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An Extreme Programming Approach for Instructor Performance Evaluation System Development

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Abstract

The aim of this research was to develop an instructor performance evaluation system for Information Technology Training Center (ITTC) of Islamic State University (UIN) Sunan Kalijaga Yogyakarta using Extreme Programming (XP) methodology. The system was designed to evaluate the performance of instructors in the ICT (Information and Communication Technology) Training process based on certain criteria. The XP method was an agile software development approach that emphasizes iterative development, continuous testing, and customer involvement. The proposed system was developed through several iterations that involve continuous feedback from the ITTC management. The development of the system followed the XP process, which was included planning, designing, coding, testing, refactoring, and integrating. Trainees can access the system to evaluate instructors, and the system helped the ICT training management to determine the instructor's performance for future employment contracts. The system has undergone functionality testing, which resulted in a 100% functionality test and 95,5% of usability test. This system was an effective tool for evaluating the performance of ICT training instructors and can be used to determine the effectiveness of training programs. The system's usability and functionality had been tested and proven to be highly effective, making it a valuable resource for ICT training management.

Keywords: Extreme Programming, Agile, Performance Evaluation System

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I. INTRODUCTION

In the world of education, the term pedagogy is so familiar. In the Big Indonesian Dictionary (KBBI), pedagogy itself defined as the mastering knowledge of education and teaching skill, which is one of the important requirements that must be possessed by an educator. As stated in Law No.14 of 2005 Article 10, pedagogy is the ability to manage student learning [1]. The components of pedagogy include understanding of students, curriculum design and development, instructional strategies and methods, assessment and evaluation, classroom management, also utilize information technology learning.

In the ICT training held at UIN Sunan Kalijaga Yogyakarta, there is no evaluation system and measurement standard for the success of training instructors, where the evaluation is a very important issue to measuring the quality, professionalism, and success of an educator in the learning process, especially for an educational institution. So, the instructors require such an assessment system, where the assessment process is not only measured by the management, but it would be better to involve the training participants to know the actual condition of the learning process.

The performance and evaluation system for ICT instructors is built based on the needs analysis conducted by the ICT management. This system was developed using the Extreme Programming (XP) method which is an agile software development methodology that emphasizes teamwork, communication,

simplicity, feedback, and flexibility [2]. From previous research on XP implementation for the development of a pharmacy management information system, it was explained that the XP method has the advantage of ease of maintenance, documentation, and suitability for implementation due to the very good test results from the user side [3]. On the other hand, research on the development of information systems training institutions that also apply the XP method explains that the advantage of this method is its ability to quickly adapt to sudden client needs when changing needs occur [4]. When XP is designed to accommodate changing requirements and deliver high-quality software products in a timely manner, therefore this method was chosen due to its simple stages and suitability for system development that involves a direct relationship between the ICT management as the client and the researcher as the developer. The result of this system development is expected to assist and facilitate the ICT management in better understanding the instructor's performance and serve as an evaluation tool for ICT management and instructors.

II. RESEARCH METHOD

A. Agile Software Development Method

Agile methods are commonly used by software companies and teams to improve productivity, speed up delivery, increase flexibility and customer satisfaction. However, transitioning to Agile can be challenging. Several frameworks and models have been proposed to ease the transition process. The challenge is maintaining agility after the transition. This issue has not been widely researched and is a cause for concern. This study aims to explore the transition to agility and provide a solution for Agile consolidation in newly Agile software teams using the grounded theory approach [5]. Preliminary findings indicate important factors such as identification of challenges, facilitators, organizational culture structure, and human roles in Agile consolidation. Table I is the comparisons of Agile methods [6] [7] [8]:

TABLE I. COMPARISONS OF AGILE METHODS

Method	Key Point	Advantages	Disadvantages
Crystal	Provide a software development approach that prioritizes maneuverability and delivers functional software while the secondary objective is to prepare for future development.	Ability to select the most suitable method based on the size and criticality of a project.	Too early to make an estimate.
XP	Customer-driven development, small teams, and daily development.	Refactoring - ongoing redesign of the system to improve performance and responsiveness to changes.	While individual practices are appropriate for a variety of situations, general descriptions and management practices have received little attention.
Scrum	Scrum determines roles within the development team and creates an iterative work mode, which is centralized through the development sprints, and defines various artefacts for which are being used by the developers to organize their given tasks.	Enforcing the paradigm shift from "defined and iterative" to the "new product development view of Scrum."	While Scrum details in specifics how to manage the 30-day release cycle, integration and acceptance tests are not detailed.
FDD (Feature Driven Development)	The complexity of the project and problems are handled by breaking them down into features and then integrating the software increments. The focus is on ensuring software quality through a strategy that includes design and code inspections.	Simplicity method, system design and implementation based on its features, object modeling.	Focusing only on design and implementation. Does not need the support of other approaches.
ASD (Agile software development)	Adaptive, collaborative, mission-driven culture based on iterative development	Organizations are seen as adaptive systems. Making an order appears from a web of connected people.	ASD is more about concepts and culture, not software in a practical way.

B. Extreme Programming

Extreme Programming (XP) is the most popular Agile method since it was introduced by Kent Beck in 1996 until now and is a methodology for software development. XP is used to meet the problem of vague and volatile requirements. The basic purpose of using this model was to create a lightweight process model. When it comes to appropriate engineering practices in software engineering, XP is the most specific in the agile frameworks. It helps in creating the software according to the customer requirements [9]. The XP

process includes four main activities: planning, design, coding, and testing as shown in Figure 1 with some of the key ideas and tasks that are associated with each activity [10].

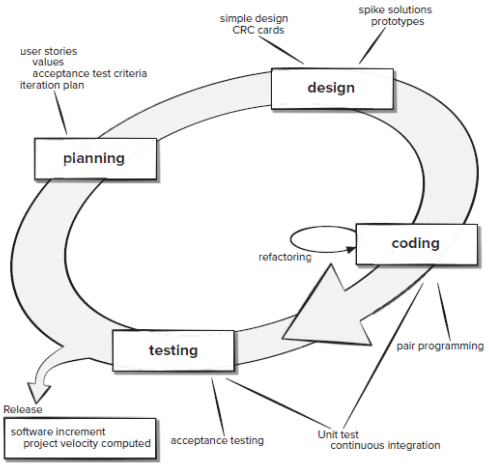

Fig. 1. The Extreme Programming Process

1. Planning

The first phase of XP is planning, this activity where customer and developer work together to decide requirements, features, functionality, and delivery date of software that will be built. The developer first gathers requirements from user stories, and then the customer assigns priority to the story based on the value of the software feature. Then the customer will validate the requirements with acceptance test criteria [11].

2. Design

The design phase of XP follows the KIS (Keep It Simple) principles. This suggests that a good quality design gives definitive logic and structure to system implementation and eliminates pointless complexity and redundancies. Furthermore, XP recommends the developer create an operational prototype of the software, so that customer can follow and monitor the progress of the software development is being working on [12].

3. Coding

This phase means the developer team transforms user stories and design into program code step by step in a series of unit test (software increment). A key concept in this activity is pair programming, which means two people work together in this phase. For example, one person as driver writes the code, while the other as observer reviews the code to check does the code meet the user stories (requirements) or not [13].

4. Testing

The final phase of XP is testing, where each code should have unit test and every code must pass the testing unit without error until the program can be implemented on customer environment. In this activity, if there are any problems found, then the developer should modify the code (refactoring) and make sure overall system features and functionality can be visible and reviewable by the customer [14].

C. Evaluation System

An evaluation system in general terms is a systematic way to examine how well something is performing. In other hand, evaluation system for educators is a systematic way to examine how well teachers are performing in their jobs. The goal of such a system is to ensure quality teaching by providing teachers with feedback and opportunities for growth [15]. There are several approaches to measure the performance of an educators, for example in this research, the ICT management want to use the evaluation and feedback software that can bridge the students for giving assessment and feedback for the ICT instructors based on specific criteria such as teaching skill, time and class management, assign student a quiz or tasks, and how the instructors giving final grade to the students. With help of XP methodology, the evaluation system software can be built based on the specific requirements from the ICT management.

III. RESULTS AND DISCUSSION

The results of this study followed the stages of the XP method, which involved planning that focused on system requirements analysis and planning the refactoring phase, designing the system processes using the data flow diagrams standard, designing the database relation, implementing coding in web-based application, and finally testing the whole system by the users. The details of each stage are explained below:

1. Planning of System Requirements

At this stage, the researcher conducted a need analysis to gain an understanding of the system to be developed. This information was crucial and therefore, the researcher engaged in the discussions and interviews with the ICT training management to obtain a comprehensive picture for the system design. These discussions and interviews were carried out by the researcher in collaboration with the ICT training management throughout the system development process, as the methodology used by the researcher was Extreme Programming focused on communication and feedback. The main essence of the system was concluded to be the development of an evaluation system that can assess ICT training instructors based on survey scores provided by training participants. The survey questions are shown in Table II.

TABLE II. LIST OF QUESTIONNAIRE QUESTIONS FOR ICT INSTRUCTOR PERFORMANCE EVALUATION

No.	Questions	Category	Scores
1.	Does the instructor have mastery of the material being taught?	Mastery of material	4: Very Good 3: Good 2: Fair 1: Poor
2.	Can the instructor explain the material well?	Delivery of material	
3.	Does the instructor provide good responses to questions from training participants?	Response to questions	
4.	Does the instructor start and end training classes on time?	Time management	
5.	Does the instructor's teaching method increase the interest of training participants in learning?	Motivation	

The results of the respondent survey were evaluated using the Equation (1):

$$Score = \frac{\sum Score\ per\ question}{\sum Total\ questions\ \times Max\ Scores} \times 100 \quad (1)$$

Thus, for each respondent who got the highest rating, it resulted in a score of 100. That score was recalculated to be divided by the number of students in each class using the Equation (2):

$$Final\ Score = \frac{\sum Score\ per\ respondent}{\sum Total\ respondent} \quad (2)$$

From the Equation (2), it can be generated an evaluation score with a value range of 0-100 for the instructor concerned.

2. Planning the Refactoring Phase

In developing this system, the developer carried out two development phases, namely due to the changes (refactoring) needed to fulfill the client desires. These differences can be seen in Figure 2 and Figure 3.

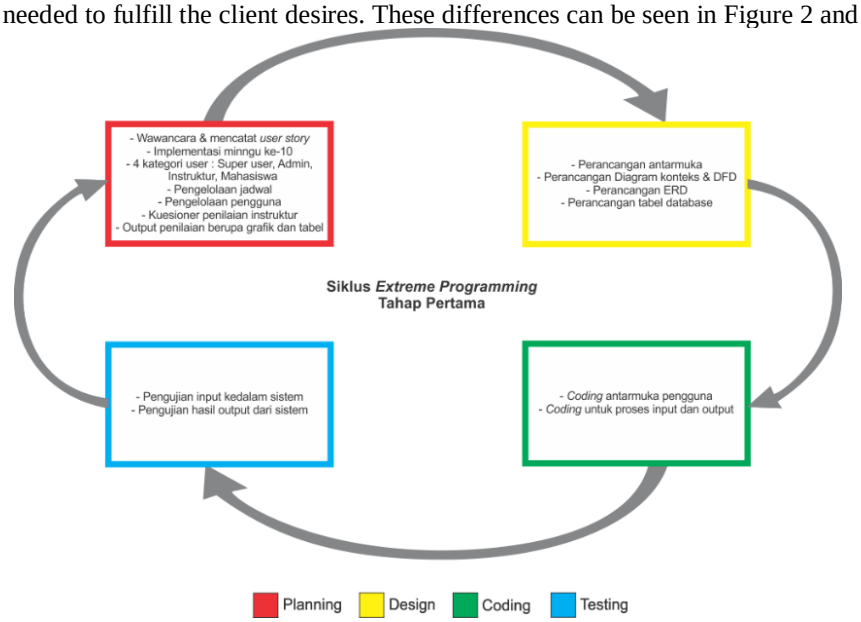

Fig. 2. XP Process Phase One

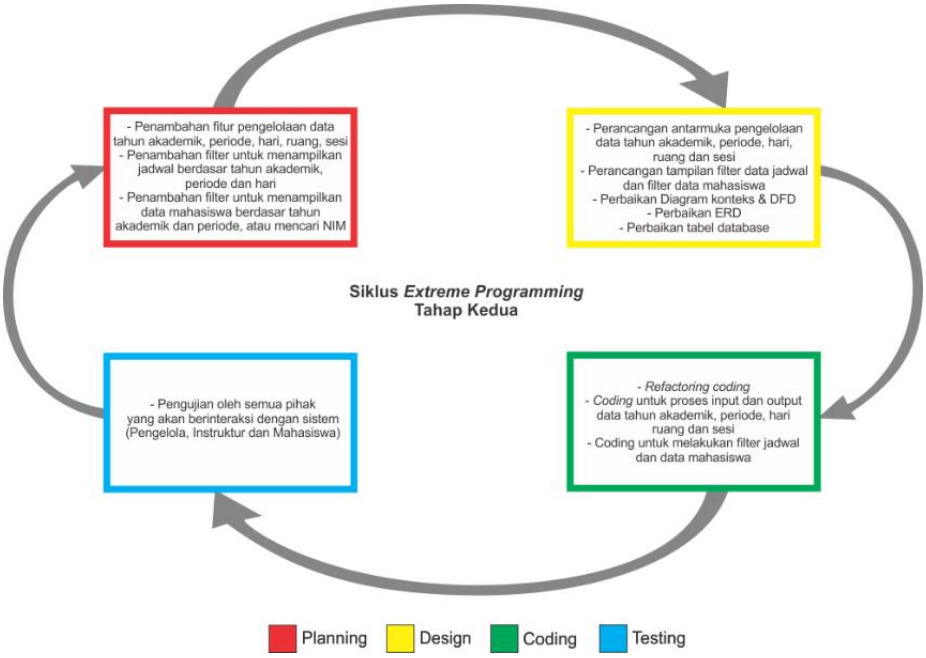

Fig. 3. XP Process Phase Two

3. Designing the System Process using DFD

Data Flow Diagram (DFD) was used to visually represent the transformation of data within a system. DFD supports the planning and design stages of system development and allows for stepwise refinement through hierarchical decomposition of processes [16].

a) DFD: Context Diagram

The first phase in designing a system was creating a context diagram. This diagram was needed to describe the process between entities and systems in general on the system being built. This diagram can be seen in Figure 4.

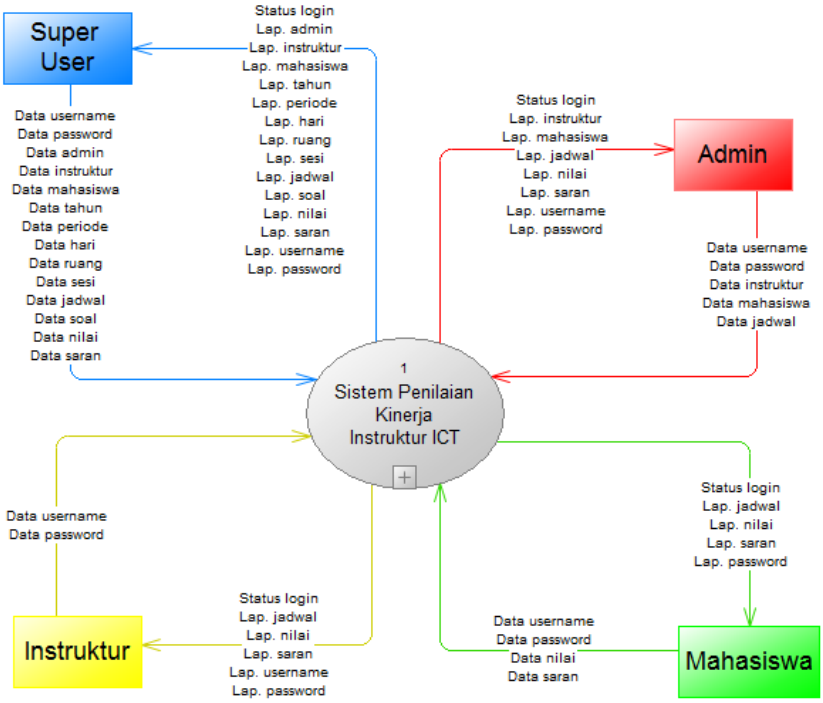

Fig. 4. Context Diagram

b) DFD: Level One

After the context diagram was created, those diagrams were decomposed to create DFD level one. This diagram described in more detail the processes that occur between entities, processes, and data. This diagram can be seen in Figure 5.

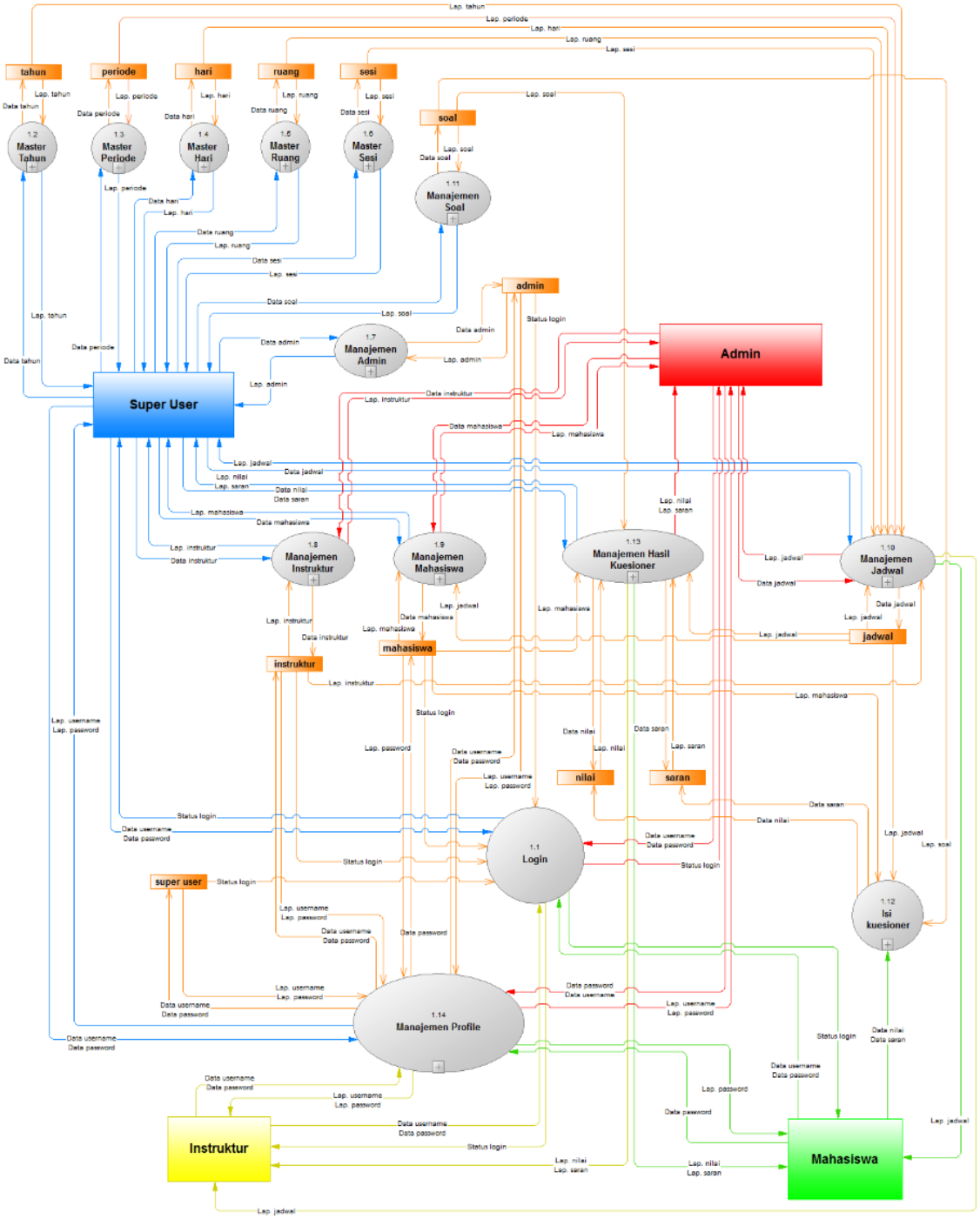

Fig. 5. DFD Level One

c) DFD: Level Two

DFD level two was more detailed diagram which explained any existing process in DFD level one. This diagram was the result of the decomposition of each process at DFD level one. This diagram can be seen in Figure 6.

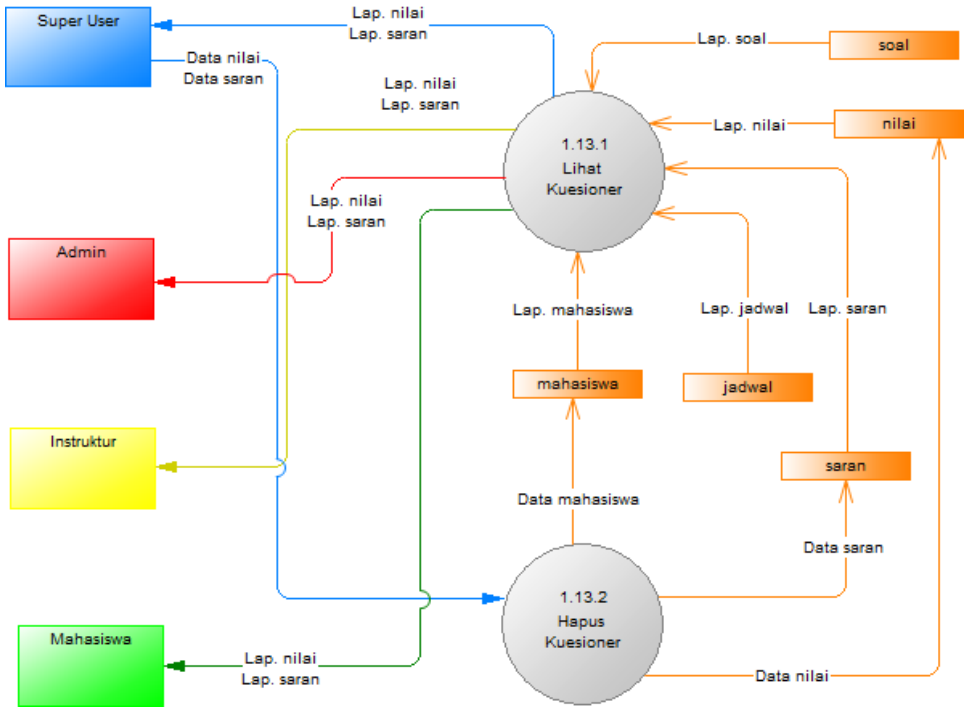

Fig. 6. DFD Level Two for Questionaire Management

4. *Designing the Database Relation*

The database design phase was used by the developer to understand the relationship between tables and data that interacted with the system being built. The database relation design can be seen in Figure 7.

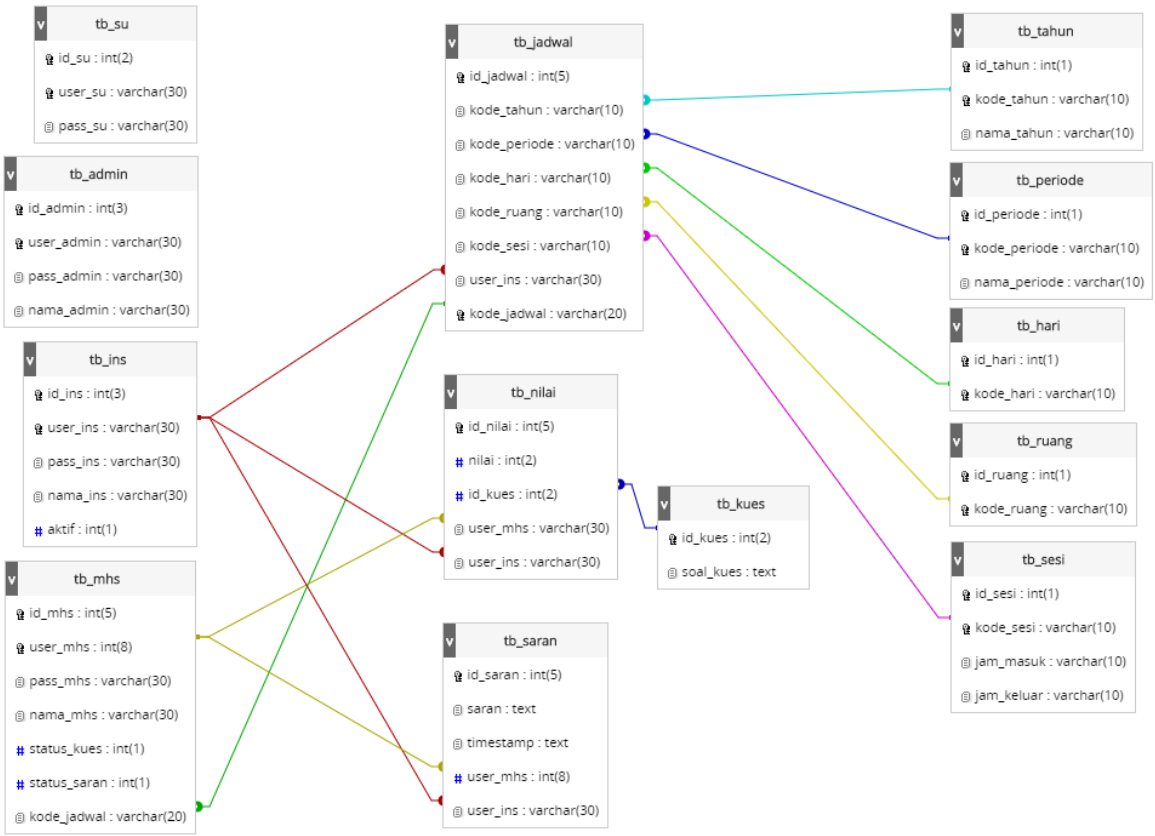

Fig. 7. Design of Database Relation

5. Implementation of Coding in Web-based Application

a) Dashboard Page

The dashboard page displayed the identity of the student after he successfully logged in. Also, there was a main button for immediately go to the evaluation filling page.

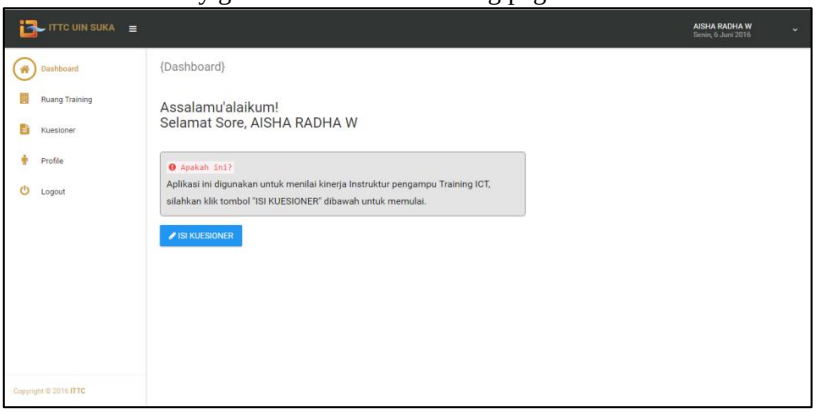

Fig. 8. Implementation of Dashboard Page

b) Questionnaire Page

This questionnaire page displayed several evaluation questions that had been determined in Table 2 above. Students can complete the evaluation by giving predetermined rating points.

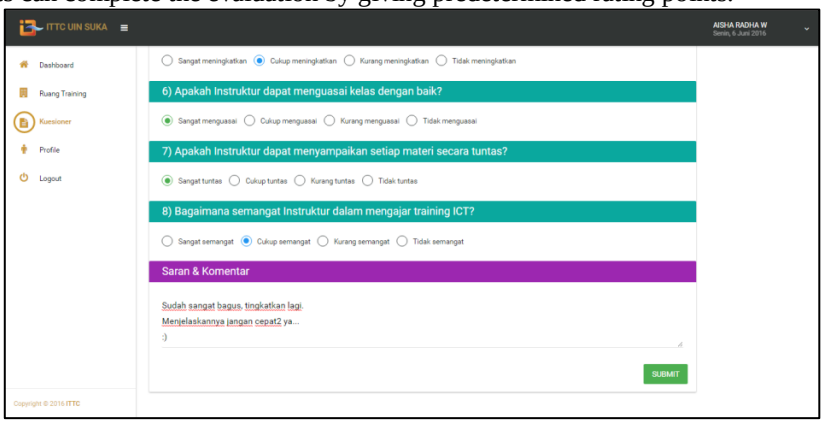

Fig. 9. Implementation of Questionaire Page

c) Result of Assessment Page

This page displayed the conclusions of the overall results of the student evaluation assessment of the instructor. This page was intended only for ICT training managers.

Fig. 10. Implementation of Assessment Page Results

6. *Testing Phase*

a) Functionality Testing

Functional testing was used to ensure that this system was functioning according to its intended behavior. It was carried out to validate all the features from the system [17]. The results of the functionality test are shown in Table III:

TABLE III. FUNCTIONALITY TESTING

No.	Statements	Answers	
		Yes	No
1.	The system can display the Login form when the student has not logged in.	500	0
2.	The system can display an error message when the student enters the wrong Username or Password.	500	0
3.	The system can display facilities according to student access rights when the student enters the correct Username and Password.	500	0
4.	The system can display Student Training Room Data.	500	0
5.	The system can display a form for filling out the ICT Training Instructor Evaluation Questionnaire.	500	0
6.	The system can display a form for filling out Suggestions & Comments for ICT Training Instructors.	500	0
7.	The system can display Results and Graphs of ICT Training Instructor Questionnaire Evaluations by the concerned student.	500	0
8.	The system can display Suggestions & Comments for ICT Training Instructors by the concerned student.	500	0
9.	Students can change their Password on the Profile page. Students can Logout and cannot re-enter the System if they have not logged in again.	500	0
	Total	5000	0
	Percentage (%)	100	0

b) Usability Testing

Usability testing was used to evaluate the system understandability, learnability, operability, attractiveness, and compliance. The goal of this testing phase is to determine how well users can understand, learn, operate, and find the system appealing under specific conditions and requirements [18]. The results of the usability test are shown in Table IV:

TABLE IV. USABILITY TESTING

No.	Statements	Scores*				
		5	4	3	2	1
1.	The system's features are easy to understand.	210	280	10	0	0
2.	The system's interface is attractive.	139	301	60	0	0
3.	The system makes it easy to evaluate the performance of ICT Training Instructors.	230	262	8	0	0
4.	The system makes it easy to provide suggestions and comments to ICT Training Instructors.	243	245	12	0	0
	Total	822	1088	90	0	0
	Percentage (%)	41.1	54.4	4.5	0	0

**Scores: Higher is better*

IV. CONCLUSION

Based on the results of research that has been done, we can conclude that the XP method is suitable for short-term development with a limited number of development team members. This is provided by the successful development of the ICT training instructor performance evaluation system through two refactoring phases. In addition, the results of functional and usability testing show a very good percentage of testing, which is 100% of functionality test score and 95,5% of usability test score. Although there are some shortcomings, the XP method can provide benefits in terms of software development management which provides results with a low error rate and minimum cost and documentation.

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