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Canvas Learning Management System Feature Analysis Using Feature-Oriented Domain Analysis (FODA)

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Abstract. The impact of Covid-19 on the world of education requires the implementation of online learning. Information and computer technology can provide solutions in education through the Learning Management System (LMS). Canvas LMS is a form of LMS that can be utilized by lecturers and students in online learning during the Covid-19 pandemic. In this study, researchers analyzed the features of Canvas LMS using the Feature-Oriented Domain Analysis (FODA) method. Researchers also conducted a mapping of canvas LMS features with the National Standard of Higher Education (SN Dikti). This study showed two stages of validation by Education and LMS experts to verify the results of the analysis. At the end of the course, we recommended a new LMS feature that complies with SN Dikti for Lecturer and Student users.

1. Introduction

The development of information and computer technology can be a solution in several areas during the Covid-19 pandemic. One of the affected areas is in the education sector; distance learning activities require educators and students to be able to utilize technology massive. As well as the higher education teaching system, the need to use the Learning Management System becomes one of the supporters of teaching and learning activities conducted online. Information technology will be used as a learning medium to facilitate the learning process through the Learning Management System (LMS). LMS has the primary function as a data center for all kinds of data needs in the learning process. The main features that LMS developers have always accommodated are 1) curriculum design, 2) instant evaluation, 3) student interest, and 4) content management [1]. LMS is generally a software application and web technology-based that comes with various functions such as creating learning plans, implementing learning processes, and assessing or evaluating learning processes. LMS presents instruction through content creation and storage, sees student participation, and assesses student performance online [2].

In some Universities around the world, LMS is used to support the implementation of mixed learning, or in other meaning of distance learning. LMS provides facilities that facilitate the interaction of lecturers and students, even through online learning. Some examples of the use of LMS include video conferences where lecturers can convey learning materials to students using live streaming. Another example of LMS function is that lecturers can give tasks online to students, so students can

then complete and collect assignments through LMS. Lecturers can also provide information related to lectures to their students so that lecturers and students can connect and communicate anytime and anywhere.

Canvas is one of the LMS that serves to manage the learning process online. Canvas was launched in 2011, and the user of the Canvas network was established in 2012. Canvas, as a good enough LMS, is already widely used by 3,000 universities and Institutions around the world. Canvas LMS was developed to support highly user-friendly and reliable online learning with intuitive interface features designed to save time. Canvas is adopted faster and broader than other LMS. Canvas LMS is also known for its ease of use, accessibility, Cloud-Native architecture, Reliability, and openness [3]. Canvas LMS is claimed to help educators to improve the effectiveness of learning processes. Canvas LMS is also straightforward to use by educators who have recently switched from other LMS before [4].

The National Standard of Higher Education (SN Dikti) is the standard of higher education in Indonesia, including the National Standard of Education, The National Standard of Research, and the National Standard of Community Service [5]. The National Standard of Education is composed of 8 Standards, namely: 1) Graduate Competency Standards; 2) Standard content learning; 3) Learning Process Standards; 4) Learning Assessment Standards; 5) Lecturer and Education Standards; 6) Standard Learning Facilities and Infrastructure; 7) Learning Management Standards, and 8) Learning Financing Standards.

In this study, researchers analyzed the features on canvas LMS using the Feature-0riented Domain Analysis (FODA) method. Canvas LMS feature analyst using the FODA method focuses more on identifying features related to learning and assessment processes in Canvas LMS. The researcher chooses Canvas LMS because of its ability to integrate learning content, and there is no research before that make mapping between Canvas LMS and SN Dikti standardization. It relevant to the purpose of researchers analyzing the suitability of Canvas LMS features based on SN Dikti. The results of the analysis will be used to formulate features on the recommended new LMS. The reason for choosing FODA because this method can provide several ways of applying domain analysis results to support software development [6]. FODA supports the reuse of features from a pre-existing system. FODA method has necessary activities: context analysis, domain modeling, and architecture modeling [7].

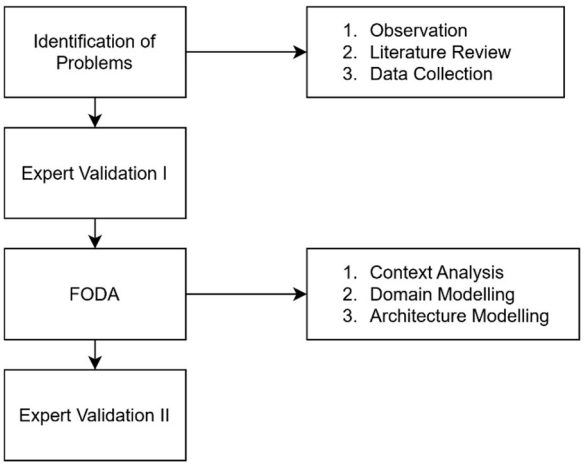

Figure 1. Research Methods

Previous research has analyzed 3 LMS features, namely Edmodo, Google Classroom, and Moodle. Analysis of LMS features in the study using the FODA method by adding expert validation stages after the expert-recommended LMS feature was successfully formulated. The study also only mapped 3 LMS features with assessment standards in SN Dikti [6]. Firstly, the fundamental difference with this study is that the analysis of the LMS features that are referenced is the features of Canvas LMS.

Second, this study also developed feature mapping that is not limited to assessment standards only but also maps features to learning process standards. Third, this study implemented two stages of validation before and after the FODA analysis was conducted.

Researchers choose Canvas LMS as the object of the study because Canvas LMS can help lecturers improve the learning process of students. The purpose of using SN Dikti on the criteria in the standard of the learning process and assessment standards because it has not been formulated LMS feature that refers to the criteria of SN Dikti. This research result may become the guideline and benchmark of the implementation of Higher Education, especially for online learning media in universities in Indonesia.

2. Research Methods

This research was conducted through 4 main stages, as outlined in Figure 1.

2.1. Problem Identification

2.1.1. Observation. At the observation stage, researchers observed the functionality of Canvas LMS features as research objects and how to use Canvas LMS directly, both as a Teacher and Student user.

2.1.2. Literature Study. At the study stage of literature, researchers gather and study various literature such as books, laws, and regulations and articles in journals related to the topics Canvas LMS, Learning Management System, FODA Method, and SN Dikti.

2.1.3. Data Collection. At the data collection stage, the author registers the features on canvas LMS, obtained the number of features in Canvas LMS as many as 71 features consisting of elements in lecturers and student users, as exemplified in Table 1.

Researchers also grouped the SN Dikti criteria into two categories. The category of the learning process that refers to the standard of learning process SN Dikti consists of criteria: 1) Interactive; 2) Holistic; 3) Integrative; 4) Scientific; 5) Contextual; 6) Thematic; 7) Effective; 8) Collaborative; 9) Student-Centered. While the assessment category that refers to the SN Dikti assessment standard consists of 1) Educational; 2) Authentic; 3) Objective; 4) Accountable; 5) Transparent; 5) Integrative. Furthermore, researchers grouped features based on activities that support the learning and assessment process. The result of the grouping will be the new LMS modeling analysis material.

2.2. FODA

FODA analysis in this study is used to analyze LMS features. This method provides several ways to apply domain analysis results from canvas LMS, to be developed on the new LMS [6]. So application developers do not take a long time and a lot of analytics tools. FODA consists of 3 stages as follows:

2.2.1. Context Analysis. At this stage, the author creates a context diagram for visualization of processes running on the LMS. The result at this stage is a model context that is a context diagram

2.2.2. Domain Modeling. At this stage, domains that have been restricted to context analysis will be analyzed for similarities and differences. The domain modeling phase consists of entity-relationship modeling feature analysis and functional analysis of Canvas LMS [7].

Feature analysis aims to find feature needs on LMS Recommendations. The process of finding these needs was through a feature analysis diagram. Feature analysis diagrams can also be called hierarchy diagrams that have tree shapes that will connect between features with sub-features [7]. In the analysis diagram, the feature was set to symbolize the relationship between the features and sub-features located in the hierarchy below them.

Entity-relationship modeling is compiled to find relationships between entities in the LMS model domain. Researchers present entity-relationship diagrams that serve as guidance in creating database models implemented in the Recommended LMS.

Table 1. List of Canvas LMS Features

Feature Code	Feature
FB001	In the account feature, lecturers and students display self-profiles.
FD002	On the dashboard feature, the lecturer has other functions to make skinny or classroom.
FM003	In the dashboard feature, students can see the courses or classes that followed.
FB004	In the course features, lecturers and students have a function as a means of learning.
FB005	In the calendar feature, lecturers and students can determine the date of the event or schedule
FB006	In the inbox feature, lecturers and students can send and receive messages from other students or lecturers.
…….	……..

2.3. Expert Validation Phase I.

At this stage, the researchers validate features by experts, as expert validation is needed to verify the decisions made [8]. Verification has proceeded by interviewing four experts, representing expert competencies of one expert in Canvas LMS and three experts in education. They master the SN Dikti sub learning and assessment process. The author asks the question openly by using the Canvas LMS feature mapping table with SN Dikti. Experts will give approval or correction to the mapping results. Expert validation at this stage aims to align SN Dikti criteria with Canvas LMS.

Functional analysis is created to determine functional features on LMS Recommendations. At this stage, the researchers compiled a use case diagram to describe the functionality of the recommended features.

2.3.1. Architectural Modeling. At the architecture modeling, researchers designed a recommended LMS architecture model. The new architecture will develop web-based LMS, whose main focus is the addition of features according to domain needs [9].

2.3.2. Expert Validation Phase II. Canvas LMS experts conduct phase 2 expert validation. This validation aims to verify the recommendations of LMS functional features to be built.

Table 2. LMS Canvas Feature Grouping and Mapping Results on SN Dikti

No	Standard	SN Dikti Criteria	Number of Canvas Features
1	Learning Process	Interactive	14
2		Holistic	13
3		Integrative	18
4		Scientific	21
5		Contextual	11
6		Thematic	12
7		Effective	21
8		Collaborative	6
9		Student-Centered	6
10	Assessment	Educational	13
11		Authentic	26
12		Lens	8
13		Accountable	11
14		Transparent	12
15		Integrative	6

3. Research and Discussion Results

The results of a series of research stages that have been conducted find various facts that support the formulation of LMS recommendations.

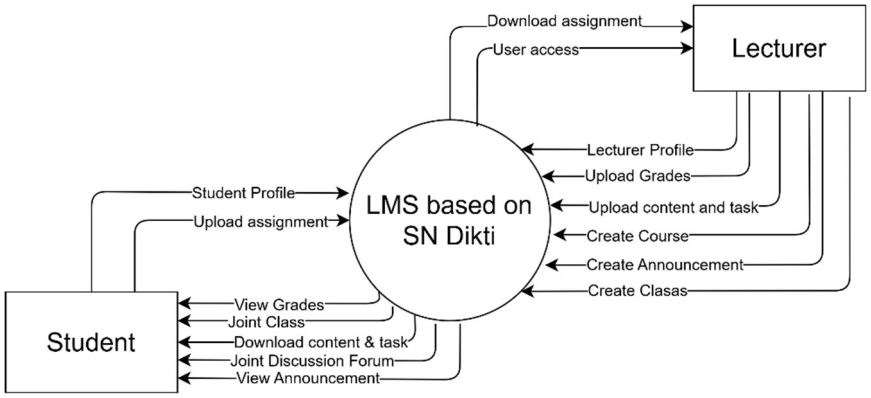

Figure 2. Context Diagram

Table 3. List of Recommended LMS Features Recommendations on Lecturer users

No.	Feature Code	Feature
1.	FR001	Lecturers can manage lecturer profiles
2.	FR002	Lecturers can manage calendars
3.	FR003	Lecturers can communicate using Messages
4.	FR004	Lecturers can create classes
5.	FR005	Lecturers can create syllabuses
6.	FR006	Lecturers can see a list of active students
7.	FR007	Lecturers can Make Announcements
8.	FR008	Lecturers can Attach Announcement Document Files
9.	FR009	Lecturers can add new students.
10.	FR010	Lecturers can Display all menus in the classroom.
11.	FR011	Lecturers can Comment
12.	FR012	Lecturers can view class information.
13.	FR013	Lecturers can create tasks.
14.	FR014	Lecturers can create groups.
15.	FR015	Lecturers can Determine the weight and point of the task.
16.	FR016	Lecturers can Specify the format of the task.
17.	FR017	Lecturers get a Deadline for Collecting Tasks.
18.	FR018	Lecturers can Manage all tasks.
19.	FR019	Lecturers can Upload material learning files.
20.	FR020	Lecturers can Store material files.
21.	FR021	Lecturers can search for files.
22.	FR022	Lecturers can create discussion forums.
23.	FR023	Lecturers can Comment on the discussion.
24.	FR024	Lecturers can Determine the duration of the discussion.
25.	FR025	Lecturers can include discussion attachments.
26.	FR026	Lecturers can Define discussion groups.
27.	FR027	Lecturers can Manage discussions.
28.	FR028	Lecturers can create quizzes.
29.	FR029	Lecturers can Specify points and rubrics on quizzes.
30.	FR030	Lecturers can Determine the type of Quiz.
31.	FR031	Lecturers can Define quiz groups.
32.	FR032	Lecturers can Specify the duration of the Quiz.
33.	FR033	Lecturers can create a list of questions.
34.	FR034	Lecturers can Give and display the value.
35.	FR035	Lecturers can Display the progress of students.
36.	FR036	Lecturers can share the value of results.

3.1. Feature Grouping and Mapping Results

Based on the list of features presented in Table 1, the grouping and mapping of the Canvas LMS feature against SN Dikti obtained results as outlined in Table 2. Each feature group is then detailed and documented to facilitate the next stage.

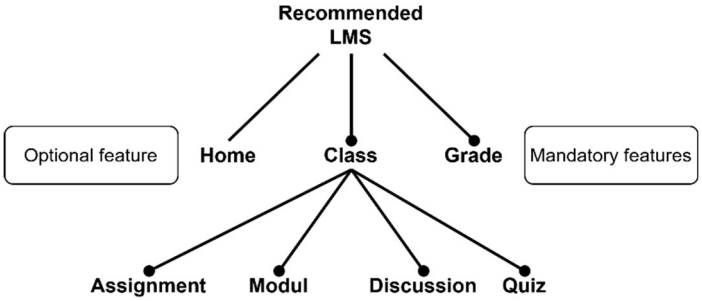

Figure 3. LMS Feature Analysis

Table 4. List of Recommended LMS Features on Student Users

No.	Feature Code	Feature
1.	FR037	Students can manage their Profile.
2.	FR038	Students can see the Classes they are in.
3.	FR039	Students can see class activity notifications
4.	FR040	Students can view calendars
5.	FR041	Students can communicate with Messages
6.	FR042	Students can see the Syllabus
7.	FR043	Students can see announcements
8.	FR044	Students can download the announcement file
9.	FR045	Students can comment on announcements
10.	FR046	Students can See class members.
11.	FR047	Students can Display menus in the classroom.
12.	FR048	Students can see Assignment Notifications.
13.	FR049	Students can Do Chores
14.	FR050	Students can attach assignment documents.
15.	FR051	Students can Comment on assignments.
16.	FR052	Students can search for materials
17.	FR053	Students can Download Materials
18.	FR054	Students can join and view information on discussion forums
19.	FR055	Students can Download discussion files.
20.	FR056	Students can comment on the discussion
21.	FR057	Students can create groups
22.	FR058	Students can see quiz notifications
23.	FR059	Students can Do Quizzes
24.	FR060	Students can see the results of the Quiz.
25.	FR061	Students can see the results
26.	FR062	Students can score

3.2. FODA

3.2.1. Context Analysis Results. Based on the results of context analysis, a context diagram illustrates the relationship between Lecturer and Student users, including the interaction of data streams from users to LMS systems and vice versa.

3.2.2. Domain Modeling: Feature Analysis Results. At the analysis stage, the recommended LMS results will have optional features, namely home and mandatory features in the first level of Class and Grade. While in the second level, the recommended mandatory features are assignment, module, discussion, and Quiz features.

Furthermore, based on the validation results of phase I and II, experts obtained the results of functional feature recommendations that are following the results of the alignment to the criteria of SN Dikti in the category of learning and assessment process. Table 3 shows a list of functional feature recommendations for Lecturer users, consisting of 36 features.

Table 4 shows a list of functional feature recommendations for Student users, consisting of 26 features.

Based on the formula of new LMS features, the features validated by experts and by the criteria of SN Dikti, in the category of learning and assessment processes. We obtained validation results that the recommendation LMS features have been 100% appropriate. It because experts have validated the recommendations and based on the previous LMS reference feature. Otherwise, the recommendation feature can be applied to the software development environment.

4. Conclusion

The study successfully selected 62 features out of a total of 71 mapped features. The number of features selected is not much reduced because, in this research, we use two standards as a mapping base, namely learning standards and assessment standards, unlike previous studies that used only assessment standards. The result of the analysis is obtained 36 functional features for lecturers and 26 functional features for students under the learning process and assessment process based on the Learning Standards and SN Dikti Assessment Standards.

Acknowledgment

The data in this study is sourced from the use of LMS based canvas LMS at Universitas Muhammadiyah Malang.

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