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# COMPARATIVE ANALYSIS OF CODEIGNITER, LARAVEL AND KTUPAD FRAMEWORKS: CASE STUDY ONLINE EXAM APPLICATIONS

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**ABSTRACT**

The speed of access to digital information is essential in making decisions, and Google Development requires a data access limit of no more than three seconds. This study analyzes performance, security, and other measurements among three frameworks: CodeIgniter, Laravel, and Ktupad. This research methodology uses digital forensics as a framework for the collection of functions, classes, and rules. In contrast to libraries that are only for a specific purpose, the framework comprehensively regulates how we build applications. Frameworks allow us to build applications faster because we will focus more on the subject matter as developers. SDLC (System Development Life Cycle) consists of 3 stages: Framework Testing, Framework Analysis, and Framework Evaluation. The case study of this research is an Online Exam at Junior High School 242 Jakarta, which was built using CodeIgniter Web Framework, Boostrap, JQuery, Laravel, and Ktupad Web Framework and then compares the three using the Research and Development method with the Extreme Programming (XP) approach. Comparison tool using Web Dev, Apache JMeter, and ZAP OWASP. The results of this study show that the performance values are 1-100 from CodeIgniter 77, Laravel 75, and Ktupad 99, and security values from CodeIgniter Medium, Laravel Medium, and Ktupad Low.

## 1. INTRODUCTION

The development of information technology has dramatically helped every person, institution, or company solve a problem and carry out its duties. The tight competition in technology causes an increase in the need for information technology. Every person, institution, or company that exists today always follows the development of information technology and needs to be able to assist its operational activities by using a more effective and efficient system in running its business. One of the business activities that are currently popular is the creation and use of websites for various purposes for every person, institution, or company in promoting sales or business and managerial needs. PHP stands for Hypertext Preprocessor, which is used as a server-side scripting language in Web development that is embedded in HTM documents. According to W3Techs (2020), PHP is used by 78.9% of websites that use serverside programming that they know. The rest are followed by ASP, net (9.8%), Ruby (3.9%) java (3.3%).

In addition, developing a PHP (Hypertext Preprocessor) framework for website creation is challenging for users in creating web-based applications. The framework is a collection of libraries organized in an architectural design to provide accuracy, speed, convenience, and consistency in application development. A widely available PHP framework becomes an obstacle for someone to choose to use it. Currently, the framework is popular and widely used for website applications such as Laravel, CodeIgniter, Zend, CakePHP, and Symfony. According to Google Trends, the authors compared user interest in Laravel, Symfony, CodeIgniter, CakePHP, and Zend, from 1 September 2019 to 23 August 2020 in Indonesia. The average interest was obtained as follows, Laravel (75), Symfony (1), CodeIgniter (53), CakePHP (1), and Zend (1).

The more popular a web framework is, the more vulnerable it is to security attacks, but building an application from scratch will take time and testing. So this research uses a web framework that has been created and is a relatively new framework, namely the Ktupad web framework. So this research is focused on analyzing and getting the results of comparing the PHP framework between CodeIgniter, Laravel, and Ktupad in the case study of the Online Exam. The identification of this research problem is based on the experience of using applications built using Joomla and WordPress, which experienced performance and security failures, resulting in the application not responding and becoming a victim of hacking. Research is needed to compare performance and security between three web frameworks, namely CodeIgniter, Laravel, and Ktupad, so that, in the end, web application developers can see one of the advantages of the framework.

Ktupad framework is a Client-Server based Framework with JSON as the data link. predictable, consistent, and modular. This is what makes Ktupad easy to use for both developers and users. Responsive. Practical ktupad, just one application for Web App, Desktop, and Mobile. Progressive Web Apps (PWA) allow working offline. The data load times become much faster (Sismadi et al., 2021). CodeIgniter is: "A PHP framework that is open source and uses the MVC (Model, View, Controller) method to make it easier for developers or programmers to build a web-based application without having to create it from scratch." The official Codeigniter website (CodeIgniter, 2022) states that Codeigniter is a robust PHP framework with few bugs. CodeIgniter is built for developers with PHP programming language who need tools to create a full-featured web. Rick Ellis, CEO of Ellislab, Inc, developed the CodeIgniter framework.

Laravel is a PHP framework released under the MIT license, built with the concept of MVC (model view controller). Laravel is an MVP-based website development written in PHP designed to improve software quality by reducing initial development and maintenance costs. To enhance the experience of working with applications by providing an expressive, precise, and time-saving syntax. Previous research Erinton et al. (2017) researched the performance

analysis of the CodeIgniter and Laravel frameworks using the apache web server. The goal is that the analysis results can be used as evaluation material and input for developers to select a framework in terms of performance. The conclusion of the analysis results can be used as an evaluation material and input for developers to select a framework in terms of performance. The disadvantage is that it only analyzes the security side of the database of each framework. The comparison with this research is to compare the performance between CodeIgniter and the Ktupad framework.

Simajuntak (2016) analyzed the Model View Controller (MVC) in the PHP Language to find out which PHP is the best for developers. In conclusion, PHP is proven to be able to run optimally in the use of reusables. The weakness is that PHP cannot run if the server condition is down or inactive, so the PHP language does not run optimally in the flexibility section. The research will compare flexibility when the server is down. Destiningrum and Adrian (2017) examined a web-based doctor scheduling information system using the CodeIgniter framework at the Yukum Medical Center Hospital. The goal is that a web-based doctor scheduling information system can be a solution for data processing and provide patients with more accurate information about health and doctor schedule. This study concludes that this doctor scheduling information system can facilitate the information and patient sections. Especially admins and doctors can input the updated doctor's practice schedule. This system was tested using three methods; the quality was produced with a percentage of responses of 87.87%, and the criteria for calculating the system was excellent. Furthermore, it is suggested that the processing of doctor's scheduling not only manages the doctor's practice schedule and information on health articles but also allows the community system to conduct consultations directly on the hospital website in contrast to this research using the powerful programming method.

Septian (2010) compares the PHP framework based on Moose CK and design quality properties using the Analytic Hierarchy Process (AHP) method. The goal is to determine the quality of the software design of the five frameworks, which one is the best so that it can provide recommendations to programmers in building web applications using the PHP framework. The method is general so that apart from being used in desktop applications, it can also be applied to web applications. This study only analyzes comparing two frameworks, CodeIgniter and Ktupad Web Framework. Utami and Sahid (2010) compared security systems for developing web 2.0 applications using the Ruby On Rails and Cakephp framework. The aim is to review more deeply the differences in the security system for website application development between the RoR framework and CakePHP. The conclusion is that the threats that can attack the security system in both frameworks are SQL injection attacks, Cross Site Scripting (XSS), Cross-Site Request Forgery (CSRF), and authentication. The weakness of this research cannot be concluded that the outline is the best alternative framework between these two frameworks. This is because both frameworks have many solutions to overcome security threats. Comparison of the two frameworks to get the best performance between the two.

Meanwhile, Prayudi and Sn (2015) examined the application of the ISSAF and OWASP version 4 methods for testing web server vulnerabilities. The aim is to find out the results of testing and analysis of web server security testing using ISSAF and OWASP version 4. The results of testing and analysis using the ISSAF method show that the IKIP PGRI Madiun web server system can still be penetrated and take over administrator access rights. In contrast, the OWASP version 4 method shows that authentication management, authorization, and session management still need to be appropriately implemented. They suggested some improvements to the application after testing. The difference with this paper was carried out using the ISSAF and OWSAP methods; Prayudi and Sn (2015) research used APDEX and OWASP. Sholeh and Wardaya (2019) analyzed and tested the vulnerability of library information systems. The penetration testing tools, the goal tested vulnerability on the writing.uinjkt.ac.id website.

Testing tools used zed attack proxy tools. TULIS has vulnerabilities ranging from moderate level (XSS Reflected, Security, Apache Jserv protocol service, Login page password guessing attack, and HTML form without CSRF protection) to severe (Sensitive Data Exposure part of web server robots.txt information disclosure). The suggestion is to fix the vulnerabilities found based on the testing and analysis results described previously.

Permatasari (2020) tested the application using the load testing method with Apache Jmeter on the Agricultural Information System. After the MeTANI application has been created, it is necessary to carry out testing to test whether the module is running according to the requirements. The Gorilla Testing testing technique was applied to the tests in section 3. This technique ensures that the module is functioning correctly and that there are no bugs. The module can be tested more than a hundred times and in the same way. Gorilla Testing is very useful for testing the robustness of the application. It is recommended to use other penetration tools such as WEB DEV or similar to Apache Jmeter. Kamarudin et al. (2018) tested the student payment web service performances system using Apache JMeter at AMIKOM University Yogyakarta to obtain information on which method has better performance so that it can be a solution for integrating student payment information systems at AMIKOM University Yogyakarta. The performance test process is carried out using the Apache JMeter tool. The test was carried out with 150 virtual users once. From the results of this study, the Response Time of the old system (SOAP) is faster than the prototype of the new system (REST). For Received/Sent parameters, the prototype of the new system is better than the old system. As for the Throughput parameter, the old system is slightly better than the prototype of the new system. The addition of latency time, min, and max parameters as test parameters must be done to produce a more in-depth performance analysis.

Fatoni and Dwi (2016) designed the extreme programming system as a system development methodology. Extreme Programming helps speed up the work of a team in an organization or company. Because the Extreme Programming life cycle requires a team to complete a series of Planning, Analysis, Design & Code, Test, and Deploy activities within the allotted time. Companies or organizations that want to implement Extreme Programming are expected to be able to understand and understand Extreme Programming practice and Scrum. If the company or organization already understands Extreme Programming practice and Scrum, they can learn Scrum and complete Extreme Programming. Latif and Kusumasari (2017), Papadakis and Kalogiannakis (2019), and Papadakis et al. (2021) researched the Performance Comparison of Executing Large Data in Yii2 and Laravel Framework. The goal is to give developers something to consider when choosing a PHP framework for their system development.

In conclusion, Laravel gives more results in terms of execution time and throughput but not in memory usage. Many factors, including the test environment, may influence these results. This study compares Laravel and Yii.

Based on the description of the problem's background, the problem question in this research is how to get the performance and security comparison results of the three web frameworks between CodeIgniter, Laravel, and Ktupad. This study emphasizes getting the best performance test results against each web framework, namely performance and security. This research aims to compare Ktupad with CodeIgniter and Laravel in terms of performance and security. Develop a Web Framework that performs better than the most popular PHP Frameworks based on Google searches. Moreover, test the application by comparing the three.

## 2. METHODS

This research methodology uses digital forensics based on a review of previous related studies as a framework for the collection of functions, classes, and rules. In contrast to libraries that are only for a specific purpose, the framework comprehensively regulates how we build

applications. Frameworks allow us to build applications faster because we will focus more on the subject matter as developers. The case study of the online examination conducted at Junior High School 242 Jakarta used the website address https://kuis.smpn242-jkt.sch.id/during April 2021. Comparative analysis was used web address htpps://kuis.ktupad.id, htpps://ci.ktupad.id and htpps://laravel.ktupad.id.

The research methodology aims to develop previous research. In this research, an analysis is carried out to determine what stages can be applied in the web framework. The framework is analyzed and tested in order to be able to conclude its development and utilization correctly. This research methodology includes four main stages: Method analysis in identifying Research Problems used, Literature Study, and SDLC (System Development Life Cycle) for Framework and Testing Framework, which consists of 3 stages, namely Framework Testing, Framework Analysis, and Framework Evaluation. The discussion of the research methodology can be described as follows:

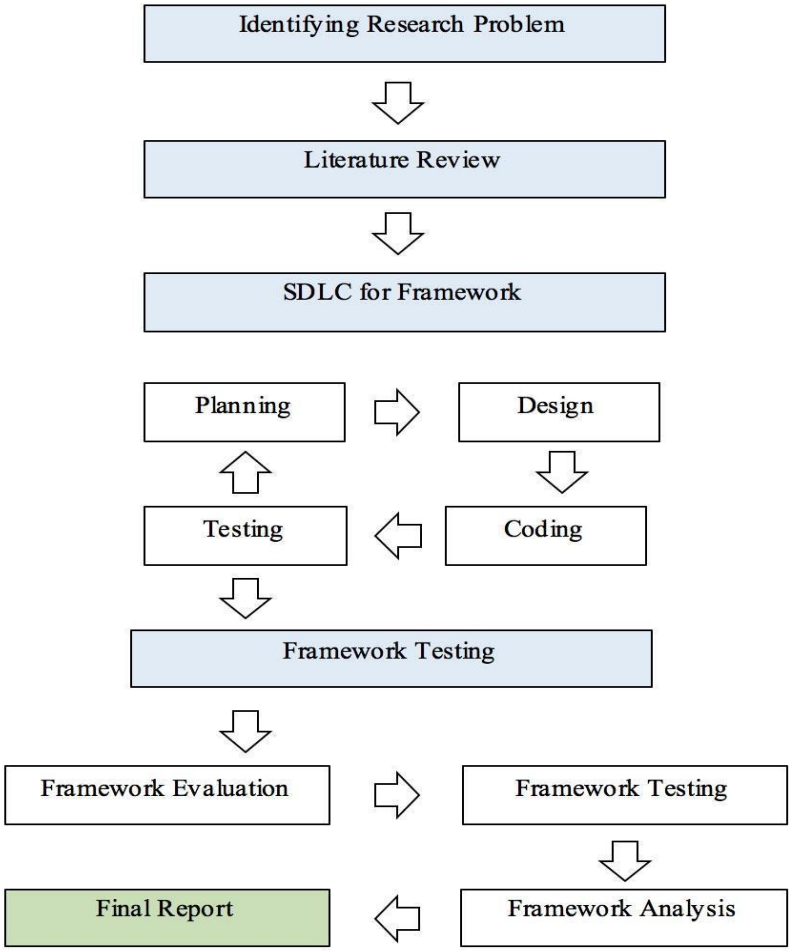


Figure 1 Research Methodology Flowchart

Identifying research problems was the first step to obtaining and determining research topics that will be studied further. This stage begins by looking at various phenomena, events, and information obtained in various ways related to the research being conducted. The research that will be carried out is the development of the framework. The developed web framework still needs to be developed. The solution offered is to develop a framework using the Systems Development method. Judging from the available resources, the authors chose Extreme programming as System Development, namely the availability of previous applications and a relatively short development time. Likewise, with the selection of testing methods, the authors used the method forensic, because it is not possible to conduct surveys

in a short time, and knowledge of participants is needed in a survey to calculate page loads and penetrate available applications; the authors chose the method forensic by utilizing load test tools and penetration test tools. The second step was conducted to obtain information on the research topic. Literature studies can be sourced from documents, books, articles, or other written materials in the form of theories, or previous discoveries, both online and offline sources.

The third step carried out in evaluating web framework development so that it can be used as a standard web framework; there are four stages of the process contained in the SDLC such as (1) Planning, which starts from gathering requirements that help the technical team to understand the business context of an application. In addition, this stage also defines the output to be generated, the features of the application, and the functions of the application being developed (2) Design, emphasizes a simple application design; to design applications, you can use Class-Responsibility-Collaborator (CRC) cards that identify and manage object-oriented classes (3) Coding programming is pair programming, involving more than one person to compose the code (4) Testing, the focus is more on testing the features and functionality of the application.

The fourth step was framework testing**.** This testing is a stage that aims to determine the feasibility of the framework that has been developed from previous research. The stages of the testing process were made, namely the trial stage, analysis stage, and evaluation stage, such as (1) evaluation framework. This stage is the first stage in conducting testing, which aims to determine the feasibility of the framework developed from previous research. The case study that has been designed will be analyzed for performance by utilizing the measurement tools that have been prepared. This case study is carried out to ensure that the stages of the framework that have been developed follow the investigation stages in conditions actual (2) test framework. This stage is where scenarios and case simulation processes are carried out on the performance of the applications that have been developed. The analysis process will also describe and identify each stage; (3) analysis framework. The stage of this research is to conduct evaluation actions on the framework that has been developed with the previous framework. The evaluation was carried out based on the results of the trials at each stage. The evaluation stage is a comparison process against the framework developed with the previous framework (4) and reports on the results of the framework analysis by comparing the advantages and disadvantages of the developed framework and the previous framework.

This research hypothesizes that Ktupad's performance and security are better than CodeIgniter and Laravel because file size affects loading time. Permatasari (2020) which is hypothesis is that there is a performance effect on applications that use the javascript framework, namely JQuery, and the use of the CSS framework, namely Bootstrap, the larger the file that must be displayed in full and the script that is not used but still runs. Configuration and write errors also affect application security vulnerabilities from attacks.

## 3. RESULTS AND DISCUSSION

At the planning or planning stage, the authors collect data on the needs and features of the online exam application. There are three entities, namely the admin, a group of users who can manage all the features in the application; teachers are users who can manage and write questions on the quiz page. Also, students are users who fill out the Quiz provided and are entitled to a graded certificate. The module of the online exam application is (1) Login, in the form of a user authentication page, on this page the user is asked to enter an account in the form of a username and PIN, in order to enter the application, this login page is expected to divide user access groups, namely admin, teacher and students (2) Profile, in the form of the main application page, which contains user information, Pin updates and a menu to enter the

page that has been provided according to the access group (3) Quiz, is a page where teachers can make questions, and students can fill in answers (4) Values, this page is in the form of information, history, which questions the student has filled in and recorded the answers to, so if there is an error in filling out, the admin can see, where the error is, whether the teacher gave the wrong question and answer key, or indeed the student was wrong in answering the question (5) Certificate, is a proof page that students have filled out answers, this certificate contains the value of questions that have been answered by (6) Access, the access page is administrated, to manage, users, what pages can be viewed, what data can be added and Edit (7) Users, this page is a user information page, which includes a username, PIN, access (8) Menu, this page is used by the admin to manage page links. Features and user interactions on the application are described in the following Use Case scenario shown in Figure 2.

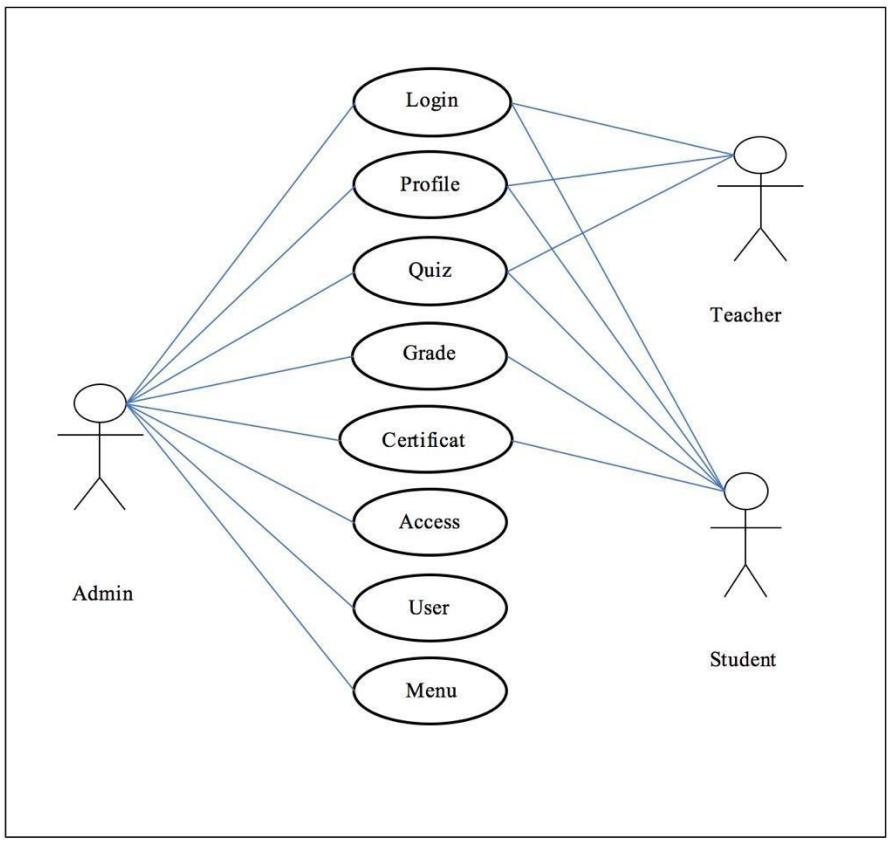


Figure 2 Use Case Diagram Online Exam

### 3.1. Design

At the design stage, a CRC Card is made to recognize and manage objects in the application by looking at user needs. By creating five classes, such as (1) Menu, this class contains objects to store application menu data; from this class the application system will direct users to pages in the application; menu data is also used as the identity of a module so that the access class can use the id of the menu class to set the terms of user access (2) Access, this class contains objects to store user access data for applications, in which there are user groups that are allowed to view, modify and add so that the users class can be used to identify users through the id of the access class (3) Users, this class contains objects to store user data, contains names, pins, and access manages who can enter the application and which access groups. So it can be used by the value class to identify the username (4) Value, this class

contains objects to store valuable data, contains quiz names, scores, and answer history, this class provides information to the score information (5) quiz class with Quiz, this class contains objects to store quiz data, contains questions and answers, this class provides information quiz name to grade class.

### 3.2. Coding Database Design

The online exam application database design uses a MySQL database base; this is because the system will operate online. Besides, the MySQL database supports many programming languages and is open source.

### 3.3. Performance Testing

At the performance and security testing stage, several tools for performance testing using measures from google measure can be accessed via the page https://web.dev/measure. Performance testing consists of six test metrics: (1) First, Contentful Paint. Measures the time it takes the browser to render the first part of the DOM content after the user has opened the page. Images, non-white <canvas> elements, and SVGs on your page are considered DOM content; anything inside the iframe is not included (2) Time to Interactive (TTI). Measures the time from when the page starts loading to when its main sub-resource has loaded and can respond quickly to user input (3) Speed Index. Measures in ms how quickly content is displayed visually during page load (4) Total Blocking Time. Measures of the time the page was blocked from responding to user input, such as mouse clicks, screen taps, or keyboard presses. The number is calculated by adding up the blocking portion of all long tasks between First Contentful Paint and Time to Interactive. Any task that runs for more than 50 ms is a lengthy task. The amount of time after 50 ms is the blocking portion. For example, if Lighthouse detects a 70 ms long task, the blocking portion is 20 ms (5) Largest Contentful Paint (LCP). It is an essential user-centric metric for measuring perceived loading speed as it marks the point in the page load timeline when the page's main content is most likely to have loaded (6) Cumulative Layout Shift (CLS). Cumulative Layout Shift is an essential user-centered metric to measure visual stability as it helps measure how often users experience unexpected layout shifts.

The authors conducted a performance test against the web framework and got the following results: First, testing the application using the CodeIgniter framework. On the web.dev page the authors enter the application address https://ci.ktupad.id into the URL form. The test results show that the application's performance built using the Codeigniter framework gets a value of 77; the following table scans the application using Codeigniter.

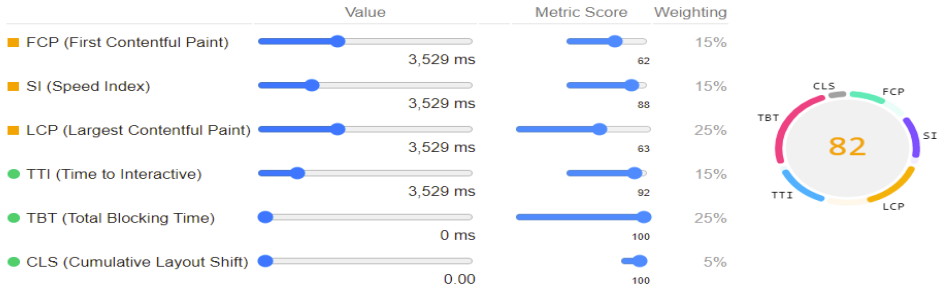


Figure 3 Performance Test Result of CodeIgniter

Second, testing the application using the Laravel framework. On the web.dev page, the authors enter the application address https://laravel.ktupad.id into the URL form.

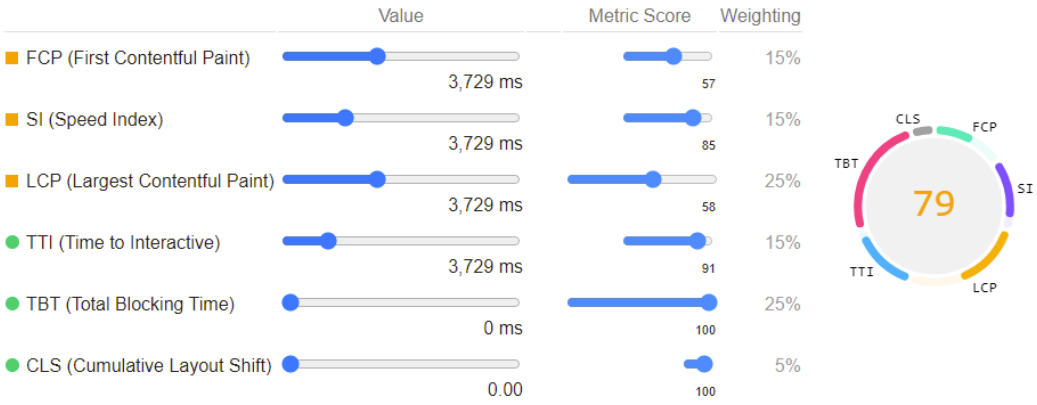


Figure 4 Performance Test Result of Laravel

Third, a test of the application using the Ktupad framework. On the web.dev page the authors enter the application address https://kuis.ktupad.id into the URL form.

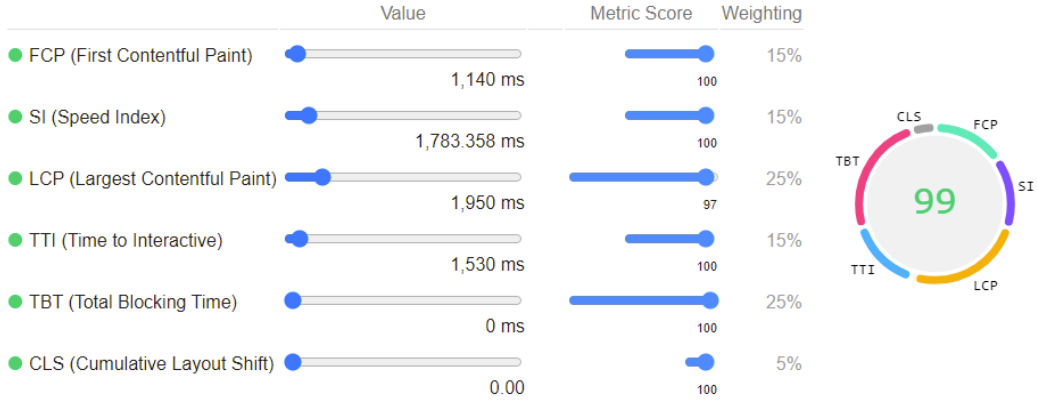


Figure 5 Performance Test Result of Ktupad

Table 1 shows the comparison of performance results between CodeIgniter, Laravel, and Ktupad seen from the aspect of FCP (First Contentful Paint), SI (Speed Index), LCP (Largest Contentful Paint), TTI (Time to Interactive), TBT (Total Blocking Time) and CLS (Cumulative Layout Shift).

Table 1 Performance Result

| **https://ci.ktupad.id** | | | | |
|---|---|---|---|---|
| | Value | Metric Score | Weighting | |
| FCP (First Contentful Paint) | 1, 530 ms | 99 | 15% | 82 |
| SI (Speed Index) | 1, 580.277 ms | 100 | 15% | |
| LCP (Largest Contentful Paint) | 1, 950 ms | 97 | 25% | |
| TTI (Time to Interactive) | 1, 530 ms | 100 | 15% | |
| TBT (Total Blocking Time) | 0 ms | 100 | 25% | |
| CLS (Cumulative Layout Shift) | 0 | 100 | 5% | |
| **https://laravel.ktupad.id** | | | | |
| | Value | Metric Score | Weighting | |
| FCP (First Contentful Paint) | 1, 530 ms | 99 | 15% | 79 |
| SI (Speed Index) | 1, 580.277 ms | 100 | 15% | |

| | | | | |
|---|---|---|---|---|
| LCP (Largest Contentful Paint) | 1, 950 ms | 97 | 25% | |
| TTI (Time to Interactive) | 1, 530 ms | 100 | 15% | |
| TBT (Total Blocking Time) | 0 ms | 100 | 25% | |
| CLS (Cumulative Layout Shift) | 0 | 100 | 5% | |
| **https://kuis.ktupad.id** | | | | |
| | Value | Metric Score | Weighting | |
| FCP (First Contentful Paint) | 1, 530 ms | 99 | 15% | 99 |
| SI (Speed Index) | 1, 580.277 ms | 100 | 15% | |
| LCP (Largest Contentful Paint) | 1, 950 ms | 97 | 25% | |
| TTI (Time to Interactive) | 1, 530 ms | 100 | 15% | |
| TBT (Total Blocking Time) | 0 ms | 100 | 25% | |
| CLS (Cumulative Layout Shift) | 0 | 100 | 5% | |

## 3.4. **Security**

The performance and security testing stage uses several tools for performance testing using Zed Attack Proxy (ZAP) from OWASP.

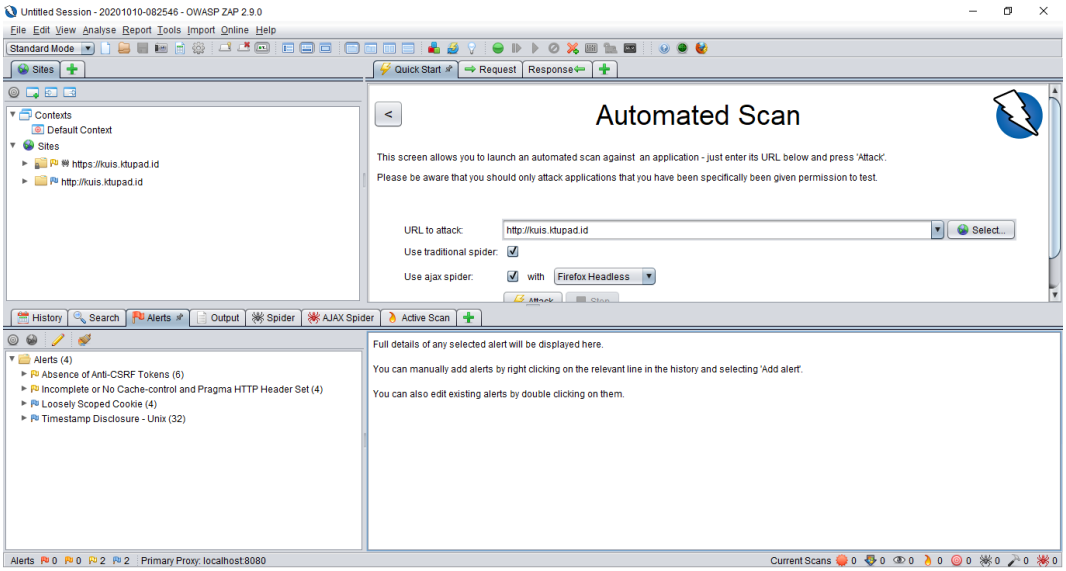


Figure 6 Tools OWASP ZAP

The authors conducted a security test on the web framework and got the following results:

Table 2 Gap Found

| Domain | Gap Found |
|---|---|
| htpps://kuis.ktupad.id | Absence of Anti-CSRF Tokens<br>Incomplete or No Cache-control and Pragma HTTP Header Set<br>Loosely Scoped Cookie<br>Timestamp Disclosure - Unix |
| htpps://ci.ktupad.id | X-Frame-Options Header Not Set<br>Absence of Anti-CSRF Tokens<br>Cross-Domain JavaScript Source File Inclusion<br>Incomplete or No Cache-control and Pragma HTTP Header Set |

| | |
|---|---|
| | Loosely Scoped Cookie |
| | Timestamp Disclosure - Unix |
| htpps://laravel.ktupad. | X-Frame-Options Header Not Set |
| | Absence of Anti-CSRF Tokens |
| | Cross-Domain JavaScript Source File Inclusion |
| | Incomplete or No Cache-control and Pragma HTTP Header Set |
| | Loosely Scoped Cookie |
| | Timestamp Disclosure - Unix |

Overall score Likelihood and Impact of information systems in the https domain ://kuis.ktupad.id is 5.59 and 2.87, https://ci.ktupad.id is 5.93 and 2.83, and https://laravel.ktupad.id is 5.93 and 2.83 along with Likelihood and Impact scores, as shown in Table 3 - 5.

Table 3 Business Impact Result

| Domain | Likelihood | Impact |
|---|---|---|
| htpps://kuis.ktupad.id | 5.59 | 2.87 |
| htpps://ci.ktupad.id | 5.93 | 2.83 |
| htpps://laravel.ktupad. | 5.93 | 2.83 |

Table 4 Likelihood and Impact Levels

| Likelihood and Impact Levels | |
|---|---|
| 0 to <3 | Low |
| 3 to <6 | Medium |
| 6 to 9 | Hight |

Table 5 Performance and Security Testing Result

| Framework | CodeIgniter | Laravel | Ktupad | Notes |
|---|---|---|---|---|
| Performa | 77 | 75 | 99 | Higher the better |
| Security | Medium | Medium | Low | Lower the better |

From the results of the Load test and penetration tests, the authors chose Ktupad as a framework for developing the Online Exam application. This research has an impact on the community to give guidance in choosing the best framework to increase the performance and security of a web application. The benefits of this research are as a means of information knowledge for developers, especially PHP programmers, in choosing the three PHP frameworks, namely the Ktupad framework, Laravel, and Code Igniter framework. This research is also expected to provide direction for developers to refactor the application being developed. This research contributes to better performance and tests the web framework comparison.

## 4. CONCLUSION

Testing of the performance and security comparisons of CodeIgniter, Laravel, and Ktupad is expected to be able to provide a comparative analysis of the three frameworks and techniques to improve web application performance with the powerful programming method; it is expected to be able to increase application performance, this is evidenced by testing on

gap application, using web.dev, Apache JMeter and ZAP OWASP. From the test results, it is hoped that an increase in accessibility best practice performance and SEO improvement; also, in terms of application security, by referring to the 10 OWASP recommendations, CodeIgniter gets 77 performance results, and security *medium*, Laravel gets 75 performance results. Security *medium* and Ktupad get performance results of 99 and security *low*, so it can be concluded from the analysis conducted that Ktupad is better than CodeIgniter and Laravel.

The results of the MVC Framework test are tests carried out using software tools, both load tests, and penetration tests. It is hoped that the following research will be tested using actual data, in the sense that the examiner is an actual human, not a virtual user, by first providing an understanding to the examiners how to calculate the load test and how to penetrate.

The digital forensic and SDLC (System Development Life Cycle) analysis tools to compare the Ktupad framework against other frameworks can be used for further research. These tools are powerful for analyzing big data with thousands of respondents. Instead of using humans, which will need tedious work for interviews and collecting data.

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