Developing an Application to Facilitate Online Courses, Webinars, Scholarships Using Waterfall Method

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***Abstract*—The pandemic has forced people to adapt to technology, especially students and teachers. The demand for online-based education is rising exponentially, whether online courses, webinars, or scholarships. There are already existing platforms to support, but they are separated and not very convenient to use. We believe there are still many things that we can do to improve student learning for the better. In response to that matter, we will develop a web application called OneEd, a more enhanced application to facilitate online courses for students and teachers, to help students find webinars, competitions, and scholarships. We decided to use the waterfall model rather than agile models to build this web application. We notice the advantages of the waterfall model suitable with our requirements, so the result of this paper will be a one-stop-solution web application that can help students with their education.**

Keywords—education, scholarship, students, online course, waterfall, webinar.

I. INTRODUCTION

As technology keeps growing, the needs of students for support education are also increasing. Today's modern students choose to gain more information from any technology they can use rather than just waiting to attend a class in college. They have the privilege and ability to gather information faster than the previous generation [1]. Especially since the Covid-19 pandemic started to spread around the globe, the limitation of interaction has shifted standard teaching-learning methods towards online-based learning. Universities had to move their courses online to keep their activities going. This accelerates technology adoption among students and teachers in the educational field [2].

One of the sectors that gained popularity is online courses, where students can learn anywhere and everywhere by subscribing to specific courses on a website. Many websites offer courses in any category such as Technology, Business, Wellness, and Wellbeing. Studies show that online learning could provide a high-quality education because it is student-centered and flexible [3]. Students have control over which content they want to focus on and their time on each chapter [4]. Moreover, every course usually has a forum for students and mentors to discuss issues and opinions regarding the topic, which will increase interaction [5].

Webinars have become more attractive since the pandemic started. Some research shows that the students are satisfied with the webinar-facilitated delivery of conceptual knowledge [6]. They also like to compete in some events to gain more experience. Much information shows that students who want to join competitions boost their academic performance, improve their social life, and indirectly implement active learning [7]. Currently, the world also offers students many facilities such as scholarships that they can access easily on the internet. For each of the students' needs, various apps offer information about their needs.

As students become more dependent on today's technology to gain more skills, seeking information about webinars, competitions, internships, and scholarships, they like to use various apps to offer their needs [1]. We find that some shortcomings can be improved to make students' learning experience more effective in these popular apps. Some online courses only provide video for the tutorials, so students can not ask the mentor if they do not understand something [8]. There is already an app that offers students information about webinars, competitions, and scholarships for gathering information. However, the app only provides features to register for the webinar. The students still have to join a group chat on another platform like WhatsApp or Line to get the meeting link and additional information about the events.

We realized that the use of various apps might lead to ineffectiveness. The students may be confused due to the many different applications they need to use. Since there are many things in different applications that students have to use to support their education, we offer OneEd, a one-stop solution to students to have one application that can offer all their needs. OneEd offers convenience to the students to access everything in only one website application. OneEd's concept is similar to various apps that already offer the features of online courses, webinars, competitions, internships, and scholarship information. Nevertheless, we combine all these features into one single app so that students can manage all of their educational needs in just one place.

There is a method to help us develop software systematically, which is the Software Development Life Cycle. The waterfall model is one of the oldest and simplest process models in the Software Development Life Cycle and is widely used in major projects. The waterfall model is sequential based, in which we go through the first until the last stage in order. First, we begin by gathering user requirements, then we design the system architecture and make the detailed version. We continue to implement it by writing the code and then testing it before deploying the software and maintaining it [10]. This model offers several advantages: it is easy to understand and use, the phases are well defined and in order, and precise time boxing [11]. Given the advantages and requirements, we decided to use the waterfall method to develop a website application for students to join courses with live meetings or look for webinars, competitions, and scholarships.

II. METHODOLOGY

For this project, we choose the waterfall model as the process model. The waterfall model itself is a sequential model that consists of 5 initial phases [12]. In this section, we will explain each phase as shown in Fig. 1.

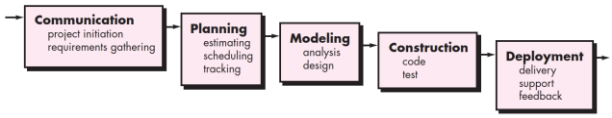

Fig. 1. Five phases of the waterfall model

A. Communication

Before starting the technical work, it is necessary to communicate with the customer to understand their needs and goals. During this phase, we initiated the project, analyzed the problem, gathered the requirements, and defined the application's features and functions. So the team knows exactly what needs to be done. The requirements can be gathered in journals, articles, and the internet.

B. Planning

This phase explains the estimation of the technical tasks to be carried out, the risks that can occur, the resources needed to create the system, the work products to be produced, the scheduling of work to be carried out, and tracking of the system work process. The team estimates the time it will take to complete the project, divides the work, and sets deadlines.

C. Modeling

This phase is concerned with analyzing and designing data structures, software architectures, interface displays, and program algorithms that suit the requirements when it is implemented in developing the application. The goal is to gain a better understanding of the big picture of what will be done.

D. Construction

Developers code the program based on the system design made in the modeling phase. After we finish all the programs, we test them to see if they work properly or if some bugs need to be fixed.

E. Deployment

This is the last phase of the waterfall model. Developers deploy the build and implement the software to the customer. Then customers provide feedback that will be used to evaluate and fix the current software later so that the system will run and grow according to the requirements. Developers also maintain the software, so it has minimum to no downtime.

III. APPLICATION DESIGN

Since we use the waterfall model as the process model, five processes previously explained we need to go through while designing the OneEd application. Our team consists of three people in total, in which we will follow the waterfall model, including communication, planning, modeling, construction, and deployment.

A. Communication

We collect the necessary data by conducting a survey consisting of 48 respondents [19]. Grouped by age, 85.4% of respondents aged between 17 and 24, and 14.6% respondents aged under 17; Grouped by gender, 60.4% are female, and 39.6% are male; Grouped by role, 93.8% are students, and 6.3% are non-students.

From the survey, 72.9% of respondents are using education applications in order to enhance their study material, with the top 3 platforms that they used are Zenius (50%), Coursera (36%), RuangGuru (30%). When using those applications, there are some problems that respondents face, such as lack of direct interaction with mentors (70,6%), lack of tutors to guide them with study (61,8%), some materials being unclear and confusing (38,2%).

In the information-gathering aspect, the top 3 platforms respondents mainly use to get information are Instagram (93%), WhatsApp (45%), LINE (39%). Respondents also face several difficulties, such as impractical ways to register for webinars (65.9%), hard to find reliable webinar information (63,6%), and lack of advertising from organizers (52,3%).

Given the fact that there are numerous applications that respondents need to utilize to support their study, 77,1% of respondents consider those unintegrated applications as impractical because respondents need to change between applications. Also, 70.8% of respondents complained that too many applications take up extra space on devices.

To sum up, these are the list requirements that respondents expect to look up to solve the previously mentioned problem:

1. One integrated application, reducing the need to change between applications and preserve more memory.
2. Interactive application, able to chat with a tutor to ask for confusing materials.
3. Feature to search for many kinds of scholarships.
4. Materials that can be downloaded and accessed offline.

Therefore, we decided to create OneEd, which facilitates online courses with live meetings, webinars, competitions, and scholarship information. When we questioned the respondents, 100% agreed that OneEd was helpful to provide their needs in student life.

B. Planning

Before starting the project, we have planned to do this project according to the timeline below.

TABLE I. PROJECT TIMELINE TABLE

Process	**Duration**	**Date**
Communication	2 weeks	25 October 2021 - 14 November 2021
Planning	2 weeks	15 November 2021 - 28 November 2021
Modeling	1 month	29 November 2021 - 26 December 2021
Construction	1 month, 2 week	27 December 2021 - 6 Februari 2022
Deployment	3 weeks	7 February 2022 - 21 February 2022

C. Modeling

Below is the general use case model of OneEd Application. This use case shows all those students/users can do using OneEd.

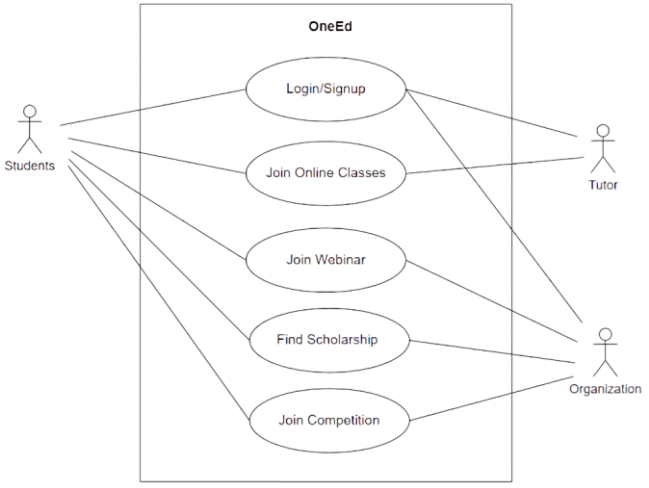

Fig. 2. General use case of OneEd application

There are three actors in our application: students, tutors, and organizations. First, students can log in/signup, join online classes, webinars, competitions, and find scholarships. Tutors can log in/signup and provide online classes. Lastly, organizations can log in/signup and organize webinars, scholarships, and competitions.

D. Construction

We decided to use Visual Studio Code in the Windows system to code HTML, CSS, JavaScript, and PHP to develop OneEd Website. To ease the development process, we decided to use Laravel and Bootstrap 5 as a framework to construct the OneEd application.

We use Laravel as it is an open-source framework that facilitates developers by saving huge time and helps reduce the thinking and planning to develop the entire website from scratch [13]. Along with that, Laravel also takes care of the application's security. Hence all its features can boost the web development pace and craft our work more efficiently [14].

Likewise, we use Bootstrap as the popular and free HTML, CSS, and JavaScript framework for developing a responsive and mobile-friendly website [15]. It is a front-end framework used for easier and faster web development. It includes HTML and CSS-based design templates for typography, forms, buttons, tables, navigation, modals, image carousels, and many others. It can also use JavaScript plug-ins [15]. Bootstrap allows for rapid, responsive development that is consistent and well supported by the development and design community [16].

In the first stage of construction, we create the app's blueprint, starting from the backend, including database structure, up to the front end, including website design. After the blueprint is complete, we start coding the backend using Laravel. Necessary databases and relations are created. Then we construct the front-end website while integrating it with the backend that we have finished beforehand.

E. Deployment

After the construction process finished, we deployed the application on the local host. We decided to deploy OneEd in GitHub, but since it is a Laravel based app, one still has to clone it into their local machine then run the app using Laravel installed on their machine.

IV. Result and Discussion

A. Function Point Measurement

Function Point Measurement is widely used for measuring in software development. Among the reasons for the success of FPA is that it can provide measures of size in the early stages of software development when they are most needed for cost estimation [17].

User Input	24	weight = complex
User Output	20	weight = simple
User Inquiries	18	weight = simple
User Files	7	weight = complex
External Interface	5	weight = complex

Value Adjustment Factor

1. Data Communications = 5
2. Distributed Data Processing = 0
3. Performance = 5
4. Heavily Used Configuration = 4
5. Transaction Rate = 4
6. Online Data Entry = 5
7. End-user Efficiency = 5
8. Online Update = 4
9. Complex Processing = 3
10. Reusability = 5
11. Installation Ease = 4
12. Operational Ease = 4
13. Multiple Sites = 1
14. Facilitate Change = 4

TABLE II. FUNCTION POINT

Domain	Value	Weighting Factors			
		Simple	*Average*	*Complex*	
EI	24	3	4	6	144
EO	20	4	5	7	80
EQ	18	3	4	6	54
ILF	7	7	10	15	105

EIF	5	5	7	10	50
Count Total (UFP)					433

$$\begin{aligned} Complexity\ Adjustment\ Factor &= 0.65 + 0.01 \times \Sigma(F_i) \\ &= 0.65 + 0.01 \times 53 \\ &= 0.65 + 0.53 \\ Complexity\ Adjustment\ Factor &= 1.18 \end{aligned}$$

$$\begin{aligned} Function\ Point &= Unadjusted\ Function\ Point \times \\ &\quad Complexity\ Adjustment\ Factor \\ &= 433 \times 1.18 \\ \textbf{\textit{Function Point}} &= \mathbf{510.94} \end{aligned}$$

B. Kilo Lines of Code (KLOC) Metrics

The effort is the main cost driver for software development. The primary element that affects the effort estimation is the developed kilo line of code (KLOC) which includes the program instructions and statements [19].

$$\begin{aligned} \textbf{\textit{JavaScript}} &= 47\ average\ lines\ of\ code \\ \textbf{\textit{HTML}} &= 34\ average\ lines\ of\ code \\ \textbf{\textit{Average Lines of Code}} &= 40.5\ lines\ of\ code \\ \textbf{\textit{KLOC}} &= FP \times Average\ Lines\ of\ Code \\ &= 510.94 \times 40.5 \\ \textbf{\textit{KLOC}} &= \mathbf{20.693 \approx 21\ KLOC} \end{aligned}$$

C. The Constructive Cost Model (COCOMO)

The COCOMO is the basic parametric model used to estimate software researched and developed by Boehm at TRW [18]. Here, Mrs. Boehm grouped the projects into three different software domains, organic, semi-detached, and embedded. The COCOMO model was developed considering that the linear equation comes in the form given in the equation below.

$$\begin{aligned} Effort &= a(KLOC)^b \times EAF \\ Time &= c(Effort)^d \\ Person &= Effort\ /\ Time \\ KLOC &= Kilo\ Lines\ of\ Code \end{aligned}$$

TABLE III. COCOMO CONSTANTS

Software Projects	a	b	c	d
Organic	0.75	1.05	2.5	0.38
Semi-detached	3.0	1.12	2.5	0.35
Embedded	3.6	1.20	2.5	0.32

TABLE IV. EFFORT ADJUSTMENT FACTOR WEIGHT

Cost Drivers	**Nominal**				
	Very Low	***Low***	***;***	***High***	***Very High***
Product Attributes					
Required Software Reliability	0.75	0.88	1.00	**1.15**	1.40
Size of Application Database		0.94	1.00	**1.08**	1.16
Complexity of the Product	0.70	0.85	1.00	**1.15**	1.30
Hardware Attributes					
Runtime Performance Constraints			1.00	**1.11**	1.30
Memory Constraints			1.00	**1.06**	1.21
Volatility of the Virtual Machine Environment		0.87	**1.00**	1.15	1.30
Required Turnabout Time		0.94	**1.00**	1.07	1.15
Personal Attributes					
Analyst Capability	1.46	**1.19**	1.00	0.86	0.71
Applications Experience	1.29	**1.13**	1.00	0.91	0.82
Software Engineer Capability	1.42	1.17	**1.00**	0.86	0.70
Virtual Machine Experience	1.21	1.10	1.00	**0.90**	
Programming Language Experience	1.14	1.07	1.00	**0.95**	
Project Attributes					
Application of Software Engineering Methods	1.24	1.10	1.00	0.91	**0.82**

Use of Software Tools	1.24	1.10	1.00	0.91	**0.83**
Required Software Schedule	1.23	1.08	1.00	**1.04**	1.10

Intermediate COCOMO

$Effort\ Adjustment\ Factor = 1.15 \times 1.08 \times 1.15 \times 1.11 \times 1.06 \times 1.00 \times 1.00 \times 1.19 \times 1.13 \times 1.00 \times 0.9 \times 0.95 \times 0.82 \times 0.83 \times 1.04$

$\boldsymbol{Effort\ Adjustment\ Factor = 1.33}$

$Effort = 2.4(21)^{1.05} \times 1.33 = 78.05\ person/months$

$Time = 2.5(78.05)^{0.38} = 13.09\ months$

$\boldsymbol{Person = \frac{effort}{time} = \frac{78.05}{13.09} = 5.96 = 6\ person}$

Discussion

Based on the COCOMO test result, we can see that it needs thirteen months and six people to finish this project. While in reality, it only took four months and three people to finish. Therefore, the calculations we make far exceed the effort, time, and person we give.

We believe that this deviation arises because the COCOMO test is intended to estimate an entire project's resource, while we are only developing as far as the prototype. So, based on the number of resources we have spent so far, it is safe to say that the COCOMO calculations make sense if we continue this project until it finishes.

D. McCall's Triangle of Quality

The McCall software quality model was introduced in 1977. This model incorporates many attributes, termed software factors, which influence software. The model distinguishes between two levels of quality attributes which consist of Quality Factors and Quality Criteria [18].

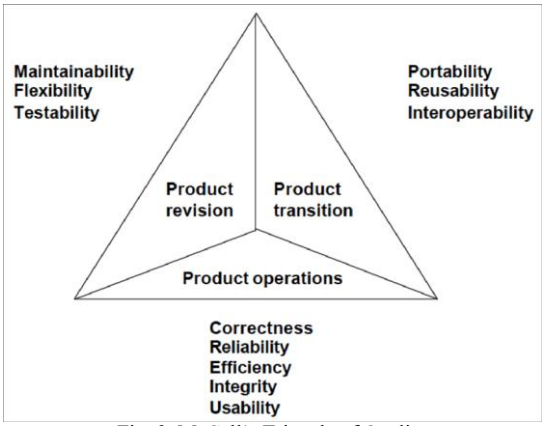

Fig. 3. McCall's Triangle of Quality

In the OneEd application, the McCall's Triangle of Quality aspect consists of:

Product Revision

1. **Maintainability**
   There is a maintenance schedule every two weeks to prevent future system damage. If there is a system failure, we will replace it immediately.
2. **Flexibility**
   Users can change the configuration (language, password, interface size, and more) according to their desire. Other than that, we can scale up OneEd with new features in the future. Therefore, we build the application using the flexibility aspect to be flexible.
3. **Testability**
   Application testing is carried out on functional and non-functional requirements. We can conclude that the application has fulfilled this aspect.

Product Transition

4. **Portability**
   The application server is recommended to run limited on the Windows operating system.
5. **Reusability**
   The application has a chat and live video meeting features using an already available API. This API can also be used in other web applications, so it can be considered reusable.
6. **Interoperability**
   The creation of an interface with a web-based system so that it can be accessed smoothly through all operating systems and all types of devices.

Product Operation

7. **Correctness**
   So far, the application has been tested using test cases and gives good results; the implementation of the application is under the requirements that have been mentioned. Thus, the application has fulfilled the correctness aspect. The test case results will be attached in the appendix.
8. **Usability**
   The application's usability has been well tested, according to the non-functional requirements mentioned above. The results can be seen in the test case.
9. **Efficiency**
   The programming language used to build this application uses HTML, CSS, and Laravel, which is suitable for this kind of web-based application.
10. **Reliability**
    This application is intended to be secure in storing data. Loss of data cannot be tolerated. The application has been tested with SQL injection, and the system's security is maintained.
11. **Integrity**
    So far, Integrity is tested from account security with all levels of users. A test case proves the account security test, and it works.

E. User Interface Application

Below is the OneEd user interface application for each feature that it has.

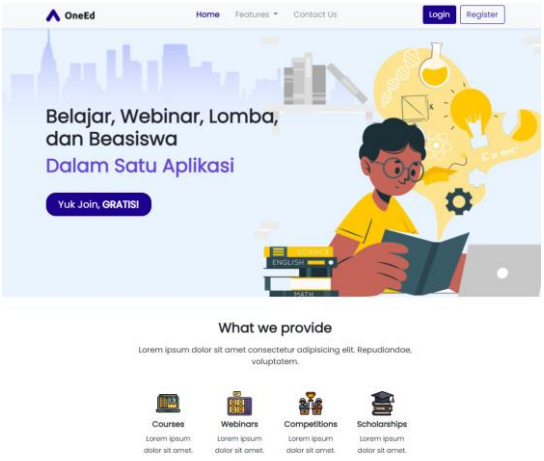

Fig. 4. User Interface for OneEd Homepage

The homepage is the first page users will see when they go to the OneEd website. Users will see a banner about OneEd that will encourage them to sign up for free. Scrolling down, users will see features that OneEd provides, such as Courses, Webinars, Competitions. and Scholarships.

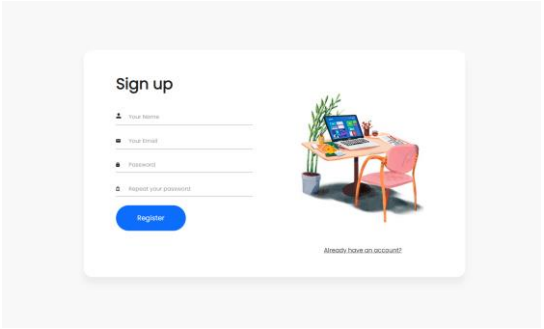

Fig. 5. User Interface for OneEd Sign Up Page

On the signup page, users are prompted to fill in their name, email, and password to create an account. Users who already have an account can click the link to log in instead.

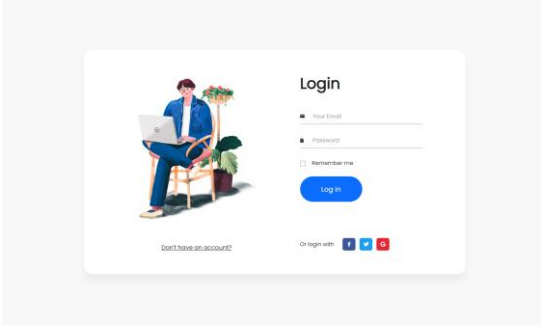

Fig. 6. User Interface for OneEd Login Page

On the login page, users are prompted to fill in their email and password to log in. There is an option to log in with other methods such as Facebook, Twitter, or Google accounts. Users who do not have an account yet can click the link to sign up instead.

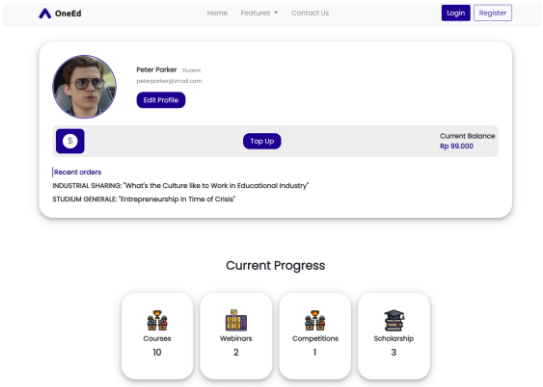

Fig. 7. User Interface for OneEd Profile Page

Users can see their data and account details on the profile page, including name, email, role, and current balance. There is also information about their recent orders and ongoing courses, webinars, competitions, and scholarships.

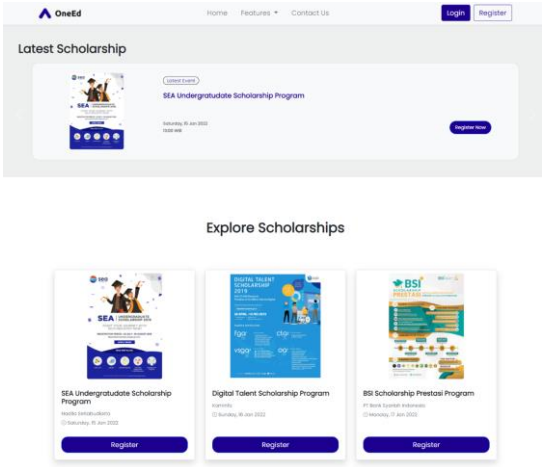

Fig. 8. User Interface for OneEd Scholarships Page

Users will see the latest competitions available at the top of the competitions page. Scrolling down, they can explore all sorts of competitions available.

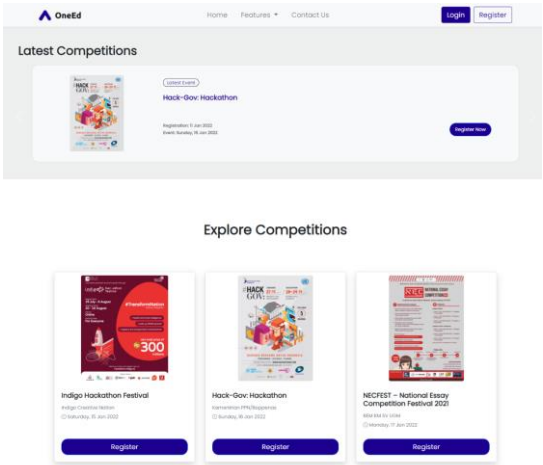

Fig. 9. User Interface for OneEd Competitions Page

On the top of the competitions page, users will be shown the latest competitions available to participate. Scrolling down, they can explore all sorts of competitions available.

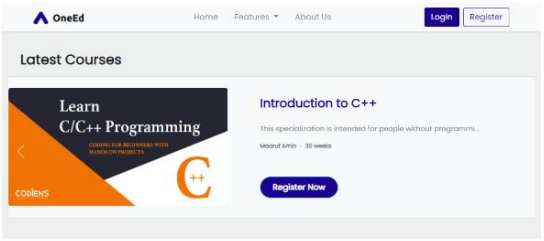

Fig. 10. User Interface for OneEd Courses Page

On the top of the courses page, users will see the latest courses available to roll. Scrolling down, they can explore all sorts of courses available.

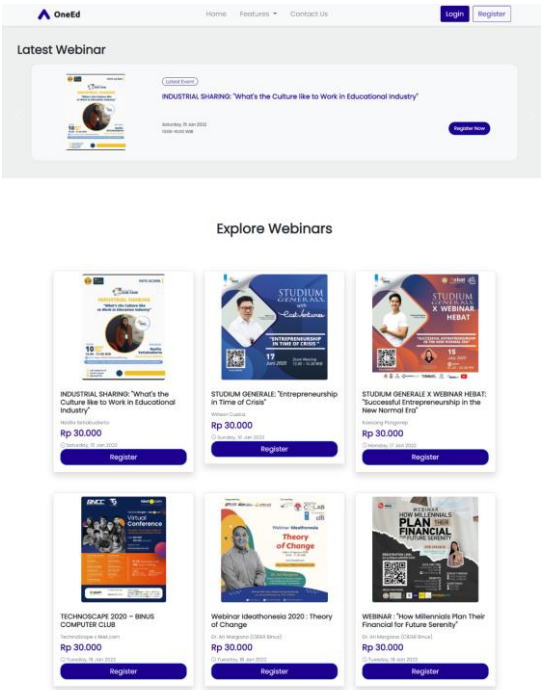

Fig. 11. User Interface for OneEd Webinars Page

On the top of the webinars Page, users will see the latest webinars available to join. Scrolling down, they can explore all sorts of webinars available.

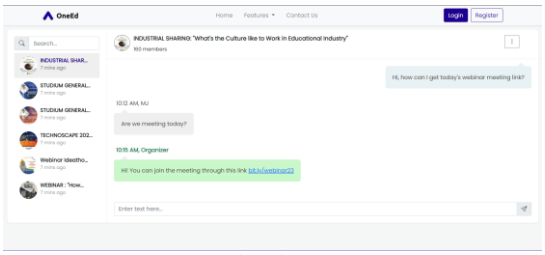

Fig. 12. User Interface for OneEd Chats Page

Users can participate in webinar/competition/scholarship conversations on the chat page they have enrolled in. They can get information related to the subject from the event organizer on the chat page.

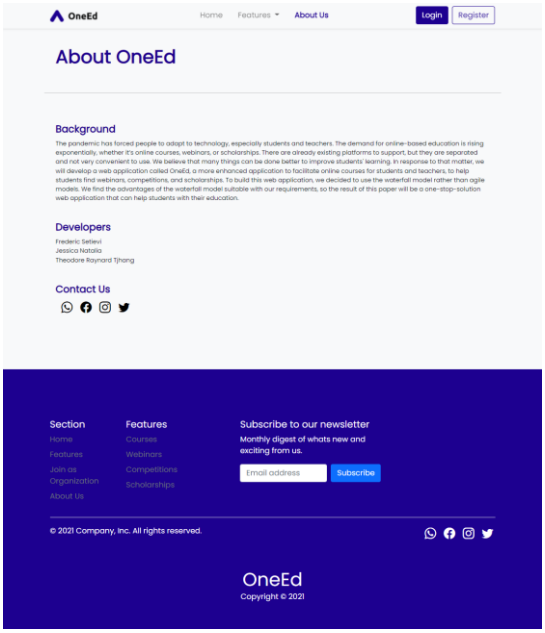

Fig. 13. User Interface for About Us Page

The about us page shows the background story of why we came up with making the OneEd website. There is also a list of the developers and how users can contact us through social media.

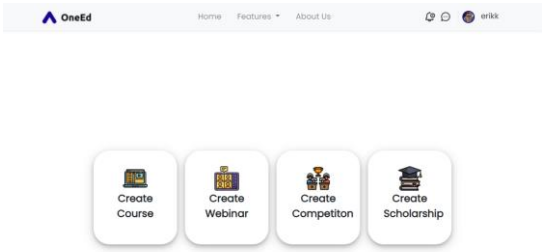

Fig. 14 User Interface for OneEd Organize Event Page

There are four options for organizations on the organized event page to create courses, webinars, competitions, or scholarships.

Fig. 15 User Interface for OneEd Live Meeting Page

Clicking the join meeting button brings the user to the live meeting page. Here we integrate Zoom API to facilitate online meetings between students and mentors.

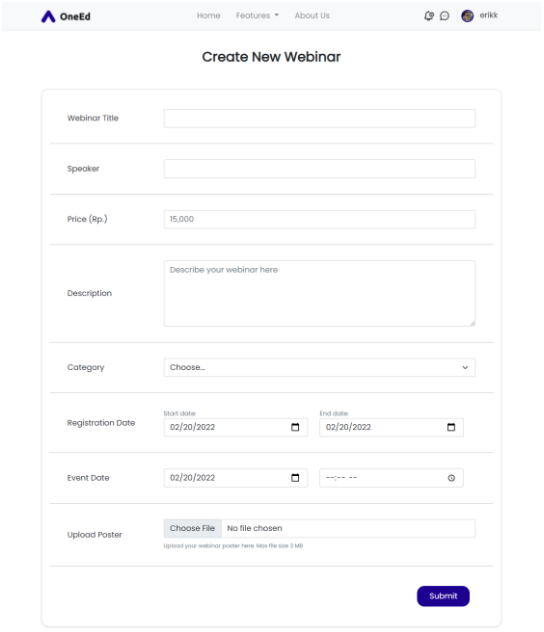

Fig. 16 User Interface for OneEd Create Event Page

This page is available only for organizations. They can create their own courses/webinars/competitions/scholarships by filling in all the information on this page. After completion, hit submit, and the request will be sent for review.

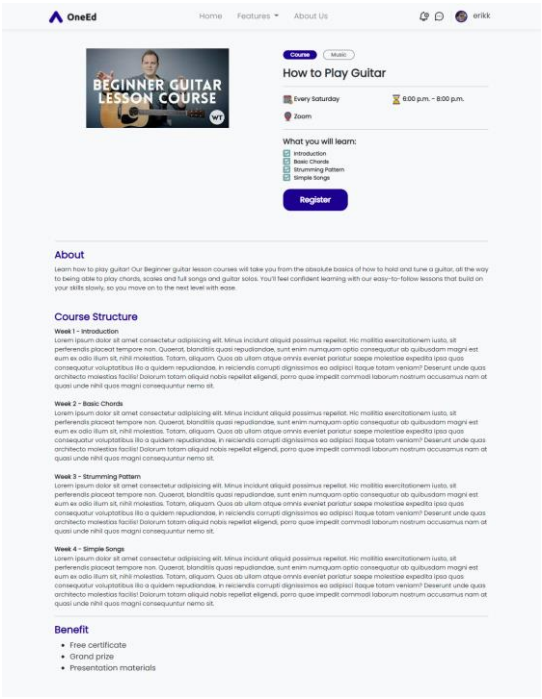

Fig. 17. User Interface for Course Detail Page

The course detail page shows the general information of the whole course, starting from the date and time, what the user will learn, and what they will get after completion. The about section describes the course's summary, and the course structure section divides the course into multiple weeks with short explanations about each week's materials.

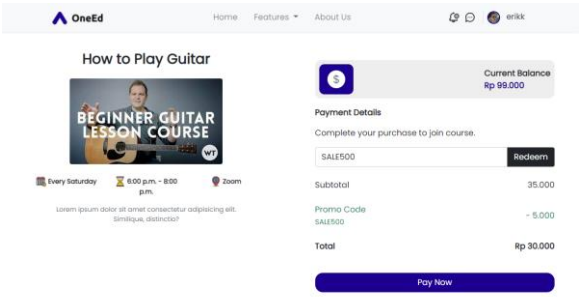

Fig. 18. User Interface for Course Payment Page

On the course payment page, users can see the course they will roll and all the payment details from the current balance to the total cost. Users can also redeem a sale code if they have one.

V. CONCLUSION

Nowadays, there are many standalone applications for students to study or search for information for webinars, scholarships, and competitions. Students may be confused due to the many different applications they need to use, which is inefficient. Therefore, we developed an application called OneEd that integrates courses, webinars, competitions, and scholarships in a single platform. Moreover, the course will have live meetings that help students understand the subject better. OneEd's goal is to make studying and joining webinars, competitions, and scholarships as effective as possible for students.

OneEd application is developed according to the software engineering principle, more precisely the waterfall model. We start by communicating the requirements, planning the

project, building the models, constructing the application, and deploying to the local host.

Based on the COCOMO calculations, we found that we need approximately thirteen months and six people to finish this project. OneEd also meets McCall's Triangle of Quality based on the McCall Triangle aspects.

The results from analyzing students' requirements, the OneEd application has fulfilled their needs in having just one app that facilitates all features that helps them to study. To scale and upgrade OneEd, we plan to reach more students, attract more mentors and add new features such as student exchanges, internships, and many more.

REFERENCES

[1] A.E.E. Sobaih, A.M. Hasanein, and A.E.A. Elnasr, "Responses to COVID-19 in Higher Education: Social Media Usage for Sustaining Formal Academic Communication in Developing Countries," Sustainability 2020, 12(16), 6520.

[2] S. Dhawan, Online Learning: A Panacea in the Time of COVID-19 Crisis. J. Educ. Technol. Syst. 2020, 49, pp.5–22.

[3] M. Suresh, V.V. Priya, and R. Gayathri, "Effect of e-learning on academic performance of undergraduate students," Drug Invent. 2018, 10, pp.1797–1800.

[4] K. Anwar and M. Adnan, "Online learning amid the COVID-19 pandemic: Students perspectives," J. Pedagog, 2020, 1, pp.45–51.

[5] S.K. Wang, The Effect of the Implementation of Webinar Learning from Student-Trainers' Perspective. In C. Bonk, M. Lee & T. Reynolds (Eds.), *Proceedings of E-Learn 2008--World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* (pp. 1359-1364). Las Vegas, Nevada, USA: Association for the Advancement of Computing in Education (AACE). Retrieved November 21, 2021 from https://www.learntechlib.org/primary/p/29820/.

[6] I. Cantador and J. M. Conde, "EFFECTS OF COMPETITION IN EDUCATION: A CASE STUDY IN AN E-LEARNING ENVIRONMENT," IADIS International Conference e-Learning, 2010.

[7] P. Jacobs, The challenges of online courses for the instructor, Research in Higher Education Journal, vol. 2. 2013.

[8] D. Singh, A. Thakur, and A. Chaudhary, "A Comparative Study between Waterfall and Incremental Software. Development Life Cycle Model". 2015.

[9] M.Nazir, Learning Management Systems Evaluation Using Fuzzy Dematel-Topsis: A Web-Based System. 2018, p.31.

[10] R.S. Pressman, Software Engineering: A Practitioner's Approach 6th Edition. McGraw-Hill, NY, 2005. pp 45 – 94.

[11] Laravel LLC,. Laravel - The PHP Framework For Web Artisans. [online] Laravel.com. Available at: <https://laravel.com/docs/9.x/installation#why-laravel> [Accessed 4 January 2022].

[12] K.I. Bagwan and S.D. Ghule, "A Modern Review on Laravel- PHP Framework," IRE Journals, vol. 2. 2019. Available at: <https://irejournals.com/formatedpaper/1701266.pdf> [Accessed 20 January 2022].

[13] B. Efron and R.J. Tibshirani, "An Introduction to the Bootstrap". New York, 1993.

[14] S. Gaikwad, A Review Paper on Bootstrap Framework. IRE Journals, 2019. Available at: <https://irejournals.com/formatedpaper/1701173.pdf> [Accessed 21 January 2022].

[15] A. J. Albrecht, Measuring Application Development Productivity. Joint SHARE/GUIDE/IBM Application Development Symposium, 1979, pp. 83–92.

[16] H.P. Patra and K. Rajnish, "Development of Software Effort Estimation using a Non-Fuzzy Model". 2017. Available at: <https://core.ac.uk/download/pdf/230489398.pdf> [Accessed 23 January 2022].

[17] H. Zeng and D. Rine, "A neural network approach for software defects fix effort estimation," in *Proceedings of the Eighth IASTED International Conference Software Engineering and Applications*, 2004, pp. 513– 517.

[18] S.K. Dubey, S. Ghosh, and A. Rana, "Comparison of Software Quality Models: An Analytical Approach," International Journal of Emerging Technology and Advanced Engineering, Volume 2, Issue 2. 2019, pp.111-11.

[19] OneEd Requirements Survey

You can see the prototype of the OneEd app at the link below: https://github.com/jessicaebd/oneEd