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Security Audit and Analysis of High School Websites Using Cross Site Scripting (XSS) Method and Insecure Direct Object Reference (IDOR) Penetration Test

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Abstract **This study investigates security vulnerabilities in secondary school PPDB websites, focusing on Structured Query Language (SQL) Injection and Cross Site Scripting (XSS) techniques. The research aims to conduct a security audit and analysis using XSS methods and Insecure Direct Object References (IDOR) penetration tests. The primary objectives are to identify existing security gaps, provide recommendations for improvement, and enhance the overall security of these websites. By addressing these vulnerabilities, the study seeks to make PPDB websites more secure and reliable in protecting users' personal data and maintaining system integrity. Additionally, this research aims to raise awareness among PPDB system managers and schools about the importance of cybersecurity in website development and management, offering practical solutions and serving as a reference for improving website security in the educational sector.**

Keywords **: IDOR, Security Audit, Testing, XSS.**

I. INTRODUCTION

In today's digital era, information technology plays an important role in various aspects of life, including in the education sector. The application of technology in the secondary school environment is not only limited to the teaching and learning process, but also to administrative systems, one of which is the New Student Admission (PPDB). The PPDB website becomes the main means in new student registration, facilitating a more efficient and transparent process. However, behind the convenience offered, challenges arise regarding data security and system integrity.

The PPDB website stores a variety of sensitive information, ranging from prospective students' personal data to confidential administrative records. Vulnerabilities on this website can be exploited by irresponsible parties to carry out various cyber attacks. One form of attack that often occurs is Cross-Site Scripting (XSS) and Insecure Direct Object References (IDOR).

Based on data from the National Cyber and Crypto Agency (BSSN) in collaboration with the Indonesian Honeynet Project (IHP), there were a total of 75,379,865 cyber attacks detected between March 2022 and March 2023. The largest sources of attacks came from India, China, and the United States. This attack detection was carried out using 52 active sensors spread across 38 provinces in Indonesia [2]. The most common types of web-based cyberattacks include Structured Query Language (SQL) Injection, Possible Bruteforce, Cross Site Scripting (XSS), Directory Listing, Clickjacking, and Sensitive Data Exposure [30].

According to w3tech statistics, 43.2 percent of developers use the software to create websites [31]. Unfortunately, with the increasing popularity of website use, more and more attacks are carried out by irresponsible parties to steal information or damage the integrity of a website whether it is a government, news, or organization website. According to WPscan statistics in 2023 there were 38,650 vulnerabilities found in WordPress and 92 percent of them were caused by plugins [31]. The most common causes of attacks were Cross-Site Scripting at 49.82 percent and SQL Injection at 6.8 percent. By knowing the type and number of attacks that occur, information system security needs to be a concern for various parties. Information system security needs to be a concern for various parties. In this research, the author will conduct security testing on the website to analyze the security of the features and data structures available on the website in supporting its operational processes. This research is conducted to find out the gaps in a website that can be attacked with Structured Query Language (SQL) Injection and Cross Site Scripting (XSS) techniques and to help the security of the website. optimize website security by providing preventive measures against these types of attacks.

This research aims to conduct a security audit and analysis of the secondary school PPDB website using the XSS method and IDOR penetration test. The main focus of this research is to identify and evaluate existing security vulnerabilities, as well as provide recommendations for improvements to enhance the security of the website. Through this audit, it is expected

that the PPDB website can become more secure and reliable in protecting users' personal data and maintaining system integrity.

In addition, this research is expected to provide insight to PPDB system managers and schools regarding the importance of security aspects in website development and management. The findings and analysis of existing vulnerabilities will assist in the development of appropriate mitigation measures, as well as increase awareness of the importance of cybersecurity in the educational environment.

With this approach, this research focuses not only on identifying vulnerabilities, but also on providing practical solutions that can be implemented to strengthen the PPDB website security system. The results of this research are expected to be a reference for other schools in evaluating and improving their website security, thus creating a safer and more trusted digital environment.

II. Literature Review and Basic Theory

A. Related Research

This research is designed based on several studies that have previously existed and used as references in conducting this research. The following is research that becomes a reference according to the attack method and research location.

The first research is a test on a website entitled Web Security Diagnosis Using the School Website Penetration Test Method. Security tests conducted on the website of SMK Negeri 13 Medan to identify components that are weak and vulnerable to cyber attacks. The attack has the potential to disrupt school operations by changing website content and spreading misinformation to the public. This problem is solved through the application of penetration testing on the website of SMK Negeri 13 Medan. The result of this research is to conduct a deeper analysis of the web security of SMK Negeri 13 Medan and provide recommendations for web security [3].

The second research is related to research on the topic of Security Analysis of E-Learning Website of SMKN 1 Cibatu Using Execution Standard Penetration Testing Method. This method consists of seven stages or phases, namely: pre-engagement interactions, intelligence gathering, threat modeling, vulnerability analysis, exploitation, post-exploitation, and reporting. Based on the results of testing the site, several security holes were found, including Web Server Transmits Cleartext Credentials, Cross-Site Scripting (XSS), and Cross-Site Request Forgery (CSRF). Recommendations or proposed improvements were developed to address the security gaps found. The conclusion of this research shows that security testing of SMKN 1 Cibatu's website using the PTES method is effective in helping schools improve the security of their information systems against hacking threats from internal and external environments [5].

The third research from research entitled Security Gap Analysis on the Website Using the Penetration Testing Method and the Issaf Framework on the SMK Al-Kautsar Website. Researchers use the penetration testing method with the ISSAF framework to identify these security gaps. The test results show that the SMK Al-Kautsar website is vulnerable to DDoS attacks, as evidenced by the use of LOIC tools which cause the website to be inaccessible during DDoS attacks. This DDoS attack aims to keep the server busy with requests from clients. However, the website proved to be safe from XSS attacks and open port attacks such as port 21, as the author failed to gain access to the website during XSS and port 21 testing [4].

The fourth research with the topic of Network Security Testing Using the Penetration Test Method on the SMK Muhammadiyah 1 Wonosobo Network. Computer network security at SMK Muhammadiyah 1 Wonosobo has never been tested before. Therefore, action is needed to test the security level of the school's current computer network. The method used is penetration testing. The simulation process of attacks on the server computer through ports 80, 445, and TCP and HTTP methods, based on previous mapping results, showed failed results. Meanwhile, the attack on the Routerboard was successful on the first try. Of the two devices, the server computer has better security because its firewall is always updated, while the Routerboard, which is rarely updated, is very vulnerable to attacks [6].

This fifth research aims to analyze the security of the SMA Negeri 2 Sumbawa Besar website using the Penetration Testing (PenTest) method. Based on the conditions that occur on the school website, research was conducted to analyze the level of security and identify weaknesses on the SMA Negeri 2 Sumbawa Besar website. In this analysis, researchers used the Penetration Testing method, which involves several stages, namely Footprinting, Scanning, Fingerprinting, Exploit, and Reporting. The results of security testing on the SMA Negeri 2 Sumbawa Besar website revealed several gaps, by detecting 13 low and medium status vulnerability sub-files. This research produces a list of vulnerabilities that can be used as recommendations for schools to improve their website security [7].

This research shows major differences with previous research in several important aspects. First, the methods used are more specific, focusing on XSS (Cross-Site Scripting) and IDOR (Insecure Direct Object References) penetration testing, while previous studies used various methods such as PTES, SQL injection, and ISSAF. Secondly, this study specifically evaluates the security of high school PPDB websites, in contrast to previous studies that cover various types of websites and institutions, including school online registration websites, campus information systems, and election institutions. In addition, this study provides practical recommendations to address the vulnerabilities found and raise awareness of the importance of cybersecurity in the management of school websites, adding practical and applicative value compared to previous studies that were more evaluative in nature.

The authors chose to address XSS and IDOR because these two types of vulnerabilities are often found in web applications and have great potential to be exploited by attackers, which can result in data theft, content manipulation, and unauthorized access to sensitive information, which is especially critical in the context of educational websites that handle students' personal data.

B. Supporting Theory

The following are general theories that are used as support in this research:

B.1. Basic Concepts of Security

B.1.1. Definition of Information Security

Information security refers to efforts to prevent and detect fraud in information-based systems, where the information has no physical form. Based on the ISO/IEC 17799:2005 standard on information security management systems, information security is a protective measure against various threats to ensure business continuity, minimize business risks, and increase investment and business opportunities. Thus, information security aims to prevent and detect unauthorized access, information theft, program changes, or physical damage to information systems that can cause losses and losses in business processes [8]. There are several key elements in information system security, which include: [9]

- Confidentiality refers to mechanisms that ensure that data and information sources can only be accessed by individuals who have legitimate authority or authorization. Trust that information remains restricted to authorized parties is essential to ensure the security of the information conveyed.
- Integrity is a component that ensures that data cannot be altered without authorization from an authorized party, thus maintaining the accuracy and integrity of the data. It includes the use of processing methods designed to ensure that data remains intact and valid.
- Availability is an aspect that ensures that information can be accessed by authorized parties whenever needed. It also ensures that users who have access rights can obtain the information according to their needs.

B.1.2. Network Security

Network security is the process of protecting systems in a network through the detection of authorized use. Network security systems are crucial in maintaining network integrity, as attacks that can disrupt or damage the connection system between connected devices can cause significant losses. To achieve optimal network security, sacrifices are often required in the form of inconvenience to users, which is one of the main considerations in the implementation of network security systems [10].

B.1.3. Website Security

Website security is a set of measures taken to protect a website from unauthorized access, attacks, and damage. The importance of website security lies in the protection of sensitive information as well as user data stored on it. Threats to website security include various types of attacks such as DDoS (Distributed Denial of Service), phishing, SQL injection, Cross-Site Scripting (XSS), and malware. To protect websites from these threats, several precautions can be implemented [11], including [12]:

- Using the HTTPS protocol
  The HTTPS protocol uses an SSL (Secure Socket Layer) certificate to encrypt the data sent between the browser and the server, so that the information sent cannot be read by unauthorized parties.
- Perform server security
  Carrying out regular maintenance on servers and installing and updating relevant security software are important steps to prevent hacking and malware attacks.
- Using encryption techniques
  Applying encryption techniques, such as hashing as well as symmetric or asymmetric encryption, aims to protect sensitive data, including user passwords.
- Perform user verification
  Require user authentication through the use of strong passwords, and enable two-factor verification to ensure secure access.
- Update software regularly
  Regularly update security software to address detected vulnerabilities.

B.2. Vulnerability Analysis

B.2.1. Vulnerability Assessment

Vulnerability Assessment is the process of identifying, quantifying, and ranking vulnerabilities in a system [14]. In the context of CEHv11, 2020 (Certified Ethical Hacker), the goal of Vulnerability Assessment is to find weaknesses in networks, applications, and information technology infrastructure that can be exploited by attackers. This process uses tools and techniques designed to identify potential vulnerabilities before they can be exploited by unauthorized parties [13]. However, there are some limitations to Vulnerability Assessment [15]:

- Does not provide comprehensive risk assessment
  Vulnerability Assessment only identifies technical weaknesses in the system without considering the overall business impact or threat.
- Does not include exploitation
  The process stops at the vulnerability identification stage and does not involve exploitation of vulnerabilities to assess their impact.
- Results can contain false positives and false negatives
  Vulnerability Assessment tools can sometimes produce false positives (vulnerabilities that are reported but do not actually exist) or false negatives (vulnerabilities that exist but are not detected).

B.2.2. Vulnerability-Management Life Cycle

The Vulnerability-Management Life Cycle is a critical process that helps identify and fix security flaws before they can be exploited. The process includes

determining the risk posture and policies for an organization, as well as a complete inventory of system assets, scanning and assessing the environment for vulnerabilities and their impact, and mitigating actions against identified vulnerabilities. Implementation of the vulnerability management lifecycle provides a strategic perspective on potential cybersecurity threats and makes insecure computing environments more resilient to attacks [18].

Vulnerability management should be implemented in every organization to evaluate and control risks and vulnerabilities in systems. An ongoing management process examines the IT environment for system-related vulnerabilities and risks. Organizations must maintain an effective vulnerability management program to ensure overall information security. Vulnerability management delivers the best results when implemented in a well-organized sequence of phases [16]. The main phases in the Vulnerability-Management Life Cycle include [17]:

- Assessment
  Involves identifying and evaluating vulnerabilities in the system through security scanning and testing.
- Prioritization
  Assesses discovered vulnerabilities based on severity, potential impact, and likelihood of exploitation to determine the priority of addressing them.
- Remediation
  Taking action to address identified vulnerabilities, including the installation of patches, reconfiguration of systems, or implementation of additional security measures.
- Verification
  Ensuring that the remedial action taken successfully eliminates or mitigates the identified vulnerability.
- Reporting and Documentation
  Documenting the findings, actions taken, and final status of the vulnerability for audit and continuous monitoring purposes.
- Continuous Monitoring and Management
  Conduct ongoing monitoring of the system to detect new vulnerabilities and ensure the effectiveness of the security measures implemented.

B.2.3. Common Vulnerability Scoring System (CVSS)

The Common Vulnerability Scoring System (CVSS) is a published standard that provides an open framework for communicating the characteristics and impact of information technology vulnerabilities [32]. The system's quantitative model guarantees accurate and repeatable measurements, and allows users to review the vulnerability characteristics used in the score calculation. Therefore, CVSS is well suited as a standard measurement system for industries, organizations, and governments that require accuracy and consistency in vulnerability impact assessment. Two common applications of CVSS are the prioritization of vulnerability mitigation actions and the assessment of the severity of vulnerabilities found in systems. The National Vulnerability Database (NVD) provides CVSS scores for almost all known vulnerabilities [20].

The Common Vulnerability Scoring System (CVSS) helps in identifying the key characteristics of vulnerabilities and generates a numerical score that represents their severity. These numerical scores can then be converted into qualitative categories (such as low, medium, high, or critical) to assist organizations in assessing and prioritizing their vulnerability management processes [20]. The CVSS assessment consists of three main metrics to measure vulnerability [19]:

- Basic Metrics: Represents the fundamental quality of vulnerability
- Temporal Metrics: Represents features that continuously change over the lifetime of the vulnerability.
- Environmental Metrics: Represents vulnerabilities that are based on a specific environment or implementation.

B.3. Type of Attack

B.3.1. Insecure Direct Object Reference (IDOR)

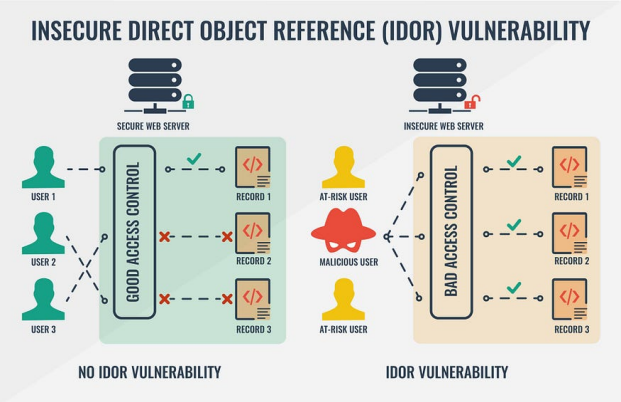

Fig. 1. Insecure direct object reference illustration

Insecure Direct Object Reference (IDOR) is a security vulnerability that occurs when an application grants direct access to objects based on user input without performing adequate validation or access control. This allows attackers to access or manipulate objects that they should not have by changing the object reference parameters in the request [21]. Therefore attacks can be classified as the following attack types [22]:

- IDOR in the URL Parameter:
  Example: https://example.com/user?id=123
  Attack: Attackers can change id=123 to id=124 to access other users' data.
- IDOR on Body Parameter:
  Example: POST request containing user_id=123 in the body.
  Attack: Attackers can change the user_id value before sending the request to access or modify other users' data.
- IDOR in Header:
  Example: HTTP header containing X-User-ID: 123.

Attack: Attackers can modify the header to access other users' data.

- IDOR on Cookie:
  Example: A cookie that stores user_id=123.
  Attack: Attackers can manipulate the cookie value to access data that does not belong to them.
- IDOR on Direct Object References:
  Example: Application uses file or directory names directly.
  Attack: Attackers can access files or directories that should be protected by modifying the name in the request.

B.3.2. Cross-Site Scripting (XSS)

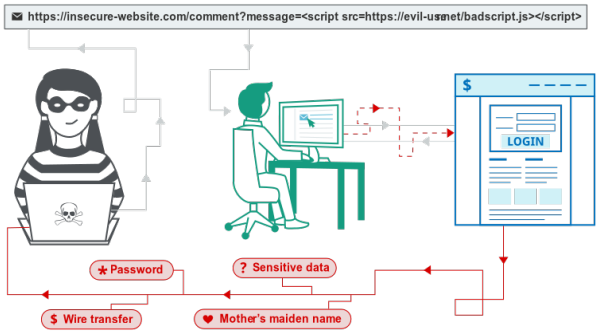

Fig. 2. Cross-Site Scripting illustration

Cross-Site Scripting (XSS) attacks exploit vulnerabilities in dynamically generated web pages, allowing attackers to inject client-side scripts into web pages. This vulnerability occurs when unvalidated input data is inserted into dynamic content that is sent to the user's browser for rendering [24]. Attackers can inject malicious scripts such as JavaScript, VBScript, ActiveX, HTML, or Flash into legitimate requests, so that the malicious program is executed on the victim's system. By circumventing client ID security mechanisms, attackers gain access rights and inject malicious scripts into specific web pages. These scripts can even overwrite the HTML content of the website [25]. There are several types of XSS attacks [23]:

- Reflected XSS
  This attack takes advantage of improperly validated input on a web page and inserts a malicious script into the URL or form, which is then used to steal sensitive information from the user.
- Stored XSS
  This attack takes advantage of a gap in the application server that allows attackers to store malicious scripts in the database, which are then executed when the web page is accessed by the user.
- DOM-based XSS
  This attack utilizes scripts that are executed by the browser, thus not requiring a connection with the application server.

B.4. Penetration Testing Tools

B.4.1. Nmap

Nmap (Network Mapper) is an open-source tool used for network exploration and security auditing. Designed to quickly scan large networks, Nmap is also effective for single hosts. The tool utilizes raw IP packets in an innovative way to identify the hosts available on the network, the services provided, the operating system being run, the type of firewall or filter being used, as well as various other characteristics [26].

Nmap works by sending specific packets to the target and analyzing the responses received. The tool offers various types of scans, such as TCP SYN scan, TCP connect scan, UDP scan, and many others, which allow users to gather detailed information about networks and systems [27].

B.4.2. OWASPZap

OWASP ZAP (Zed Attack Proxy) is an open-source security tool used to detect vulnerabilities in web applications. Developed by the Open Web Application Security Project (OWASP), ZAP is designed to assist security testers in identifying web application weaknesses automatically or manually. The tool is popular among penetration testers and developers who aim to improve the security of their web applications [28].

B.4.3. Burp Suite

Burp Suite is a free security tool that is very useful in performing web application security activities or for penetration testing activities. Burp Suite was originally only a proxy server application to intercept both http-requests and http-responses to servers and web applications [29].

III. Research Methodology

A. Research Flow

In this research, the following flow is used as a guide to carry out the research so that the achievement of the predetermined objectives can be carried out as desired. The research stages are depicted in the flow chart presented in Fig. 3.

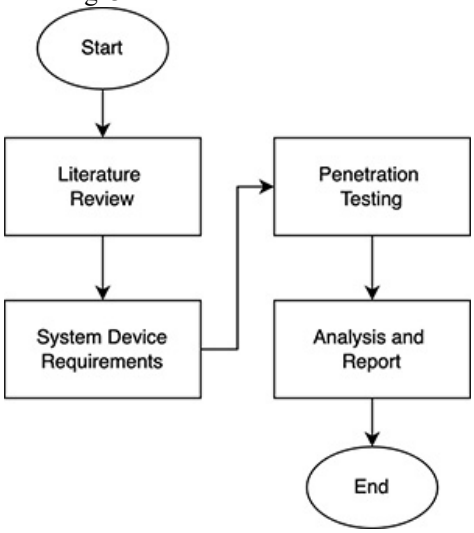

Fig. 3. Flowchart of research stages

Fig 3 shows the flowchart of the stages of the research to be carried out. The first stage is a literature study, which includes collecting relevant data such as journals and papers needed. The second stage is the identification

of system device requirements, which includes software and hardware requirements to build the system. The third stage is penetration testing, which involves testing data with the black-box method. The fourth stage is analysis and report generation, which includes report generation and penetration testing analysis that is continued using the OWASP Top 10 framework as an assessment of the security of high school websites in Indonesia requires comprehensive guidance to identify potential vulnerabilities. This stage also evaluates the test results and draws conclusions.

A.1. Literature Review

In the literature study stage, several scientific articles discussing XSS (Cross-Site Scripting) and IDOR (Insecure Direct Object References) were reviewed. In addition, the author also utilized data and information from various sources, including the internet, books, papers, e-books, and scientific articles that focus on XSS and IDOR.

A.2. System Device Requirements

At this stage, various device requirements are described, which include software and hardware, which will be used in the process of designing and testing the system. The specifications of software and hardware requirements for this system are as follows:

A.2.1. Software

- OWASPZap

  Software used to identify vulnerabilities on websites. OWASP ZAP provides automated scanning and manual analysis features to find security holes such as SQL injection, cross-site scripting (XSS), and incorrect security configuration.
- Nmap

  It is a network mapping tool used in the information gathering stage during penetration testing. It allows security testers to efficiently identify hosts, open ports, running services, and operating systems. Nmap supports various scanning techniques such as SYN, UDP, and ACK, and can detect firewalls and other security rules.
- BurpSuite

  It is a tool used for network mapping in the information gathering stage during a penetration testing. In the process of penetration testing, Burp Suite facilitates the collection of critical information such as host identification, running services, and an overall network map. The tool also comes with the ability to intercept, manipulate and examine network traffic, as well as perform attacks such as injection and fuzzing to further identify vulnerabilities.

A.2.2. Hardware

- Laptop

  The laptop is used as a means to test security vulnerabilities. The hardware used is as follows:
  Asus VivoBook TP420IA laptop with AMD Ryzen 7 4700U processor.
  RAM with a capacity of 16 GB.
  SSD with a capacity of 512 GB.

A.3. Penetrant Testing

The testing stages have a testing flow consisting of several stages as in Fig. 4.

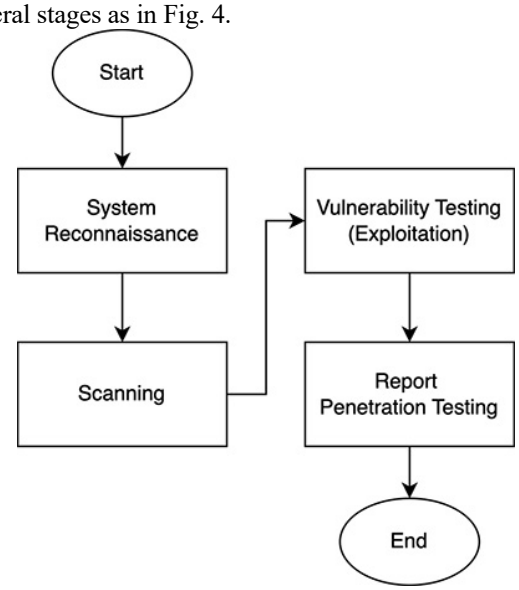

Fig. 4. Penetration scenario

A.3.1. System Reconnaissance

The initial stage in a penetration test is reconnaissance, which aims to gather as much information as possible from the high school site. This process involves using various tools such as OWASP zap and other similar tools to identify potential penetration methods and ways to improve them.

A.3.2. Scanning

In the security gap scanning stage of the high school website, several vulnerability scanning tools, such as OWASP Zed and Burp Suite, were used. These applications serve as web application security testing tools that can automatically detect vulnerabilities such as Insecure Direct Object References, Cross Site Scripting, and various other vulnerabilities. The security gap identification stage is performed using these vulnerability scanners.

A.3.3. Vulnerability Testing

Vulnerability testing (exploitation) of secondary school websites is performed by taking advantage of security holes detected at the scanning and information gathering stage. This testing utilizes tools such as Burp Suite. The attack simulations performed were limited to Insecure Direct Object References (IDOR) and Cross-Site Scripting (XSS) methods.

A.3.4. Penetration Testing Report

In this last stage, the data obtained from the scanning and exploitation results will be analyzed to produce a report that is useful as a reference for developers in improving website security. The data obtained from the scan is grouped by type of security hole, source of the hole, and the solution to fix it to facilitate analysis. The information obtained during testing should be explained in detail with easy-to-understand technical language, so that it can be an informative and useful report as a suggestion for improvement for website managers. The output of this

research report includes the approach used in the penetration testing and security assessment process.

A.4. Analysis and Report

The final step is analysis and report generation, which involves creating a report and analyzing the results of penetration testing using the OWASP Top 10 framework. The OWASP Top 10 framework provides a comprehensive guide to identifying and addressing the most critical security risks. Reporting the findings helps in documenting vulnerabilities and recommending fixes.

IV. Results and Discussion

In this stage of the research, information was collected from 12 secondary school websites using tools such as Burp Suite to obtain the necessary data. The list of secondary school names and website addresses used in this experiment is shown in Table I.

TABLE I. LIST OF HIGH SCHOOL WEBSITES

No	*School Name*	*School Website*
1.	Pondok Pesantren Al Hasan	psb.alhasan.co.id
2.	Ma Unggulan Al-Hikmah	ppdb.maunggulanalhikmah.sch.id
3.	MTs Negeri 5 Jember	ppdb.mtsnegeri5jember.sch.id
4.	SMP Ib Al-Qomar	smp-ib.ypdialqomar.sch.id
5.	SMK Plus Darussalam	ppdb.smkplusdarussalam.sch.id
6.	Ma'had Al-Izzah	pendaftaran.alizzah.smartpayment.co.id
7.	SMP Al Mubarak	almubarakbenhil.sch.id
8.	SMP Unggulan Zainul Hasan	smp-unggulan-zaha.sch.id
9.	SMP Plus Al Kohar	smpplusalkohar.sch.id
10.	SMA Katolik St. Louis 2 Surabaya	pcpdb.smakstlouis2.sch.id
11.	Pondok Pesantren Al-Ishlah	psb.alishlah.ac.id
12.	Pondok Pesantren Terpadu Al Fauzan	pesteralfauzan.com

A. System Reconnaissance

At this stage, system reconnaissance steps are carried out with the aim of gathering as much information as possible about the target attack on the high school web domain that can be accessed via the internet. Basic information to be collected includes potential security holes, form URLs, availability of file upload features, open ports, and authentication page behavior.

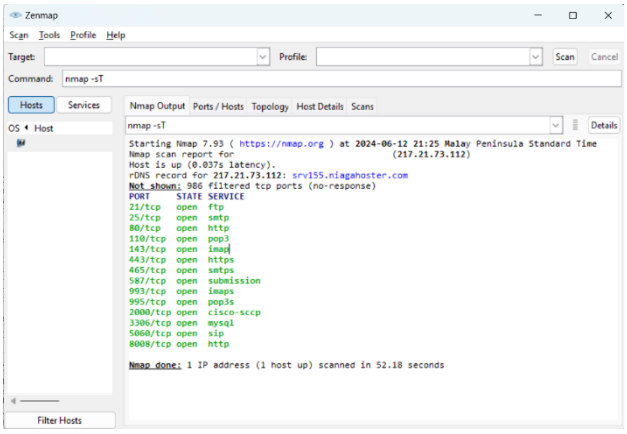

Fig. 5. Results of Nmap scan with -sT mode

In Figure 5, in-depth information collection on the available and open ports in a network is conducted. In this experiment, a tool such as Nmap was used, which effectively serves as a network mapping and information gathering tool. The port scan data for the middle school web domain is shown in Fig 4. Nmap has the ability to detect ports open on the system, provide information about network security, and identify services running on specific ports. By analyzing the scan results using Nmap, the data obtained includes available port numbers, availability status, protocols used, and a list of services that may be running.

B. Scanning

At this stage, scanning is more focused on direct interaction with devices or systems from the high school web. The information obtained from this scanning stage includes a detailed technical vulnerability report, which includes risk levels and threat modeling. This report will be used as a reference in the next stage to perform exploitation on the target web.

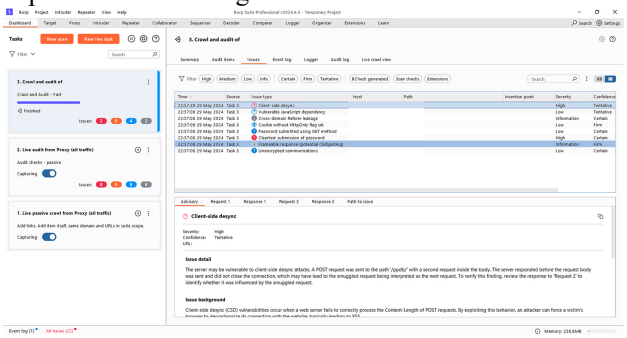

Fig. 6. XSS scan results using BurpSuite

Fig 6 shows some of the gaps found during scanning, namely XSS vulnerabilities of the type Reflected Cross-Site Scripting (Reflected XSS), or Non-Persistent XSS, is a security vulnerability in web applications that occurs when malicious scripts sent as part of HTTP requests are reflected back by the server and executed in the context of the user viewing the page.

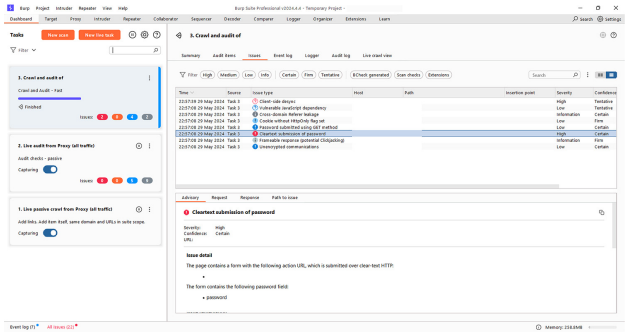

Fig. 7. IDOR scan results using BurpSuite

In Fig 7 a vulnerability, known as Cleartext submission of passwords, occurs when passwords are submitted in cleartext without going through an encryption process. In the context of scanning using Burp Suite, this finding indicates that authentication forms in web applications send sensitive data, such as passwords, over the HTTP protocol without additional encryption.

This vulnerability has serious implications for application security as it allows attackers to easily intercept and obtain authentication information during the data transmission process between the client and server. This eavesdropping can be done by an attacker who has access to the network used by the user, such as a public Wi-Fi network or a vulnerable internal network.

C. Vulnerability Testing

The results of scanning using various scanners and reconnaissance tools were followed by testing to ascertain the impact of vulnerabilities on high school websites, where researchers focused the attack methods on IDOR and XSS. From the exploitation results, it was found that 7 out of 12 websites had vulnerabilities, with details of 5 IDOR vulnerabilities and 7 XSS vulnerabilities. The following are the results of vulnerability testing along with the CVSS score.

TABLE II. VULNERABILITY TESTING RESULT DATA

No	*Methods*	*Risk Level*	*Score SVSS 3.0*
1.	Reflected Cross-Site Scripting	6.4 MEDIUM	CVSS:3.0/AV:N/AC:L/PR:N/UI:R/S:C/C:L/I:L/A:L
2.	IDOR Leading to Account Takeover	9.6 CRITICAL	CVSS:3.0/AV:N/AC:L/PR:N/UI:N/S:C/C:H/I:H/A:H

In Table II researchers can calculate the risk of the two attacks found. XSS attacks on personal data forms are attacks that take advantage of user input that is not properly validated. Using this metric, the baseline score for XSS on personal data forms is 6.4, which is categorized as medium to high risk. This attack requires user interaction, but can still be exploited with relative ease and can impact the confidentiality and integrity of user data, although the impact is not as great as IDOR leading to account takeover.

Whereas an IDOR attack leading to account takeover is a very serious type of vulnerability. With the above metrics, the base score for IDOR leading to account takeover is 9.6, which is categorized as a critical risk. This indicates that this attack has a potentially huge impact on data confidentiality and integrity, and can be exploited easily without requiring any prior user interaction or access rights.

Through the scanning phase, a number of significant vulnerabilities were identified, exposing potential security holes that could be exploited by irresponsible parties. The analysis conducted during this scanning process revealed several critical findings, including:

C.1. Reflected Cross-Site Scripting

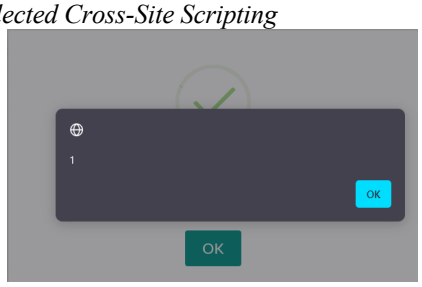

Fig. 8. XSS vulnerability testing

In Figure 8 it can be seen that the Reflected Cross-Site Scripting test results show validity, where the attacker was able to insert a malicious JavaScript script into the "Full Name" input field. The insertion of this <script>alert(1)</script> script is executed when the data is re-displayed to the user or administrator without sufficient validation and sanitization, resulting in persistent pop-ups when the website is opened by other users.

C.2. IDOR Leading to Account Takeover

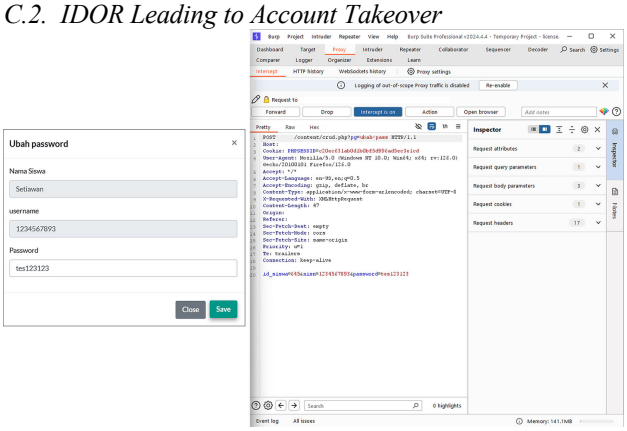

Fig. 9. IDOR vulnerability testing

In Figure 9, it can be seen that interception is performed using the Burp Suite tool on URLs that are vulnerable to the user "id" parameter, in order to perform further exploitation. As shown in Figure 7, in the new student registration, registration is done first by creating two accounts. The first account is used to perform Insecure Direct Object Reference (IDOR) on the second account. When the first user changes the password and activates Burp Suite, then presses the "save password" button, a code appears in the interception section of Burp Suite. This allowed the attacker to replace the first user's "id" with the second user's "id" because the "ids" on the website were sequential. This makes it easier for the hacker to find the other user's "id".

Once the security analysis testing phase is complete, assessing the security of Indonesian secondary school websites requires comprehensive guidance to identify potential vulnerabilities. The OWASP Top 10 lists ten major vulnerabilities in web applications. This guide can be used as a reference for conducting vulnerability assessments on secondary school websites. Based on the research results, Fig 8 shows the security profile of the secondary school website in Indonesia evaluated based on the OWASP Top 10 - 2021. According to the figure, the two most common vulnerabilities found on this website are Broken Access Control and Injection. In contrast, there are eight vulnerabilities that were not found on the Indonesian secondary school websites, namely Cryptographic Failures, Insecure Design, Security Misconfiguration, Vulnerable and Outdated Components, Identification and Authentication Failures, Software and Data Integrity Failures, Security Logging and Monitoring Failures, and Server-Side Request Forgery (SSRF).

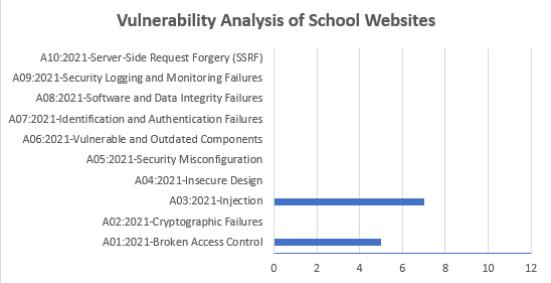

Fig. 10. Graph of High School Website Base on OWASP Top 10

In Figure 10, it is found that the above security analysis testing stages show that one of the 7 websites has the same vulnerability out of a total of 12 websites tested. This shows that high school websites still have a low level of security and pay little attention to small details that can endanger users.

D. Report Penetration Testing

The results of the website security analysis experiment using the penetration testing method for XSS and IDOR produce a report that includes testing vulnerabilities, risks, impacts, and CVSS scores. This report will be used by developers, operators, and administrators of secondary school websites to make system improvements by patching or updating to reduce the impact of risks caused by identified vulnerabilities.

TABLE III. VULNERABILITY IMPACT ASSESSMENT RESULTS

No	*Vulnerabilities*	*Impact of Attack*	*Testing Results*
1.	Reflected Cross-Site Scripting on full name form parameter	Attackers can steal cookies or sessions, as well as run JavaScript code in the user's browser without requiring authentication when the user accesses a link containing reflected XSS.	Successful, the web returns the active user's cookie
2.	IDOR Leads to Account Takeover on user password change	These attacks can lead to unauthorized access to sensitive user data, such as personal information and authentication credentials. This enables account takeover, including changes to passwords and account settings, which can result in a loss of control by the original owner.	Successfully, changed another user's password and NISN

In Table III, factors such as attack methods, attack complexity, access rights requirements, user interaction, and impact on data confidentiality, integrity, and availability are comprehensively evaluated. The results of this evaluation help developers understand the level of risk associated with system security and take the necessary preventive measures to reduce potential vulnerabilities and the impact of possible attacks.

Therefore, the following are some solutions that can be used to reduce security gaps on high school websites, especially against IDOR and XSS attack types. To prevent IDOR attacks that lead to account takeover and XSS attacks on Reflected Cross-Site Scripting on high school websites, strict implementation of access control and thorough input validation are required. In the context of IDOR, each access request must be verified to ensure that the user making the request has proper authorization, using either role-based access control (RBAC) or attribute-based access control (ABAC) mechanisms.

And to prevent XSS, all user inputs should be properly validated and sanitized, using a whitelisting approach to accept only expected characters and formats, as well as ensuring that all outputs are properly encoded before being displayed on a web page. In addition, the use of Content Security Policy (CSP) can help limit the type of content that can be loaded and executed by the browser, thereby reducing the risk of malicious script injection. Thorough implementation of these measures will improve the security of the middle school website and protect user data and privacy.

V. CONCLUSION AND SUGGESTION

This study has identified and analyzed security vulnerabilities in Indonesian secondary school PPDB websites using Cross-Site Scripting (XSS) and Insecure Direct Object References (IDOR) methods through penetration testing. The results revealed that 7 out of 12 websites exhibited vulnerabilities, with 5 sites showing IDOR vulnerabilities and 7 sites showing XSS vulnerabilities. These findings underscore the prevalent risk of cyberattacks on secondary school PPDB websites, particularly in terms of access control and input validation. To mitigate these risks, it is crucial to implement strict access control and thorough input validation. Additionally, employing Content Security Policy (CSP) can help limit the types of content that browsers can load and execute, thereby reducing the risk of malicious script injections. These measures will enhance the security and reliability of PPDB websites, ensuring better protection of users' personal data and maintaining the integrity of the systems.

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