

Developing Online Learning Application for Programming Language

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ABSTRACT

Online learning is one of the most practical and promising learning alternatives nowadays. Flexible time and low cost of online learning are advantages that offline learning does not have. In addition, in online learning, each student can enrol the material according to their level, interest and abilities. This study aims to build an online learning application for programming language. The method used in this study was Scrum software development. Scrum is one of the Agile method in software development. The system design using use case diagram resulted 3 actors and 8 use cases. The product backlog resulted in this study was five backlogs. The sprint composed based on product backlog result 4 sprints in total 120 days' work. All five product backlogs were built successfully using Scrum. This system can be an alternative in learning programming language that offers the flexibility to the student, based on their ability and time.

I. INTRODUCTION

Programming language is a communication tool or intermediary between humans and computers. The programming language is divided into 3 levels, namely, low level programming languages (Low Level Programming Language), intermediate level programming languages (Medium Level Programming Language) and high level programming languages (High Level Programming Language). Current technological developments change industry standards in particular the need for IT personnel. Programming language has become a scientific discipline that currently attracts the attention of the general public with various groups and backgrounds.

To learn the programming language itself there are 2 ways that can be done, first through formal education and non-formal education. Formal education such as through high school / vocational high school and tertiary education levels which need much money. Non-formal education such as

courses that are opened by individuals and groups and certainly with a lower cost compared to Formal Education. Formal and non-formal education has several disadvantages, namely for formal education, especially tertiary education, only high school students majoring in Natural Sciences and Vocational School majoring in computer network, multimedia, and software engineering can register. For non-formal education such as courses, applicants are required to come to the location of the course and of course will add their own fees for applicants whose location is quite far from the location of the course held.

By these limitations, then a solution is made with the method of online learning (e-learning). There are several definitions of online learning including [1] defining online learning as sending instruction to distance learners using the web as an intermediary, while Carliner [2] defines online learning as educational material presented through computers. The study by [3] describe online learning as learning that is entirely online. With this online learning media, it is expected to be able to reduce the existing limitations and of course with

a lighter cost and can be accessed anywhere. Online learning media is created by presenting material and a case study approach to facilitate understanding in understanding a material. Online learning is focus on the needs of individual learners as an important factor in the process of education rather than on the instructors', or educational institutions' needs [4]. The advantages of online learning include flexibility, convenience and self-paced-learning [5].

There are many learning management system (LMS) nowadays, free or paid. But based on [6], the limitation of ability in LMS in order to manage learner's contents or evaluation system is not standard. This study aims to develop an online learning application for language programming. The application will include learning materials and also the final test .

II. RELATED STUDY

There are several studies on learning computer programming and online learning. Nguyen [7] states overall, there is strong evidence that online learning is generally as effective as the traditional format. The study also concluded that some literature suggests researchers should move to be more effective than traditional learning and consider the next stage of online learning.

Other studies, such as those conducted by [8], use visualization techniques, which aim to visually convey concepts and programming information to students. The mapping between the actual construction of game content and source code forms an example-based learning environment, which allows programming concepts to be more clearly conveyed than in conventional integrated development environments (IDE) or static lecture material.

Swacha and Baszuro in study [9] propose a platform that is so classic that it uses an editor to type program source code and compile it, but they include game elements in it. For example, courses on their platform are indicated by set areas that are completed, the number of points received and the level achieved. In addition, it is possible to challenge other students and take part in contests. Another example is Khan Academy, in which there are interactive lessons and videos with training in programming code [10].

Of all the studies discussed, it can be seen that online learning also has the same effectiveness as offline. So that learning like this should be considered and developed as a more flexible and inexpensive alternative. In addition, if developed more seriously, this learning might be better than offline learning. Of all the studies discussed earlier, there are no studies that Scrum methods to build the online learning application. Therefore, in this study Scrum methods were used to build online application.

III. METHOD

This study examines objects in the form of using the Scrum framework in developing online learning application. The data in this study are primary data collected through literature study and observations. The observation is done by

studying some online learning application that already exists. The data collected in this study are: the course materials, question banks, and the flow of user to take a course and quiz.

The development of this online learning application uses the Scrum framework. Scrum is a framework for Agile software development methods. Scrum is made to be able to develop software flexibly and quickly. According to [11], there are considerations for using Scrum or traditional software development methods, as shown in Table 1.

TABLE I. DIFFERENCES IN SCRUM AND TRADITIONAL METHODS

Scrum	Traditional model
The project scope has not been clearly defined and can suddenly change throughout the course of the project	Scope is clearly defined. The same project has been made before
Project requirements often change, because users learn and know what they want when the project is running	Needs are clearly defined, only small changes during the project and project requirements are expected to experience no change
Development activities are not well defined and estimates or planning are difficult	Well-defined and predictable activities can be carried out
Each process runs iteratively and depends on the completion of the previous process	The process is long-term and can be broken down in several phases
Project success is measured by customer / user satisfaction	Project success is measured by the achievement of project objectives, costs and time
Users can use the system when several sub-products / deliverables have been completed	Users cannot use the system before the project is completely finished

There are three roles in Scrum, namely the Product Owner, Scrum Master and the development team. The product owner is someone who is responsible for a product backlog and maximizes the value of a project. This role will define product backlogs and ask the team to determine product backlog items and ensure all team members have a good understanding of the project and product backlog. Another task is to monitor the development of the entire project. Scrum masters are experts who will guide the floating team and ensure that all teams follow the framework. While the development team is a team of application experts who develop project products.

The general Scrum timeline is shown in Figure 1. The timeline is broadly divided into two, namely pre sprint and sprint. In the pre-sprint stage there will be a vision statement that provides a summary of the description of the project's objectives, which will help the development team to stay focused on the path. Next is the product roadmap which is the initial timeline of working on the main features and usually done by the Product Owner. Collection of user needs and make them features. This section is called a story. Story is usually made by the Product Owner based on the needs of the user. All stories will form a Product Backlog. Project can be done without having to wait for a 100% product backlog, and product backlogs can also change throughout the course of the project.

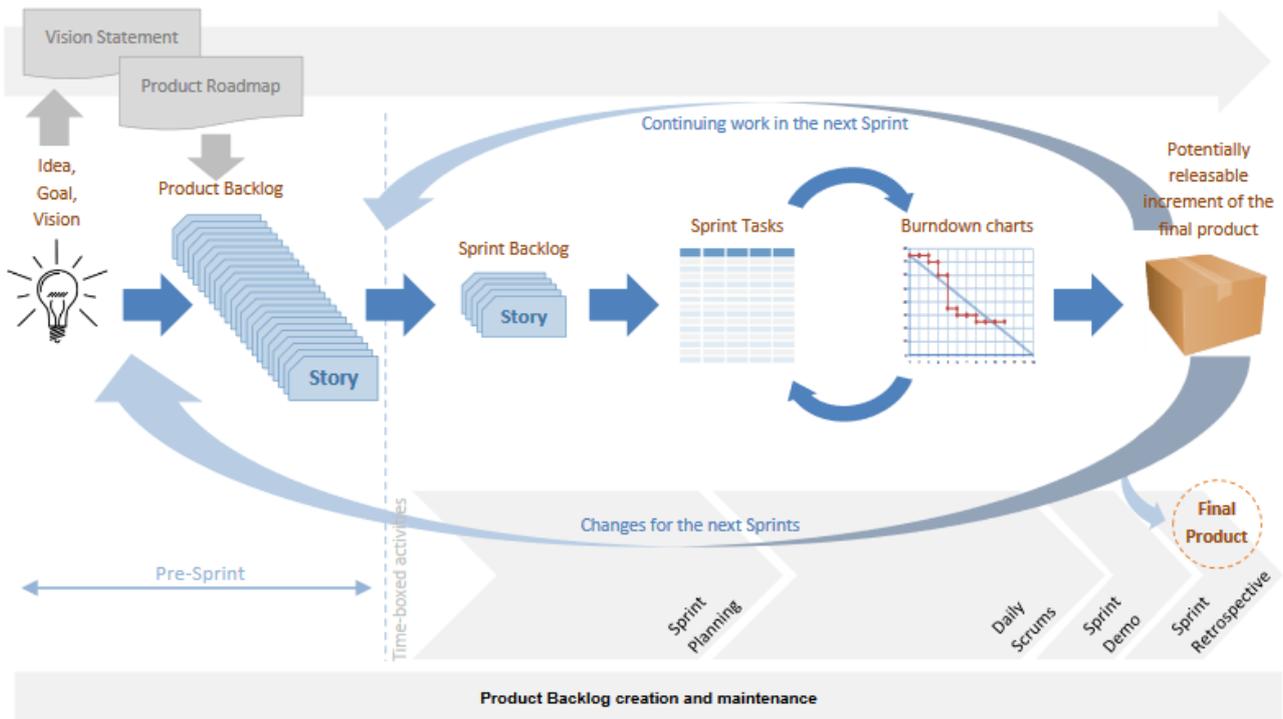


Fig. 1. Scrum timeline [11]

The next stage is the sprint stage, where the first thing to do is a sprint planning meeting that aims to plan what will be done on a sprint (a certain period to make a sub product). The product owner will prioritize these needs and decide on content from the sprint backlog. Furthermore, all stories (features, functionality and sub-products / deliverables) will build a sprint backlog, so the sprint backlog is a list of all the stories that will build the next sprint. The development team will do story solving in several tasks. The team will use 30 days or according to the need for some stories to be done. The development team conducts 15 minutes of daily meetings to work together. At the end of each sprint, the team will demonstrate the story (sub product) to the customer. Scrum Retrospective is the time when the team reviews the sprint and determines the corrective steps. The Scrum master ensures the Scrum process is followed and guides all the teams involved.

IV. RESULT

A. The Pre-Sprint

In this step, all the stories were collected from the user to form the product backlog. The use case diagram in Figure 2 shows the actor and the use cases for each actor. There are three actor in this online learning system which are:

1. Course admin : this actor can access the login menu, manage course material and also manage test
2. Visitor : the visitor must register into the system to access all the fitur as a student
3. Student : this actor can access login menu, view/read course materials and take a test.

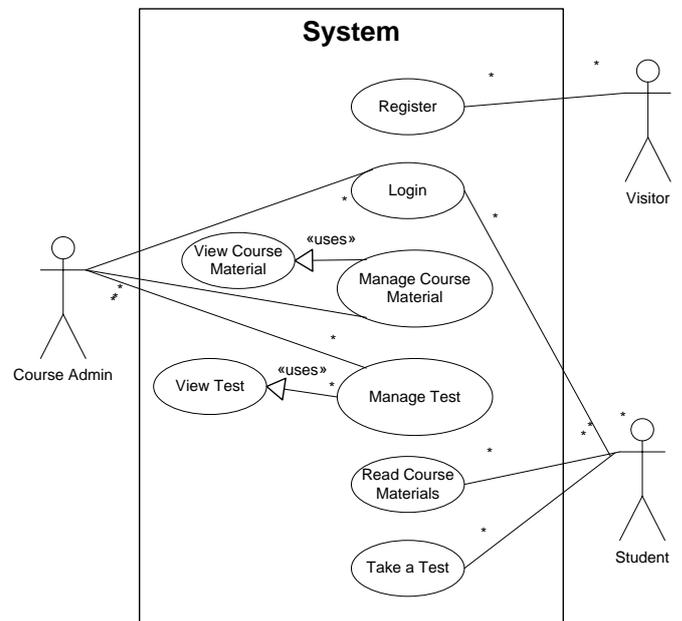


Fig. 2. Use case diagram of online learning application

The stack of products produced based on the story shown in Table 2 is the result of the design of several sources of learning system development experts. This is in accordance with the findings that the design of learning systems based on web programming that supports scientific learning can improve students' thinking learning in schools [12], [13]. There were five product backlogs as shown in Table 2.

TABLE II. PRODUCT BACKLOG

Product Backlog	Description
Registration	This product backlog handle the user registration and verification via email
User Management	Logged User Management handle user login and the role management of each user.
Material Management	Material management manage all about course material including insert new material, edit the material, and show the material into the student.
Quiz Management	Quiz management manage the question bank, including add new question, editing the question and delete the wrong question
Take quiz	The scoring backlog handle randomize the question when the student take a quiz, the score calculation and rank.

B. The Sprint

This step define the items in the backlog items and the period for each item. The product backlog was shown in Table 3. Based on the product backlog in Table 3, the sprint was composed into 4 sprints as shown in Table 4. Registration and Logged User Management was done in one sprint, while the other has its own sprint.

The result of the the first sprint was shown in Figure 3. As shown in Figure 3, the visitor must register first and then they will receive the account verification via registered email. After the verification is completed, the they can log into the site and access the entire menu as a student.

TABLE III. PRODUCT BACKLOG ITEM

Product Backlog	Item	Period (Days)
Registration	Register	10
	Email verification	
User Management	Login	10
	Role Management	
	Add new material category	
Material Management	Add new material	40
	Edit and delete material	
	View material for admin	
	Show material for student	
Quiz Management	Add new quiz	30
	Edit and delete quiz	
	View quiz for admin	
	Randomize the question for student	
Take quiz	Scoring	30
	Rank	

TABLE IV. SPRINT FOR ONLINE LEARNING APPLICATION

Sprint	Product Backlog	Period (Days)
Sprint 1	Registration, User Management	20
Sprint 2	Material Management	40
Sprint 3	Quiz Management	30
Sprint 4	Take quiz	30
Total		120

Fig. 3. Result of Sprint 1 – The register and login interface

The second sprint develops the material management, which include the creation, update, delete (CRUD) and view the course material. The CRUD is shown in Figure 4. This

process is done by the course administrator. While view the course material that can be accessed by the student, was shown in Figure 5.

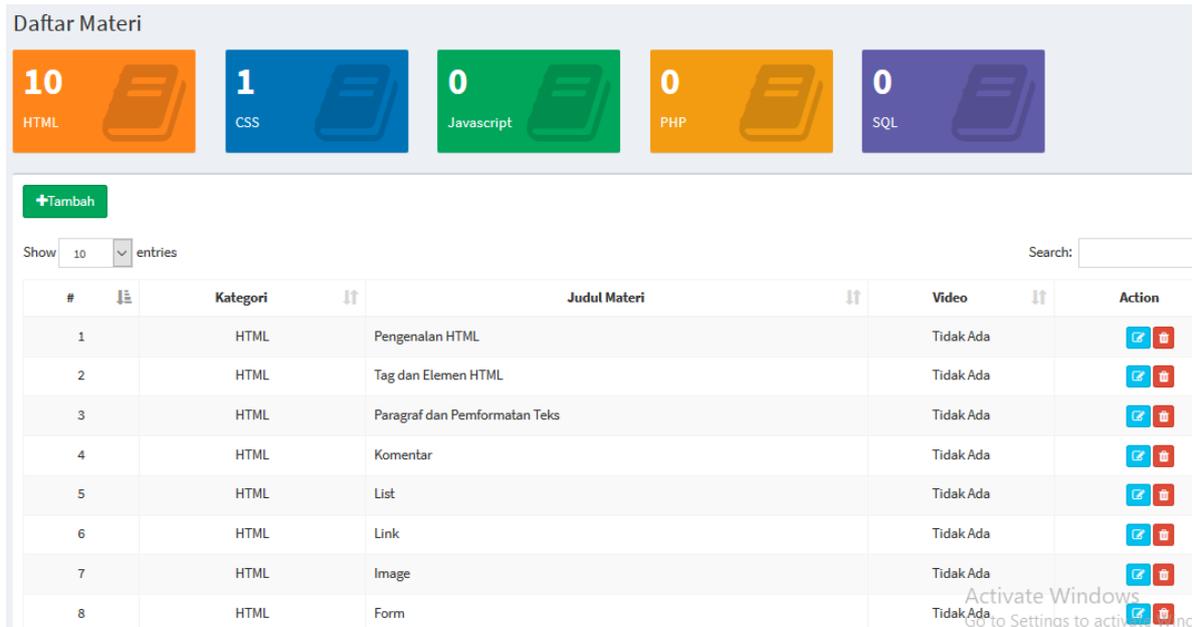


Fig. 4. Result of Sprint 2 – The CRUD of Course Material by Course Administrator

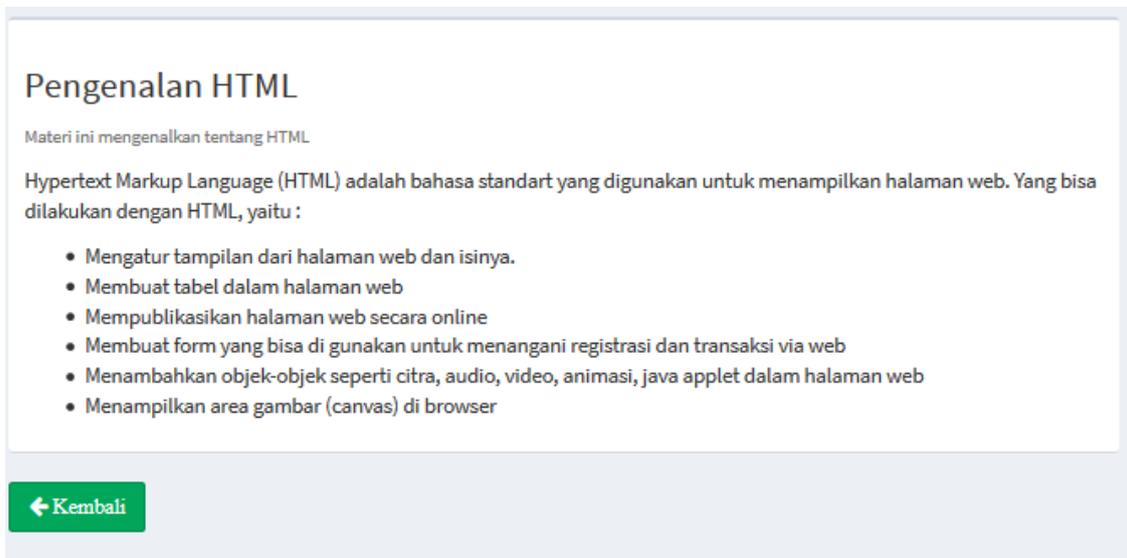


Fig. 5. Result of Sprint 2 – View Course Material by Student

Figure 6 shows the result of sprint 3. This sprint was dedicated to develop the quiz management or the question bank. This menu can be accessed by the course administrator.

The last sprint develops quiz taken by the student. The question shows must be taken random from the question bank. After the student submit all the answers, the scoring process was done and the rank for the students was shown.

Show 10 entries Search:

#	Level	Kategori	Pertanyaan	Kunci	
1	Fundamental	HTML	Tag HTML yang digunakan untuk membuat paragraf ?	A	 
2	Fundamental	HTML	HTML merupakan singkatan dari ?	A	 
3	Fundamental	HTML	biasanya digunakan untuk ?	C	 
4	Fundamental	HTML	Saat ini HTML versi berapa yang paling banyak digunakan	D	 
5	Fundamental	HTML	Untuk membuat teks menjadi miring (italic) pada HTML kita bisa menggunakan tag ?	B	 
6	Fundamental	HTML	ekstensi file html berakhiran ?	D	 
7	Fundamental	HTML	Untuk membuat table kita bisa menggunakan tag ?	C	 

Fig. 6. Result of Sprint 3 – Quiz Management by Course Administrator

1. Untuk membuat table kita bisa menggunakan tag ?

<p>

2. Saat ini HTML versi berapa yang paling banyak digunakan

HTML2

HTML4

3. Tag HTML yang digunakan untuk membuat paragraf ?

<p></p>

<textarea></textarea>

4. Untuk menampilkan video pada HTML5 sudah dibuatkan tag khusus yaitu ?

<video>

5. biasanya digunakan untuk ?

Menampilkan audio

Membuat link

6. Untuk membuat teks menjadi miring (italic) pada HTML kita bisa menggunakan tag ?

</i></i>

7. HTML merupakan singkatan dari ?

Hyper Text Markup Language

Hybrid Text Markup Language

Fig. 7. Result of Sprint 4 – Take Quiz by Student

C. The System Evaluation

The application developed offers course materials based on student level and can be taken anytime based on student time and speed of learning. The application was focus on the student development and ability. That's why this application can be a good solution in learning programming language. This is in accordance with the results of research which is known that the speed of completion of learning and obtaining

good learning outcomes is an indicator of student independence in the learning process [14], [15]. The advantage of using Scrum was, the application can be release, while the next sprint is produces by the development team. The application' users can report any bug or request any improvement based on the current deliverable, and the development team can fix any bugs reported by users, while produce the next sprint.

V. CONCLUSION

From the study that has been done, it can be concluded that the use of the Scrum framework used is able to build an online learning application. The use of this framework fits perfectly with the characteristics of users who have not been able to clearly and in detail define their needs. The existence of deliverables that are directly given and can be used by users directly after a sprint is executed is able to explore more data on user needs. The rapid development time also became an advantage of the Scrum framework in developing this online learning system.

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