfaction.

Measurement of the success of the University of Jambi legacy SIAKAD has been carried out in preliminary research by distributing questionnaires to 156 respondents consisting of lecturers, students and academic managers. The questionnaire used was adapted version of the DeLone and Mc Lean models. From the results of the questionnaire data revealed that the percentage of users who were dissatisfied with the legacy SIAKAD system reached 40.8%. These results show the level of user satisfaction is in the medium category.

Some of the main problems of the legacy SIAKAD are (1) There are limitations to the application including there is no scheduling feature so that caused clashes in lecture and room usage. Moreover, the curriculum must be inputted every year so as the result is an inaccurate identity of the subjects, (2) In terms of base design data, there is no document relationship between entities and the level of normality of relations. This situation causes difficulties in maintaining and accessing database data, (3) It has not been developed with the latest PHP framework so that it is vulnerable to security issues and difficult in system maintenance, (4) The application development did not involve user so it is understandable that many important features have not been coded well on the legacy academic system.

One key to the success of an information system is user acceptance [9]. Based on the complexity of the legacy SIAKAD problem, it is necessary to rebuild a new academic information system oriented to user satisfaction. Thus the process of redesigning the application needs to involve users, especially users of the server category in application development. Users of the servant category are leaders who provide academic services to students, such as the head of the study program, the vice dean of academic affair and the head of the academic department. Paying attention to user expectations is one of the keys to the success of an information system project [10]. End-user engagement in the creation of an information system will improve user satisfaction [11].

User engagement and its relationship to the outcomes of decision support systems production are seen as complex phenomena [12]. The degree of user participation was considered significant in the design process. The theory of participation in decision making provides a basis for predicting that user engagement will improve the quality of the system by fulfilling the user's power, preventing the development of unnecessary features and improving user understanding of the system.

Most information systems development models are intended to design new applications. Not a lot of knowledge that the author has about re-building applications. There are a number of reasons why the existing development model cannot necessarily be used to rebuild buildings, including 1) concerns for not being accepted by users, 2) legacy applications have a lot of data that needs to be migrated so users need to be convinced that the system and migration are running as it should be, and 3) culture has been formed in legacy applications.

One of the development models used in the development of Information and Communication Technology (ICT) products is the ADDIE model, which stands for Analysis, Design, Development, Implementation, Evaluation. This model has been widely used in the development of ICT-based learning media. This model has enough space to accommodate user participation, build trust in new applications, and change culture through a limited set of applications. By considering the success of this model in the development of ICT-based media, the authors adopted this model to rebuild the academic information system to improve user satisfaction.
2. Method

This research uses two research strategies, namely survey and design. The survey strategy was used to determine the success of legacy and new academic information systems, and the design research strategy was to determine the SIAKAD re-design process with user participation-based development model. To find out the effectiveness of the development model, the success of the SIAKAD legacy is compared with the new one. The research design can be seen in Figure 1.

![Figure 1. Research Design](image)

For the purposes of re-designing the application, the researcher adopts and modifies the ADDIE development model. This model was modified to provide a space for anticipating the possibility of rejecting new applications through application recognition activities, building confidence in the new system through testing and migration of data from legacy SIAKAD to new SIAKAD, the formation of new cultures through a limited application. Diagram of the development model as in Figure 2.

![Figure 2. New SIAKAD Application Design and Rebuild Model](image)

The population is the University of Jambi lecturers and students. This study uses different samples to measure the satisfaction of new and legacy SIAKAD users, namely lecturers/students registered in the 2016/2017 academic year for legacy SIAKAD and lecturers/students registered in the 2018/2019 academic year for the new SIAKAD. The sample of this study was obtained by a stratified random sampling technique, in which the population was grouped by type of work and study program. The minimum sample size is obtained by the Slovin formula, and 401 samples are obtained.

This study evaluates the quality of information systems based on the information system success models DeLone and Mc Lean (2003). There are three main dimensions of the model, namely system
quality, information quality and service quality related to user satisfaction. These three dimensions will be independent factors, while the dependent factor is user satisfaction with SIAKAD Jambi University. Factors and questionnaire items were adapted from [2].

The measurement scale in this research uses a Likert scale from 1 to 4. The choices are (1) Strongly disagree, (2) Disagree, (3) Agree, and (4) Strongly Agree. Data processing and analysis techniques utilize the three dimensions of information system success, according to DeLone and McLean where predetermined factors influence user satisfaction with SIAKAD. The data processing and analysis phases are as follows:

First, test the validation of the instrument to measure whether the questionnaire used can measure the desired research construct. If r results are positive, as well as r results> r table then the item is valid.

Table 1. Factors and items of academic information system accessibility

| Factors                | Items                                                                                                                                 |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| System quality         | Academic data displayed by SIAKAD is correct data                                                                                 |
|                        | Data displayed on SIAKAD can be read clearly                                                                                  |
|                        | The menu on SIAKAD is easy to use                                                                                            |
|                        | SIAKAD application is always updated in terms of appearance and menu                                                            |
|                        | Reports on SIAKAD have very high accuracy                                                                                       |
|                        | Reports on SIAKAD are consistent from time to time                                                                             |
|                        | All academic information needed can be found easily at SIAKAD                                                                   |
|                        | I easily find academic information at SIAKAD                                                                                   |
|                        | Existing pages in this application are displayed quickly after I click the menu/link.                                           |
|                        | Downloading data/information in SIAKAD does not require a long time                                                            |
| Information quality    | SIAKAD displays all important academic information                                                                              |
|                        | I can find information that I consider important in SIAKAD easily                                                               |
|                        | SIAKAD displays information related to academic activities only.                                                                  |
|                        | SIAKAD can display all academic information that I need                                                                           |
|                        | The information displayed on SIAKAD is clear and easy to understand                                                              |
|                        | SIAKAD displays useful information for me                                                                                       |
|                        | The form of information display on SIAKAD is interesting                                                                        |
|                        | The information content on SIAKAD is interesting and important                                                                    |
|                        | SIAKAD always provides the latest information                                                                                  |
|                        | Periodic information is displayed by SIAKAD in a timely manner                                                                  |
|                        | The amount of information displayed by SIAKAD is as needed                                                                       |
|                        | SIAKAD provides true and accurate information                                                                                  |
| Service quality        | SIAKAD provided real and useful services to me                                                                                  |
|                        | Information displayed on SIAKAD can be trusted                                                                                    |
|                        | If there are academic problems, SIAKAD can provide solutions in the form of information needed                                   |
|                        | SIAKAD provides certainty data and information                                                                                  |
| User satisfaction      | I am satisfied with the information provided by SIAKAD                                                                         |
|                        | I am satisfied with the ease of operating SIAKAD                                                                               |
|                        | I am satisfied with the speed of data and information access at SIAKAD                                                          |
|                        | My academic affairs have become easy and efficient with the help of SIAKAD                                                      |
|                        | I am pleased with the details and features that are available at SIAKAD                                                        |
|                        | I am satisfied with SIAKAD's interface                                                                                         |
Second, the instrument reliability test to measure the stability of respondents' answers from time to time. Measurement of reliability in this study is the One Shot method or measured once, that is, the measurement is done once and then the results are compared with the results of other questions. If \( r \) is Alpha positive and \( r > r_{table} \), then the questionnaire items are relative.

If the items are valid and reliable, the items can be used to calculate the variables already. The next step is to test whether the parameters for assessing the current construct are correct. Thirdly, the effect of independent variables on the dependent variable is determined using multiple linear regression analysis.

To determine whether there are differences in user satisfaction between the legacy SIAKAD and the new SIAKAD, a similarity test of two averages (T-test) with an independent sample is conducted. There are two stages of analysis carried out, namely:

- The Levene test is conducted whether the population variances of the two samples are the same or different. Both variances are said to be the same if the probability number > 0.05
- With T-test, and based on the results of the analysis number, a decision is taken. The two population averages are said to be different if the probability number is <0.05.

### 3. Results

#### 3.1 Test Validity and Reliability of the Questionnaire

Before testing the hypothesis shown in the research model, it is necessary to carry out reliability and validity tests. There are 99 respondents in this test, and test results can be seen in the table below.

**Table 2. Corrected Item Total Correlation (CITC) dan Reliability Coefficient (RC)**

| Item code | CITC  | RC   | Item code | CITC  | RC   | Item code | CITC  | RC   |
|-----------|-------|------|-----------|-------|------|-----------|-------|------|
| System quality | .602  | .906 | Information quality | .946  | .899 |
| S1        | .602  |      | I1        | .802  |      | L1        | .781  |      |
| S2        | .651  |      | I2        | .797  |      | L2        | .787  |      |
| S3        | .686  |      | I3        | .689  |      | L3        | .744  |      |
| S4        | .657  |      | I4        | .757  |      | L4        | .800  |      |
| S5        | .731  |      | I5        | .763  |      | K1        | .802  |      |
| S6        | .741  |      | I6        | .761  |      | K2        | .834  |      |
| S7        | .699  |      | I7        | .701  |      | K3        | .771  |      |
| S8        | .688  |      | I8        | .779  |      | K4        | .820  |      |
| S9        | .673  |      | I9        | .766  |      | K5        | .831  |      |
| S10       | .529  |      | I10       | .800  |      | K6        | .768  |      |

It can be seen from all items that \( r \) items in CITC > \( r \) table (0.13), so it can be concluded that all items are valid while \( r \) alpha on RC > \( r \) table (0.13) so that it can be concluded that each item is reliable. Thus, the questionnaire can be used to measure the success of the information system, both the legacy SIAKAD and the new SIAKAD.

#### 3.2 Factors Influencing the Success of the legacy SIAKAD

There are 3 (three) independent variables that influence the success of academic information systems in terms of user satisfaction both in the legacy SIAKAD and the new SIAKAD: system quality, information quality, and service quality. To find out whether these three are independent variables, multiple regression analysis needs to be done. After testing a number of regression analysis requirements, it is known that the data meet all the provisions, such as normality, linearity, and multi-collinearity tests.
The sample size for the purposes of regression analysis is 350 respondents consisting of lecturers and students. Table 3 reveals that the assumptions of the linear model are acceptable because the significance number for the linearity test of 0.000 < 0.05 means that the linear model is acceptable. Furthermore, it can be seen at Table 3 that Adjusted R Square 0.650, which means the effect of all independent variables together on the satisfaction of legacy SIAKAD users is 65%.

Table 3. Summary of multiple regression analysis

| Variable            | Regression coefficient | t-value | Sig  |
|---------------------|------------------------|---------|------|
| Constanta           | 1.220                  | 1.221   | 0.224|
| System quality      | 0.139                  | 2.840   | 0.005|
| Information quality | 0.198                  | 3.256   | 0.001|
| Service quality     | 0.385                  | 4.714   | 0.000|
| **F-value**         | **= 101.199**          |         | 0.000|
| **Adjusted R Square**| **= 0.650**           |         |      |

Meanwhile, to determine the effect of each independent variable on the dependent variable, the formula is used:

\[ \text{influence} = \text{regression coefficient} \times \beta \times \text{correlation coefficient} \times 100\% \quad (1) \]

The results of the calculations can be seen in Table 4.

Table 4. Summary of Correlation and Regression Analysis

| Variable            | Coefficient of beta regression | Correlation coefficient | \( R^2 \) | Influence (%) |
|---------------------|--------------------------------|-------------------------|---------|--------------|
| System quality      | 0.219                          | 0.702                   | 0.65    | 15.37        |
| Information quality | 0.307                          | 0.765                   |         | 23.49        |
| Service quality     | 0.359                          | 0.746                   |         | 26.78        |
| **Total influence** | **= 0.650**                   |                         |         | 65.64        |

The influence of system quality, information quality, and service quality are 16.01%, 25.55%, and 22.73% respectively on user satisfaction. From this table it can be seen that the influence of these three variables is still classified as moderate, amounting to 64.29% on user satisfaction, which means the influence of other factors is still quite large at 35%. Thus the re-design of the academic information system of the University of Jambi is needed.

3.3 Application Rebuilding Process

This study adapted the ADDIE development model to design and rebuild an academic information system whose effectiveness is measured through user satisfaction. To accommodate the needs of users, user involvement is categorized as a service provider at several stages, namely introduction, testing, restricted development, and implementation. The entire development procedure can be seen in Table 5.

There are a number of key issues in the background of concern for the new redesign SIAKAD in the form of concerns about not being accepted by users, fluency in migration, changes in the culture of application usage. The apprehension of new applications is not being accepted is anticipated by introducing new application drafts to university and faculty leaders (3.1), accommodating all notes and input of leadership elements in new applications, testing new applications by internal experts, namely people involved in developing SIAKAD legacy, launching new SIAKAD by the highest leadership in front of all university leaders and senates. With this step, all aspirations are fulfilled and rejection can be minimized.
### Table 5. Procedures and activities of recreating the new SIAKAD application

| No. | Stages            | Activities                                                                 |
|-----|-------------------|-----------------------------------------------------------------------------|
| 1   | Analysis          | a) Conduct a study of the weaknesses and advantages of the old system       |
|     |                   | b) Make a decision to redesign academic applications                        |
| 2   | Design            | a) The design includes a database, information systems, and interfaces      |
|     |                   | b) Encoding                                                                 |
| 3   | Development       | a) Introduction of new application drafts to university and faculty leaders  |
|     |                   | b) Record all feedback from the leadership of the application in a formal meeting |
|     |                   | c) Record the leader's input to the application through the WhatsApp platform discussion group |
|     |                   | d) Analysis of input and application revisions                             |
| 3.1 | Introduction      | a) Testing by a new SIAKAD application developer system analyst             |
|     |                   | b) Testing by an internal expert from the legacy SIAKAD developer           |
|     |                   | c) Conduct testing by external experts who come from application security experts |
|     |                   | d) Analyst input and application revision                                 |
| 3.2 | Testing           | a) Make coding for migration                                                |
|     |                   | b) Freeze the legacy SIAKAD database                                       |
|     |                   | c) Collect data that still occurs in the old SIAKAD in a temporary database (TS1) |
|     |                   | d) Migrate data from legacy databases to new databases                     |
|     |                   | e) SIAKAD has just begun to store data in a new database                    |
|     |                   | f) Freeze data on TS1 and open a new database (TS2)                        |
|     |                   | g) Migrate TS1 to a new database                                           |
|     |                   | h) Freeze data on TS2                                                      |
|     |                   | i) Migrate TS2 to the new database                                         |
|     |                   | j) Analyze events on migration and improve the application                 |
|     |                   | The whole process of migrating data can be seen in Diagram 3.               |
| 3.3 | Data migration    | a) Create a workshop where the participants are the Study Program Coordinator (KPS) and the Vice Dean for Academic Affairs (WD1), and Academic Operators (OA). |
|     |                   | b) KPS, WD1 and OA input data on the new SIAKAD application                |
|     |                   | c) Communicating problems in operating applications and providing information through WhatsApp social media groups |
|     |                   | d) Appoint two study programs to use all SIAKAD features starting from curriculum input and schedule by Head of Study Program, opening contract schedule by WD1 lecture contract by students, KRS approval by PA lecturers |
|     |                   | e) Analysis of input and application revisions                             |
| 4   | Implementation    | a) Launching the new SIAKAD application by the highest officials and normative institutions |
|     |                   | b) Apply the application to all users.                                      |
|     |                   | c) Receiving input from users on the application of the application        |
|     |                   | d) Revise and add application features if needed                           |
| 5   | Evaluation        | a) Evaluation of information system success based on new SIAKAD user satisfaction |
One of the most difficult parts of the rebuilding activities is data migration. This is due to the large volume of data in the Legacy Database. On the other hand, the use of academic information systems must not be stopped during data migration. So that users believe in the results of data migration, the process is adopted from [14] as in step 3.3, namely data migration with the data migration process as Figure 3.

Meanwhile, the culture of using legacy SIAKAD is gradually eliminated by implementing a new SIAKAD in a limited environment (two study programs), answering all questions and solutions to the problems of the Study Program Heads and operators through communication groups, holding several workshops both for the study program manager, lecturers and students, and then apply the new SIAKAD to all users.

![Figure 3. Data Migration Process](image)

### 3.4 Factors Influence the Success of the New SIAKAD

| Variable                | Regression coefficient | t-value | Sig   |
|-------------------------|------------------------|---------|-------|
| Constanta               | 0.734                  | 1.739   | 0.083 |
| System quality          | 0.084                  | 3.461   | 0.001 |
| Information quality     | 0.167                  | 5.887   | 0.000 |
| Service quality         | 0.774                  | 12.444  | 0.000 |
| F-value                 | = 677.473              |         | 0.000 |
| Adjusted R Square       | = 0.803                |         |       |

After redesigning the academic information system called the new SIAKAD, it is necessary to analyze the success of the new SIAKAD with the same instruments and statistics as the analysis of the legacy SIAKAD. The number of samples used was 500 respondents consisting of lecturers and students. To get the effect of independent variables on user satisfaction variables, multiple linear regression analysis is performed with the summary results as in Table 6.
Table 6 shows that the Sig for each variable <0.05, which means that each of each factor, namely system quality, information quality and service quality significantly influence user satisfaction. The influence of each quality factor on user satisfaction can be seen in Table 7 below:

### Table 7. Summary of Correlation and Regression Analysis

| Variable       | Coefficient of beta regression | Correlation coefficient | R\(^2\) | Influence (%) |
|----------------|--------------------------------|-------------------------|--------|---------------|
| System quality | 0.132                          | 0.782                   | 0.804  | 10.322        |
| Information quality | 0.290                      | 0.855                   |        | 24.795        |
| Service quality | 0.517                          | 0.874                   |        | 45.186        |
| Total influence |                                |                         |        | 80.301        |

Table 7 shows that the factors of system quality, information quality, and service quality each affected 10.284%, 23.880%, 46.675% of user satisfaction. Table 5 also shows that there is an influence together with the variables of system quality, information quality, and service quality of 80.8% on the University of Jambi SIAKAD users.

#### 3.5 Comparison of new SIAKAD User Satisfaction with legacy SIAKAD

The analysis shows that the probability number in the Levene Test 0.784 means that both variances are assumed to be the same. Furthermore, the t-test results obtained a probability number of 0.000 which means that the two sample groups have different averages at a 95% confidence level where the average user satisfaction with SIAKAD legacy is 17.7 and the average user satisfaction with new SIAKAD is 19.22.

Based on the regression analysis and the similarity test of two average user satisfaction on the SIAKAD legacy with the new SIAKAD the following comparisons are obtained:

- There is an increase in the influence of the three independent variables on SIAKAD user satisfaction, namely 65% on legacy SIAKAD and 80.8% on new SIAKAD. This figure shows that user satisfaction can be better explained in the new SIAKAD.
- Significant differences between user satisfaction with the new SIAKAD and user satisfaction with the legacy SIAKAD. In other words, lecturers and students are more satisfied with the new SIAKAD compared to the SIAKAD legacy.

#### 4. Discussion

The expanded ADDIE model was used successfully to build new SIAKAD and increase user satisfaction. There are several main reasons for explaining this result, namely 1) users, especially users of service providers have been involved from the initial stage up to the application. By involving users, all aspirations can be known and used to improve applications [15]. 2) the migration process went well without any chaos on student data and study results. The smoothness of the migration process and results raise the confidence of lecturers and students in the new application. Having an effective and efficient strategy for doing data migration is essential for every data center [16]. Furthermore, the stages of applying a new SIAKAD to a restricted environment encourage a smooth change from the old culture to the new culture. With this limited application, feedback will be obtained to be revised so that when SIAKAD is applied on a broad scale, all users can receive the new SIAKAD without objection and obstacles.

In order for the expanded ADDIE model to work well in the re-design of the application to increase user satisfaction, the requirements needed are to involve the user in each development stages, the migration process must run smoothly, correctly, and need to be applied in a limited scope before being used in the actual circumstances.
5. Conclusion

Based on data analysis and studies relating to the redesign of the academic information system to increase SIAKAD user satisfaction in University of Jambi, the following conclusions are obtained:

1. There is a strong and significant relationship between system quality, information quality, and service quality with user satisfaction at the University of Jambi. This strong relationship was found both in legacy SIAKAD and new SIAKAD. (2) The ADDIE model for rebuilding an information system has an introduction, testing, data migration, rectified deployment, and formative evaluation extensions. Formative evaluation is needed at each stage in the development phase so that user aspirations and input are accommodated. (3) The effect of system quality factors, information quality, and service quality on user satisfaction is classified as moderate, namely 64.29% in legacy SIAKAD where the design process does not involve the user to the fullest. Meanwhile, the joint influence of these factors is relatively high, reaching 80.84% of user satisfaction on the new SIAKAD. The high influence is due to the redesign of SIAKAD that engages users. (4) Redesigning information systems using ADDIE models which involve users can increase user satisfaction. There is a significant difference between the average satisfaction of new SIAKAD users and legacy SIAKAD, where in average the score of new SIAKAD user satisfaction is higher than legacy SIAKAD.

To improve the quality of the academic information system at the University of Jambi it is necessary to evaluate the quality of the system, the quality of information, and the quality of services on a regular basis. The evaluation needs to involve users so that their aspirations and needs are properly applied to the academic information system.

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