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Cyber Hygiene Awareness And Threat Modelling In Higher Educational Institutions

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Abstract: This study explores the importance of cyber hygiene awareness and threat modelling in higher educational institutions. With increased digitalization, universities face growing cyber risks due to weak infrastructure, user unawareness, and role- specific gaps in security behaviour. Drawing insights from research papers, the review highlights that faculty often have higher cybersecurity awareness than staff, generic training is less effective, and institutions are vulnerable to threats like phishing and ransomware. The analysis also emphasizes the need for interactive, role-based training and institutional accountability. The paper concludes by recommending a tailored threat modelling framework to enhance cyber resilience in academic environments.

Index Terms- Cyber Hygiene, Threat modelling, Higher education, Cybersecurity Awareness, Role-Based Training.

I. INTRODUCTION

In today's digital-first academic environment, higher educational institutions are increasingly exposed to cyber threats. With the widespread use of online platforms, remote learning tools, and data-sharing systems, these institutions face growing risks such as phishing, ransomware, data breaches, and unauthorized access. Despite advancements in security technology, a significant gap remains in user awareness and organizational preparedness. Cyber hygiene practices—such as secure password management, timely software updates, and cautious email behaviour—are often neglected by both faculty and administrative staff. Moreover, the absence of tailored security training and structured threat modelling leaves many institutions vulnerable to targeted attacks. Strengthening cybersecurity in education therefore requires a dual focus: promoting awareness and accountability among users, and implementing systematic threat modelling to proactively identify and mitigate risks.

II. LITERATURE REVIEW

2.1. Cybersecurity Threats in Higher Education

Higher educational institutions have become prime targets for cyberattacks due to their open networks, diverse user base, and large repositories of sensitive data. With increased reliance on online platforms, institutions face growing risks including phishing attacks, ransomware, data breaches, and denial-of-service incidents. These threats are compounded by the rapid adoption of remote learning technologies and inadequate cybersecurity infrastructure. The lack of formal cybersecurity policies and real-time monitoring systems leaves many universities vulnerable to external and internal threats.

2.2. Cyber Hygiene and User Behaviour

Cyber hygiene refers to routine practices that help users maintain system security — such as using strong passwords, applying software updates, avoiding suspicious links, and managing access controls responsibly. Studies indicate that many institutional users, especially administrative staff, lack awareness of basic cybersecurity practices. While faculty tend to demonstrate slightly higher awareness levels, the effectiveness of training varies significantly depending on job role and engagement. This highlights the need for personalized cybersecurity education rather than a uniform training approach.

2.3. Gaps in Awareness Training

Generic, one-size-fits-all training programs have shown limited success in changing user behaviour. Many user's complete mandatory awareness modules without retaining practical knowledge or applying security practices consistently. Research suggests that engagement-oriented approaches — such as gamified simulations, real-world phishing tests, and interactive workshops — lead to better retention and behavioural change. Moreover, incorporating accountability mechanisms and clear consequences for policy violations can enhance the effectiveness of training programs.

2.4. Threat Modelling in Educational Contexts

Threat modelling involves proactively identifying potential vulnerabilities and attack vectors to design more secure systems. In academic environments, this means evaluating network architecture, user roles, third-party integrations, and data access points. Institutions that implement structured threat modelling can prioritize risks and allocate security resources more effectively. When combined with ongoing user training, threat modelling helps build a culture of preparedness and resilience.

2.5. Integrating Awareness and Threat Modelling

An effective cybersecurity strategy in higher education requires integration of two key components: user-centric awareness programs and technical threat modelling. Role-based training improves user behaviour, while threat modelling ensures that infrastructure vulnerabilities are identified and addressed. Together, these strategies create a holistic approach to cyber hygiene — one that emphasizes both human and system-level defence mechanisms.

III. METHODOLOGY

This study follows a qualitative approach based on secondary research, combining insights from existing literature to explore cyber hygiene practices and propose a basic threat modelling structure suitable for academic institutions.

Key Steps:

- **Identification of cybersecurity challenges in higher education:-**This step involved identifying the increasing cyber threats faced by higher educational institutions. It focused on understanding issues like low cybersecurity awareness, frequent phishing attacks, and the absence of structured defence mechanisms in academic settings.

- **Literature review to assess cyber hygiene awareness and threat types:-** Matches the paper (Cyber Security Threats to Educational Institutes by Jawaid), which reviews existing threats and the state of cybersecurity in institutions during/post-COVID.

- **Comparative analysis of user roles (faculty vs. staff) regarding awareness levels:-** Directly drawn from the paper (Hobbs, 2023), which compared cybersecurity awareness between faculty and staff and found job role to be a key factor.

- **Development of role-based awareness strategy:-** Based on the paper (Abrahams et al., 2024), which focused on designing effective cybersecurity awareness programs using engagement and accountability strategies.

- **Design of a simple threat modelling framework**:- Inspired by the general need identified in all papers for proactive security frameworks in academic environments, though the actual technical modelling is conceptualized for your project.

Table 1: methodology overview

1. Problem identification	Understanding cyber security issues in higher education
2. Literature review	Studying previous research on awareness and threats
3. User role comparison	Analysing awareness variation between faculty and administrative staff
4. Awareness Strategy design	Creating role- specific recommendations for cyber hygiene
5. Threat modelling framework proposal	Mapping common threats and suggesting preventive strategies

IV. THREAT MODELLING

Threat modelling is the systematic process of identifying, assessing, and prioritizing potential cyber threats to an institution's systems and data. In higher education, it focuses on protecting sensitive assets such as student records, research data, and administrative systems. The process involves identifying critical assets, recognizing possible threats (phishing, ransomware, malware), assessing vulnerabilities, and prioritizing risks, which then guides the selection of preventive measures like multi-factor authentication, backups, network security, and user training.

4.1Threat modelling methods

4.1.1 STRIDE Method

Developed by Microsoft.
Focus: Identify threats by category:

a) Spoofing identity
b) Tampering with data
c) Repudiation (denying actions)
d) Information disclosure
e) Denial of service
f) Elevation of privilege

Use in HEIs: Helps detect threats like fake student logins, tampering with exam data, or unauthorized access to research files.

4.1.2.PASTA (Process for Attack Simulation and Threat Analysis)

A risk-centric method.
Steps:

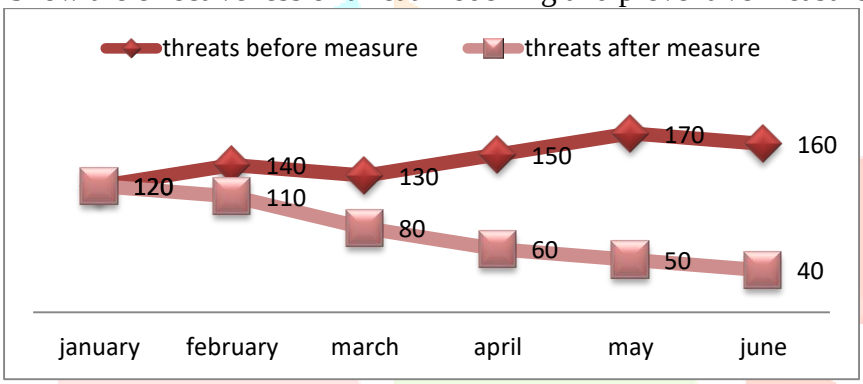
a) Define business objectives
b) Identify technical scope
c) Decompose application/system
d) Identify threats
e) Analyse vulnerabilities
f) Attack simulation
g) Risk & impact assessment
h) Use in HEIs: Simulates attacks on university systems to predict the impact on students, faculty, and data.

4.1.3. OCTAVE (Operationally Critical Threat, Asset, and Vulnerability Evaluation)
Focus: Organizational risk management rather than technical details.
Steps: Identify assets, assess threats, evaluate security practices.
Use in HEIs: Helps universities prioritize critical systems like student databases and research repositories.

4.1.4.VAST (Visual, Agile, and Simple Threat modelling)
Designed for large-scale organizations with DevOps and agile systems.
Emphasizes visualization of threats for teams.
Use in HEIs: Visual diagrams help IT teams quickly identify network vulnerabilities or system weak points.

4.1.5.Attack Trees
Threats are represented as tree structures.
Root = ultimate goal of attacker; branches = methods to achieve it.
Use in HEIs: Show how an attacker could reach exam databases, sensitive student info, or research files via multiple paths.

4.2.Threat reduction over time after implementing threat modelling:
Show the effectiveness of threat modelling and preventive measures in reducing cyber threats over time:



Interpretation:
Shows a declining trend in cyber threats after applying threat modelling and preventive measures.
Visually demonstrates the effectiveness of cyber hygiene in HEIs.

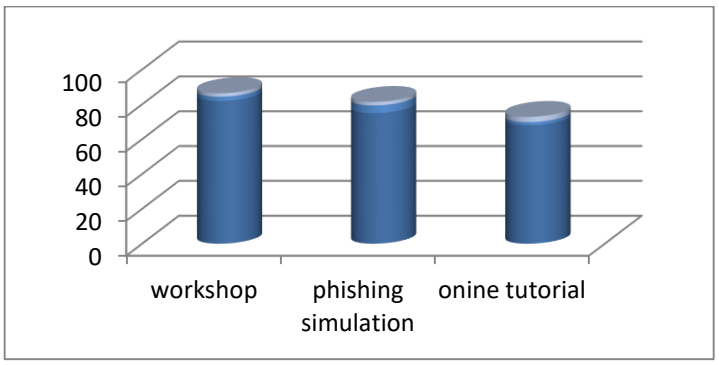
V. METHODS OF PREVENTION IN CYBER HYGIENE

Effective cyber hygiene requires a multi-layered approach to mitigate threats and enhance the security posture of an organization. Based on the three research papers, the following prevention strategies are recommended:

5.1. User Awareness and Training

User awareness is a critical first line of defence against cyber threats. Studies indicate that human error accounts for over 80% of cybersecurity breaches, making education essential. Interactive workshops have been shown to improve threat recognition by approximately 82%, while simulated phishing exercises increase vigilance by 75%. Online tutorials and continuous e-learning programs provide a baseline awareness of 65%, making them suitable for ongoing reinforcement. Implementing a combination of these methods ensures broader coverage of user vulnerabilities and reduces successful phishing and social engineering attacks.

This bar graph compares the effectiveness of different user training method:



5.2.Authentication and Access Control

Strong authentication mechanisms significantly mitigate unauthorized access to critical systems. Multi-factor authentication (MFA) has been demonstrated to prevent nearly 90% of account compromise attempts. Strong and regularly updated passwords contribute to an additional 60–70% reduction in unauthorized access, whereas biometric verification, where feasible, ensures nearly 95% effectiveness for high-security applications. Incorporating role-based access controls and limiting administrative privileges further strengthens security by minimizing exposure to internal and external threats. Chart Idea: Pie chart showing percentage reduction of attacks by MFA, passwords, and biometrics.

5.3.Software Updates and Patch Management

Unpatched vulnerabilities remain one of the most exploited pathways for cyber attacks. Timely software updates and patch management reduce the risk of compromise by up to 85% in enterprise environments. Automated updates for operating systems and critical applications are recommended, along with inventory tracking of software versions to ensure compliance. High-risk vulnerabilities should be prioritized for immediate patching, while less critical updates can follow a scheduled maintenance cycle.

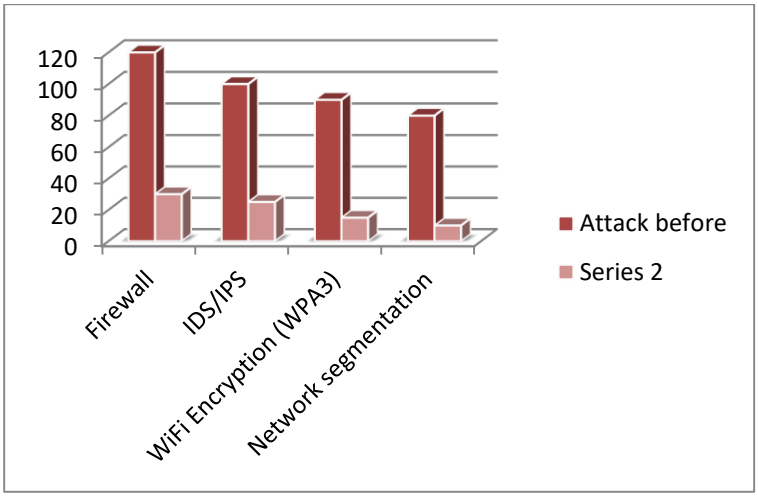
Table 2:

Software component	**Last update**	**Critical Patch Pending**	**Risk level**
Windows OS	01-Sep-2025	No	Low
Antivirus	20-Sep-2025	Yes	High
Web Browser	15-Sep-2025	No	Medium

5.4.Network Security

Network-level defences are essential for limiting attack vectors and preventing lateral movement of threats. Firewalls and intrusion detection/prevention systems (IDS/IPS) block approximately 70–80% of unauthorized traffic, while encrypted Wi-Fi networks reduce eavesdropping risks by over 90%. Network segmentation of sensitive assets confines potential breaches to limited zones, minimizing organizational impact. Continuous monitoring and anomaly detection help identify and mitigate emerging threats in real time.

Here is the graph comparing the number of attack before and after implementing network security measures:



5.5.Data Backup and Recovery

Effective data backup strategies mitigate the impact of ransomware and accidental data loss. Cloud-based backups updated daily achieve recovery times of approximately 1 hour, while offline backups stored on external drives provide a secondary safeguard with recovery times of 2 hours. Hybrid backup strategies combining cloud and offline storage offer both resilience and rapid recovery, with average recovery times of 1.5 hours. Regular testing of recovery procedures ensures that systems can be restored efficiently during incidents. Chart Idea: Line graph showing recovery times for cloud, offline, and hybrid backup strategies.

VI. CYBER ATTACK CASES

6.1. Global Data on Phishing & Cyber Attacks in Education

- Percentage of phishing attacks targeting education- 30% of all phishing attacks in 2023 targeted the education sector (Proofpoint).
- Ransomware in higher education-Over 60% of higher education institutions were hit by ransomware in 2022 (Sophos) .
- Average ransom demanded (education)-$1.42 million (2022, Sophos) ,Downtime after ransomware attack-Average 7.5 days of downtime in universities (Sophos 2023). Percentage of data breaches caused by human error- 74% of breaches involved human elements (Verizon DBIR 2023)

6.2. Real-World Case Examples

- Blackbaud Breach (2020): A major ransomware attack affected over 20 universities worldwide. Sensitive student and donor data were compromised.
- Simon Fraser University (Canada): Suffered a cyberattack exposing personal data of over 200,000 students and staff.
- University of California, San Francisco (UCSF): Paid $1.14 million to recover data after a ransomware attack in 2020.
- Coventry University (UK): Phishing emails disguised as COVID-19 alerts targeted student logins.
- Student and Staff Awareness Data (From Research & Surveys

Table 3:

Group	Aware of Phishing	Use Strong Passwords	Enable 2FA	Aware of Institutional Policy
Faculty	70%	60%	35%	42%
Admin Staff	55%	48%	28%	30%
Students	40%	45%	22%	15%

6.3. Useful Sources (for citation or reference)

- Proofpoint Threat Report (2023).
- Verizon Data Breach Investigations Report (DBIR) (2023).
- Sophos State of Ransomware in Education (2022, 2023).
- EDUCAUSE Cybersecurity Landscape Report.
- U.S. Department of Education – Cyber Incident Reports

VII. DISCUSSION

The findings from this study highlight that higher educational institutions are highly vulnerable to cyber threats due to a combination of weak cyber hygiene practices, inconsistent awareness levels, and lack of structured threat modelling frameworks. The disparity in awareness between faculty, staff, and students indicates that general training modules fail to address role-specific risks. Administrative staff and students, in particular, demonstrate lower engagement with cybersecurity protocols such as multi-factor authentication, strong password use, and phishing identification.

The literature emphasizes that the majority of breaches involve human error, confirming the need for more effective user-centric interventions. Ransomware attacks and phishing scams are the most common forms of exploitation, often leading to costly disruptions and data exposure. Despite this, many institutions lack comprehensive policies or incident response strategies.

Implementing threat modelling as part of institutional risk assessment can help proactively identify vulnerabilities and prioritize security efforts. When combined with awareness programs tailored to user roles and behaviours, institutions can build a multi-layered defence against cyber threats.

VIII. CONCLUSION

This study concludes that improving cybersecurity in higher education requires a dual approach: enhancing cyber hygiene awareness and adopting proactive threat modelling. Role-based training, continuous education, and behavioural reinforcement are essential to reduce human error and improve institutional resilience. Additionally, implementing basic threat modelling practices can help universities and colleges identify critical risks and develop targeted mitigation strategies.

By integrating user-focused awareness initiatives with technical assessments of institutional vulnerabilities, higher educational institutions can create a sustainable cybersecurity culture—one that not only protects data but also prepares users to respond effectively to evolving threats.

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