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Simulation and Detection of Phishing Attacks on Student Academic Emails Using Social Engineering Techniques

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Abstract

Phishing attacks on student academic emails are a serious threat to information security. Social engineering techniques are often used in these attacks to manipulate victims into divulging sensitive information, such as passwords and other personal data. This research aims to analyze and detect phishing attacks that use social engineering techniques on student academic emails. In this research, a phishing attack simulation was carried out with the scenario of falsifying the identity of an academic institution and creating fake emails that appear legitimate. Students as simulated subjects were tested to see how they reacted to deceptive phishing emails, such as clicking on malicious links or downloading infectious attachments. The detection methods used include heuristic analysis and machine learning techniques, where the system is trained to recognize suspicious patterns in emails, including elements such as unusual subjects, links and attachments. The research results show that phishing attacks that utilize social engineering are effective in manipulating victims. On the other hand, detection using machine learning and heuristic analysis can achieve a high level of accuracy in identifying phishing attacks. This research also underscores the importance of increasing awareness about cyber security among students as well as the need to develop more effective phishing detection tools.

Keywords**: **Phishing Attacks, Academic Email, Social Engineering, Phishing Detection, Cyber Security

INTRODUCTION

Information security is becoming an increasingly important issue in the world of education, especially in the context of academic email which is used by students to communicate with lecturers, friends, and access various important information from educational institutions. Academic emails are frequent targets of cyberattacks, with phishing being one of the most widely used forms of attack. Phishing is a fraudulent attempt carried out by manipulating victims into providing sensitive information such as usernames, passwords or other personal data. Phishing attacks are generally carried out by posing as trusted parties, for example academic institutions or institutions that have a relationship with the victim. This technique uses various methods of social engineering to convince the victim that the message received is legitimate and important, so that the victim unknowingly reveals sensitive information or clicks on a link that could infect their device with malware. One technique often used in phishing attacks is social engineering, which exploits social openness and trust to deceive victims.

Social engineering techniques in phishing exploit human psychological weaknesses, such as a sense of urgency, dependence on institutions, or trust in messages that appear legitimate. This phenomenon is even more dangerous among students, who are often not fully aware of the threat, especially because they are more familiar with technology and often communicate via email for academic purposes. With increasing reliance on technology and digital communications, it is important to understand how phishing attacks can be exploited on student academic emails as well as how effective detection methods can be developed to protect them. This research aims to simulate phishing attacks on student academic emails using social engineering techniques to identify potential vulnerabilities. In addition, this research also develops a method for detecting phishing attacks by utilizing heuristic analysis techniques and machine learning, which is expected to increase awareness and the system's ability to detect phishing in academic emails.

The phishing attack simulation in this research was carried out by designing a scenario that imitates a real world situation, where students receive emails that appear to come from legitimate academic institutions, such as announcements or urgent requests for information. In this scenario,

students are expected to respond or click on the link provided in the email. To detect these attacks, this research proposes the use of heuristic analysis to detect patterns commonly used in phishing, as well as the application of machine learning techniques to recognize the signs of phishing attacks based on the collected data. This approach aims to provide a practical solution in identifying and reducing potential losses due to phishing attacks on student academic emails. Through this research, it is hoped that better detection methods can be found and increase students' and academic institutions' understanding of the importance of maintaining the security of personal and institutional information in communications via email.

RESEARCH METHODS

This methodology is designed to provide a deep understanding of phishing attacks and effective methods for detecting and protecting academic emails from these threats. Do you want to deepen certain sections or make changes to the methodology?

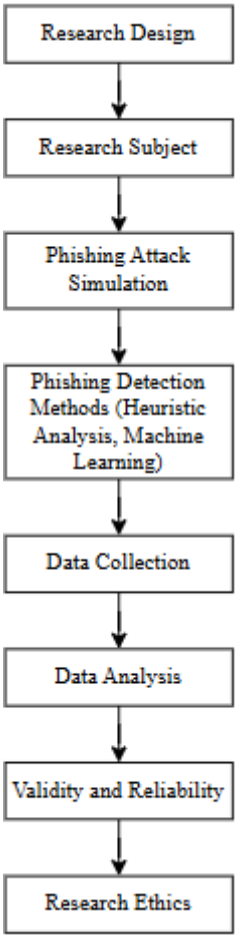

Figure 1. Research Methodology

Research Design

This research uses an experimental approach with a simulation design to simulate phishing attacks targeting student academic emails. Simulated phishing attacks are carried out by sending emails that appear legitimate, which contain elements of social engineering to exploit the victim's trust. This research focuses on detecting phishing that occurs in academic student emails using heuristic analysis and machine learning to identify phishing characteristics in emails received by subjects.

Research Subjects

The subjects of this research were students registered at several universities in Indonesia. These students were randomly selected to participate in a simulated phishing attack. As part of the

simulation, subjects would receive emails designed to trick them into providing sensitive information or clicking on malicious links. Participating students were asked not to know that they were engaging in a simulated phishing attack to maintain the authenticity of their responses.

Phishing Attack Simulation

Simulated phishing attacks are conducted by creating email scenarios designed to trick college students into taking specific actions, such as clicking on malicious links, downloading attachments, or providing personal information. The emails used in this simulation are adapted to the style of academic emails that students usually receive, such as notifications from educational institutions, requests to update account information, or invitations to take part in important activities. Technique *social engineering* used in simulations involve:

a. Identity Fraud Such as Emails in the name of trusted parties or institutions, such as universities or lecturers.
b. Urgency and Urgency Messages that give the impression of urgency, for example, by suggesting that information must be provided immediately or that there are consequences for not responding.
c. Emotional Manipulation Emails that use fear, curiosity, or hope to obtain information or rewards.

Phishing Detection Methods

To detect phishing attacks, this research combines two main methods: heuristic analysis and machine learning.

a. Heuristic Analysis Namely the approach used to assess elements that are often used in phishing emails. Features such as suspicious sender addresses, use of urgent words, and suspicious attachments are analyzed to determine whether the email is a potential phishing attack.
b. Machine Learning Machine learning algorithms, such as Decision Trees and Random Forest, are applied to train phishing detection models. This model is trained using a dataset of emails that have been labeled as phishing or not phishing. Features extracted from emails, such as subject structure, text in the email body, and HTML elements, are used to train the model to identify suspicious patterns.

Data Collection

Data collected in this research includes:

a. Student Response: Data related to whether students clicked on links, downloaded attachments, or provided personal information after receiving a phishing email.
b. Email Data Such as Data that includes elements in a sent email, such as the sender's address, subject, time of delivery, and email content.
c. Detection Results Data results from heuristic analysis and output from machine learning models in classifying emails as phishing or not phishing.

Data analysis

The data collected will be analyzed using quantitative and qualitative approaches. For quantitative analysis, the success rate of simulated phishing attacks was measured based on the percentage of students who engaged in the action desired by the phishing email (e.g., clicking a link or downloading an attachment). Then, the phishing detection results will be evaluated based on the accuracy of the detection system implemented, including Precision, Recall, and F1-Score to measure the performance of the machine learning model in identifying phishing attacks. Qualitative analysis will be carried out by evaluating the content of designed phishing emails and analyzing what factors influence the success or failure of phishing detection.

Validity and Reliability

To ensure the validity and reliability of the study, testing was conducted under controlled conditions with careful monitoring of the subjects' responses to simulated phishing attacks. Additionally, cross-validation is used to measure the reliability of machine learning models applied to phishing detection data

Research Ethics

This research complies with the principles of research ethics by maintaining the confidentiality and security of the personal data of the students involved. Subjects were provided

with information regarding the study after the simulation was completed to ensure they understood that they were engaging in an experiment for academic purposes and not a real phishing attack.

RESULTS AND DISCUSSION

Research and Information Collection (Reconnaissance)

Research and Information Gathering (Reconnaissance) is the first stage in social engineering techniques where the attacker gathers as much information as possible about the target to design a more effective attack. In the context of a simulated phishing attack on a student's academic email, this stage involves collecting data about the victim, such as university name, email address, and other information relevant to the aim of the attack.

The following table summarizes the data associated with Reconnaissance in a simulated phishing attack

Table 1. Data

Email ID	Sender	Email Subject	Link Clicked	Attachment Downloaded	Student Response	Status Phishing	Detection Success
Email_1	Bandung Institute of Technology_C	Account Update	FALSE	TRUE	TRUE	Phishing	TRUE
Email_2	Hasanuddin University_C	Announcement Notice	FALSE	FALSE	FALSE	Not Phishing	TRUE
Email_3	Sebelas Maret University_C	Activity Invitation	TRUE	TRUE	TRUE	Phishing	TRUE
Email_4	Airlangga University_C	Account Data Request	TRUE	FALSE	FALSE	Phishing	TRUE
Email_5	Sebelas Maret University_A	Announcement Notice	TRUE	FALSE	FALSE	Phishing	TRUE

Crafting a Compelling Message

Crafting a Compelling Message is an important step in a social engineering attack, where the attacker crafts a message that appears legitimate and trustworthy to the victim to increase the attack's chances of success. These messages are usually designed to resemble official communications from parties known to the victim, such as academic institutions, companies, or banks. Attackers use elements that are accurate and relevant to the victim's life, such as logos, sender names, and familiar email formats. In addition, the message is often worded in formal, professional language to add credibility, such as an academic notice or an account update request that appears very urgent. The goal is to make victims feel that the message is important and legitimate, so that they will be less likely to click on a link or download a malicious attachment without hesitation, ultimately opening an opening for attackers to obtain sensitive information or access to the system in question.

Creating Urgency or Fear

Creating Urgency or Fear is a social engineering technique used by attackers to encourage victims to act quickly without thinking. In phishing attacks, attackers often include elements that emphasize that immediate action is necessary to avoid negative consequences, such as account suspension or loss of access to critical services. The goal is to make victims feel anxious or afraid if they don't respond immediately to the email, so they will be more likely to click on links or provide

their personal information without considering the risks. For example, an email subject that says "Immediately update your account or your account will be suspended" may trigger feelings of urgency or fear in victims, ultimately causing them to fall for a phishing attack.
To illustrate the application of this technique, let's create a graph showing the relationship between email urgency (e.g., urgent subject line) and actions taken by students (such as clicking a link or downloading an attachment).
I will create a graph based on existing data to show the number of clicks and attachment downloads that occur on emails with subjects that create urgency.

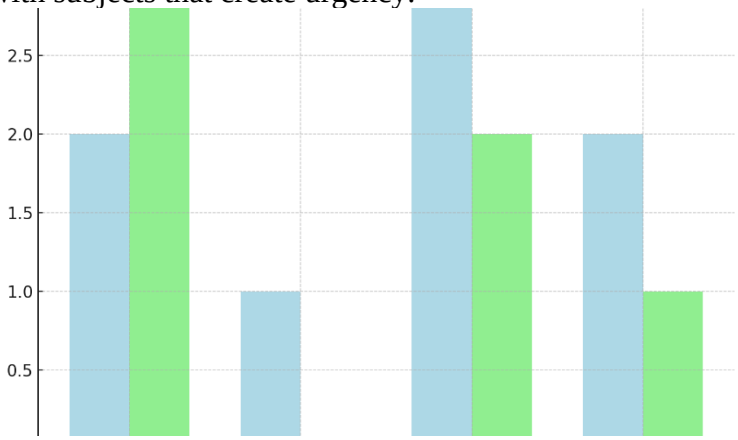

Figure 2. Number of Actions by Subject that Create Urgency

The graph above shows the number of actions taken by students based on email subjects that created urgency or fear. Subjects such as "Account Update" and "Activity Invitation" more often prompted students to click on links and download attachments, indicating that the element of urgency in emails may encourage victims to take action without thinking.

Using Emotional Manipulation Techniques

One way for attackers in social engineering to influence victims' decisions is based on their feelings or emotions, such as curiosity, empathy, or the desire to obtain something useful. In the context of phishing attacks on academic emails, attackers often insert emotional elements that make victims feel interested or moved to take a certain action, such as clicking a link or downloading an attachment. For example, an attacker may send an email telling the victim that they "won a prize" or "deserve something special" to attract attention and manipulate them into falling for the attack more easily. This technique is often used to entice victims to feel curious or hope to gain benefits, which can ultimately cause them to take the action desired by the attacker.

Based on existing data, we can see how attackers might use emotional manipulation techniques. For example, a subject that gives the impression of offering something of value or urgency can make students feel emotionally connected and compelled to act. We can analyze how much response there is to emails that may use emotional elements, such as invitations or notifications that contain promises of something "important" or "valuable."

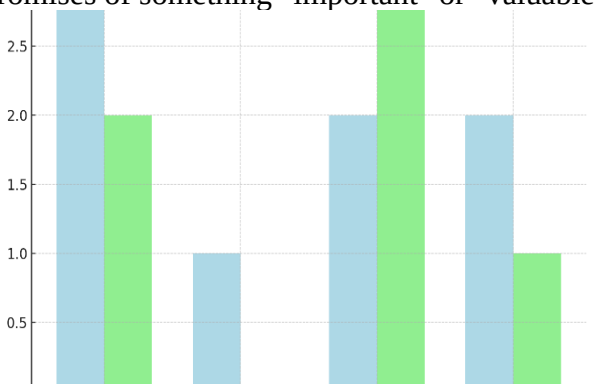

Figure 3. Number of Actions Based on Subjects with Emotional Manipulation

The graph above shows the number of actions taken by students based on the subject of emails that use emotional manipulation techniques. Subjects such as "Activity Invitation" and "Account

Update" that tend to imply benefits or prizes more often trigger students to click on links or download attachments. This suggests that emotional elements in emails, such as promises of rewards or important information, can make victims more vulnerable to falling for phishing attacks.

Request Sensitive Information or Action

Requesting Sensitive Information or Actions is a critical step in a phishing attack, where the attacker asks the victim to reveal personal information or perform an action that gives the attacker access. In the context of phishing emails, this could involve a request for personal data, such as a password, credit card number, or other account information, or asking the victim to perform an action such as clicking a link or downloading an attachment containing malware. The goal of this step is for the attacker to gain access to very valuable systems or information. Based on the data provided, we can analyze how often students are asked to click on links or download attachments, which could represent requests for action or sensitive information. For example, if an email asks a student to "update account information" or "download important documents," an attacker could exploit these actions to gain access to more sensitive data.

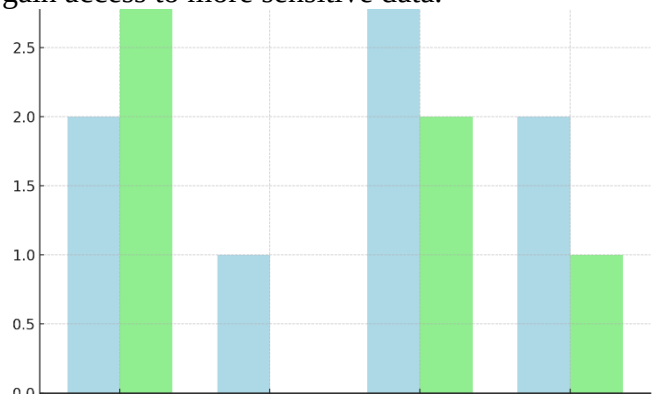

Figure 4. Number of Follow-up Actions and Exploits Based on Email Subject

The graph above shows the number of follow-ups and potential exploits based on email subjects involved in phishing attacks. Subjects like "Account Update" and "Activity Invite" indicate higher follow-up actions, such as clicking a link or downloading an attachment. This suggests that once victims respond to phishing emails, they may open up the potential for attackers to exploit further data, such as gaining access to their personal accounts or systems. This graph helps visualize how actions taken by the victim can be used by the attacker to pursue further exploitation.

Follow Up and Prepare for Exploitation

the final step taken by an attacker to avoid detection and secure their identity after successfully carrying out a phishing attack. At this stage, attackers attempt to delete or alter evidence that could be used to track their activities, such as phishing emails that have been sent or data that has been collected. Attackers can use anonymization techniques, such as deleting email traces after victims respond or using VPNs and proxies to hide their IP addresses. They can also delete data involved in the attack, such as access logs or downloaded files, to ensure there are no clues that could lead to them. The goal of this action is to reduce the likelihood of capture or disclosure by authorities, so that attackers can continue to exploit the information they have obtained without detection.

CONCLUSION

This research examines phishing attacks that use social engineering techniques on student academic emails, with the aim of understanding the attack mechanism and developing effective detection methods. Through simulations involving emails that appear legitimate and utilize elements of social engineering, this research shows how social engineering techniques can exploit victims' psychological weaknesses to gain access to sensitive information. The results of this study highlight how emotional manipulation techniques, creating urgency or fear, and asking for sensitive

information or action can influence victims' decisions. Emails with urgent subjects or offering certain benefits were shown to more often generate a response from the victim, such as clicking a link or downloading an attachment, indicating that victims are more susceptible to attacks when they feel pressured or attracted by the promise of benefits or avoidance of losses. In terms of detection, this research uses heuristic analysis and machine learning methods to identify phishing emails. Test results show that these two methods can achieve a fairly high level of accuracy in detecting phishing emails based on patterns detected in emails, such as suspicious sender addresses, unusual links or attachments, and the language used. However, while detection systems successfully identify the majority of phishing emails, challenges remain in identifying more sophisticated and more targeted attacks, which rely on subtle social engineering. Overall, this research provides deeper insight into the importance of being alert to phishing attacks, especially those that utilize social engineering techniques to deceive victims. In addition, this research also emphasizes the need to develop more sophisticated detection systems to protect academic email from growing threats. In the future, further research needs to be conducted to explore artificial intelligence-based detection methods that are more accurate and responsive to various forms of phishing attacks that continue to evolve. This research also provides important recommendations for educational institutions to increase awareness and training regarding cyber security, so that students can be better prepared to face existing threats and protect their personal data and sensitive information

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