The Impact of Data-Driven Approaches on Cyber Security Awareness in Nepal's Digital Landscape

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Abstract

Nepal's increasing reliance on digital platforms has heightened the risks posed by cyber threats such as phishing, malware, and data breaches. Despite growing internet penetration, cyber security awareness remains low among individuals and organizations, leading to significant vulnerabilities. Traditional methods of enhancing awareness, including generic training programs and reactive policies, have proven insufficient to address the evolving nature of cyber threats. These approaches lack personalization and fail to leverage advancements in technology for targeted and proactive solutions. This study aims to explore the impact of data-driven approaches, including machine learning, behavioral analytics, and personalized training, to improve cyber security awareness in Nepal's digital landscape. The objectives include identifying gaps in existing awareness, analyzing successful global strategies, and recommending actionable, localized solutions. Through leveraging secondary data, the study compares strategies from countries with similar challenges and assesses their applicability to Nepal. The novelty of the research lies in its focus on adapting globally proven data-driven methods to the unique context of Nepal, considering its infrastructure limitations, digital literacy levels, and cultural factors. Findings highlight the effectiveness of personalized training and real-time threat monitoring in enhancing awareness. Recommendations emphasize collaborative efforts between government, organizations, and cyber security firms to implement tailored, data-driven strategies, fostering a more resilient digital environment in Nepal.

Keywords—Cyber security Awareness, Data-Driven Strategies, Digital Literacy, Cyber Threat Mitigation, Nepal Digital Landscape

Introduction

There has been an emergence and rapid growth in the use of Digital media in Nepalese market over the few years due to the increasing connectivity of internet, mobile devices and transition in the preference of the consumers from traditional method of business such as electronic business like E-commerce, E-banking etc. Various

government programs like the Digital Nepal Framework have enhanced the country's efforts to get digitalized [1]. But this has been made possible by the development of internet-based platforms which have compounded the problem of cyber security threats [2]. Phishing, malware attacks, hacking amongst other cyber threats are increasing in frequency because most people and organizations are not well equipped with cyber security skills. However, attacks such as phishing particularly on the side of financial institutions and users of online banking services have increased with client information being at high risk [3]. Nevertheless, the threats keep on increasing, and the overall consciousness of cyber threats and cyber threats protection among ordinary Nepali people and Nepalese companies is still low. Most of the users remain ignorant about simple measures when it comes to cyber security for instance, recognizing fake emails or the use of hard to guess passwords [4]. Largely, research indicates that various organizations such as Small Medium Enterprises rarely adopt sound security measures mainly because they lack sufficient capital and human resource expertise in the field. This lack of awareness puts Nepal at a disadvantage because a number of criminals are willing to take their opportunity and exploit the lack of prevention and general knowledge [5]. Thus, the implementation of data-oriented solutions as a means to increase the cyber security level is obligatory. Machine learning, behaviour analysis, and cyber security education stemming from users data and experience have therefore acted successfully internationally [6]. Thus these strategies can work in the Nepali context in order to raise awareness and modify people's behaviour in the digital environment [7]. Nepal consequently can develop the awareness campaigns regarding vulnerabilities which can help the population to minimize the increasing risks of cyber threats for individuals and organizations.

Research Questions:

- What are the key data-driven approaches used globally to enhance cyber security awareness?
- How can data-driven approaches be implemented in Nepal to address current cyber security awareness gaps?
- What barriers and challenges exist in implementing these approaches in Nepal?

The paper is arranged as follows. Section II existing work are discussed. In section III proposed method are provided. In section IV findings and summary are provided. Conclusion and further research are provided in section V.

Literature Review

A. Cyber Security Landscape in Nepal

Despite the emergence of cyberspace in Nepal, the field is relatively young, and resources are scarce, which hampers the country's efforts to improve its cyber security situation. With the recent adoption of technology, new threats continue to emerge while others frequently encountered include; phishing, ransomware, fraud related to financial transactions, and data theft [8]. For instance, Nepalese banking sector has equally been prone to cybercrime where there are many cases of phishing against online banking customers. Lack of effective organizational security framework, and poor appreciation of the general public towards cyber security are some of the challenges that worsen the issue. Unfortunately, though the government has made some attempts at paving the way, including the creation of the National Information Technology

Policy, the state of cyber security is still in its infancy [9].

B. Data-Driven Approaches in Cyber Security

Analytical methods are becoming indispensable in combating cyber threats. One is the use of machine learning for threat pattern recognition is used to scan through the large incoming stream of data for tell-tale signs of a cyber-threat. These algorithms can identify a phishing email, report a malicious website and prevent an unusual user behavior hence stop a breach before it happens. Other key functions include data analyse for monitoring user activity as well. It can also reveal threats from employees since their activities are recorded in an electronic format [10]. Behavioural analysis based security awareness training provides educative content that is dependent on the traditional and technical activity of the user thus makes awareness campaigns more effective. For instance, if for days a user has been liking on those links known to be malicious, then the system may recommend a lesson on how to avoid such websites. Such approaches make use of big data and AI to look for and prevent cyber threats more quickly than conventional methods.

C. Global Case Studies

Such programs have already been adopted by countries with comparable digital environments, for instance, in India and Sri Lanka. India's Cyber Swachhta Kendra has given a native real time malware and AntiVirus monitoring and response system including Machine Intelligence for threat detection and notification to the users [11]. Sri Lanka, via its Cyber Security and Incident Response Teams, has incorporated data analytics into proceedings to increase user knowledge, conducts surveillance on users' and behaves online to post alerts and relay personalized counseling to at-risk users [12]. The aforementioned samples illustrate how the use of data analysis might be facilitative of increasing awareness of cyber security in nations possessing emergent digital landscapes [13].

D. Awareness Challenges

A number of descriptive and comparative assessments have been made to measure the effectiveness of the cyber security awareness programmers conducted in Nepal in the past, and these studies highlight disparities in both methodology and results owing to Nepalese context and its digital realities. For example, Biz Serve IT recently introduced a non-commercial program for youths by which students engaged in applying practical sessions run by professionals in cyber security. This experience emphasized not only the significance of gaining the Thus, this initiative showed that people with more practical experience and those who work within communities can accurately raise awareness among the younger generations [14]. Also, the process of framing the National Cyber Security Policy in Nepal has involved the stakeholders to spread education and awareness domain wise thereby pointing towards a strategic method of educating the general population about policies. As found out by the studies done, lack of cyber security awareness results to higher risks hence calling for an enhanced educational approach that would involve utilization of information.

The best interventions often incorporate a combination of attention-grabbing topics like simulations and case studies which appeal to learners and bring about enduring behavioral modifications. However, the combination with artificial intelligence, as well as training adapted

to the concrete local threats and challenges, can additionally strengthen awareness campaigns [15]. The main concern is that the population of Nepal is still not well informed of cyber threats and their company counterparts have not prioritized cyber security education either. This means that a big number of users are not aware of simple things such as password protection, which may make them Vulnerable to hackers. Further, most organizations, especially the small one fail to embrace Information Security since its expensive while attracting the right talent is also a challenge. This lack of awareness only increases the overall cyber security threat level, and it makes it very important to develop concrete, empirically-based procedures that will enable overcoming this gap.

Research Methodology

Descriptive research method will be employed in the study for assessing the current level of knowledge if cyber security in the Nepalese context and emerging data-based strategies implemented by organizations across the world. Meeting this research gap, comparative analysis will be employed to analyse cyber-security strategies used in countries that are experiencing similar conditions as that of Nepal and the results will then be compared. Some of the secondary data sources will be as follows the government data research papers on Nepalese organization cyber security usage Cyber security organization reports from Nepal. In addition, certain theoretical analytic case based on the countries where data oriented approaches were applied will be also considered. Data analysis method in this study shall include content analysis to establish trends and comparative analysis to establish the applicability of these strategies in Nepal.

1. Research Design: Mixed-Methods Action Research
    a. Approach: Sequential exploratory design (qual → QUAN) with participatory elements
    b. Justification: Combines local stakeholder insights with measurable outcomes
2. Nepal-Specific Sampling Strategy
    a. Target Populations:
        i. Financial sector: 5 commercial banks (Kathmandu Valley + Pokhara)
        ii. Academia: 3 technical colleges (IOE, Purbanchal, Pokhara University)
        iii. Government: 15 IT officers from key ministries
        iv. General public: 200 smartphone users (stratified by age/digital literacy)
3. Data Collection Methods:
    a. Baseline Assessment:
    b. Cyber security Literacy Audit:
        i. Localized phishing simulation (Nepali-language emails/SMS)
        ii. Public WiFi vulnerability testing at 10 hotspots
        iii. Analysis of Nepal CERT incident reports (2019-2023)
    c. Intervention Phase:
    d. Data-Driven Tools Implemented:
        i. Nepali-Language Dashboard:
            1. Visualizes real-time cyber threats specific to Nepal
            2. Integrates with Nepal Rastra Bank's security alerts
        ii. Gamified Learning App:
            1. "CyberSuraksha" mobile app with scenario-based training
            2. Incorporates local fraud cases (e.g., SIM swap scams)

iii. Community Radio Campaigns:
1. 15-minute weekly programs in Nepali/Newari/Maithili
2. Based on trending threat data from monitoring

e. Evaluation Methods:
i. Quantitative:
1. Pre/post knowledge tests (validated Nepali version)
2. Behavioral metrics from app usage analytics
3. Reduction in reported incidents (compared to control groups)
ii. Qualitative:
1. Focus groups with female digital borrowers (addressing gender gap)
2. IT manager diaries documenting implementation challenges
3. Policy roundtables with NTB and ISP representatives

4. Data Analysis Framework:
a. Quantitative Analysis:
i. Spatial analysis of threat patterns using QGIS
ii. Predictive modeling of high-risk districts
iii. Network analysis of attack vectors
b. Qualitative Analysis:
i. Thematic analysis of local media reports on cybercrime
ii. Institutional ethnography of bank security teams
iii. Discourse analysis of social media cyber security conversations

5. Ethical Considerations:
a. Local IRB approval from participating universities
b. Data sovereignty protocols for cross-border threat data
c. Community advisory board with DIGITAL Nepal representatives

6. Implementation Timeline:
a. Phase 1 (3 months): Baseline study + tool localization
b. Phase 2 (6 months): Pilot in 2 banks + 1 college
c. Phase 3 (3 months): Nationwide scaling with telecom partners

7. Validation Approach:
a. Member checking with Nepal Computer Association
b. Comparison with regional benchmarks (Bangladesh, Sri Lanka)
c. Longitudinal tracking of behavioral changes

This methodology addresses key Nepal-specific challenges:

1. Multilingual digital literacy barriers
2. Cross-sector coordination needs
3. Infrastructure limitations outside urban centers
4. Cultural trust factors in technology adoption

A. Research Design

Secondary research will be relied upon for the descriptive study, and would encompass government reports of Nepal (for instance, Ministry of Communication and Information Technology), articles published by academic philosophers on cyber security and data mindedness, industry reports from companies like Kaspersky, Cisco and other firms, and case studies of countries with similar contexts regarding data awareness for cyber security. In the proposed research, the quantitative method of data analysis that will be used is content analysis which will help in coming up with important results such as trend analysis, research findings and general themes from the secondary data.

Content analysis entails a study of text material with a view of identifying patterns, common themes and hidden messages. When it comes to content analysis for this study, the publications from community and academic, industrial reports and case studies of countries with similar digital ecosystem will be considered. The first activity will focus on the collection of secondary data which means that data collected from other sources will be reviewed and summarized to provide the relevant information concerning the current level of cyber security awareness in Nepal. This also involved consideration reportage from the Nepalese Ministry of Communication and Information Technology that will shed light on the current state of cyber security policies, initiatives in raising public awareness as well as achievements and setbacks of the country. Furthermore, literature review will also be performed in order to collect some evidence about how other countries have implemented data-driven approach and whether it may be adaptable in Nepali context according to the findings of existing academic papers and journal articles. Next, secondary data from industries and journals from ITU and other global cyber security organizations will be collected to understand the current trends and measures in the cyber security field. These reports encompass statistical data, tendencies in cyber threats, and assessments of current awareness programs, with which these priorities will reveal standard problems in awareness deficiencies.

B. Cyber Security Awareness in Nepal

The current level of cyber security awareness in Nepal can be described as low – people rarely have enough knowledge about it, and practice even less. This paper seeks to reveal that, even though the country is rapidly going digital, the use of internet, candidate devices, and mobile devices has grown, the aspect of cyber security is not well developed. There have been efforts from government and private sector to make people aware of cyber security, but these have not been consistent nor comprehensive enough to capture all the people. Studies completed secondary data surveys also suggest that a large percentage of the population of the general public in Nepal has limited or poor basic awareness of cyber security. Among the SC reports that have been taken from Ministry of Communication and Information Technology (MoCIT) of Nepal, majority of those users are with little knowledge of basic cyber security knowledge like how to detect phishing attempts, protecting oneself/own information, and choosing an appropriate password. Most of the time, people lose their hard earned money to fraudsters, hackers and cybercriminals through phishing, online scams and financial fraud because they cannot discern fake activities online. The general population has low digital literacy levels, in addition to which most people have not had proper education on cyber security. The same grim depiction of cyber security can be painted for organizations, especially Small Medium Enterprises: Small companies are especially vulnerable to cyberattacks: Most organizations currently lack a specialized cyber security team and often weaker information security protocols than larger companies is shown in fig 1.

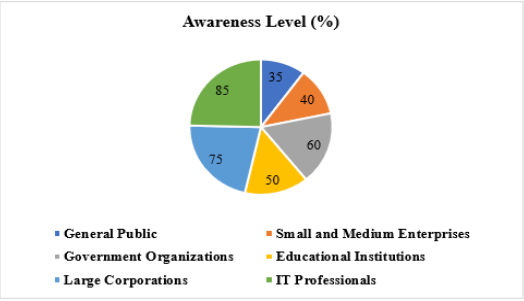

Fig. 1. Cyber Security Awareness Level in Nepal

A recent reports reveal that majority of enterprise in Nepal still lack advanced security measures like firewalls and even those few who acquire tools like antivirus programs they are not using them effectively with the best security protocols and measures in place. Small Medium Enterprise bear the brunt of security threats such as data breach, malware attacks and insider threat the reasons being that Small Medium Enterprises rarely perform a security audit of their firm or train their employees on security issues. Additionally, cyber security policies are not well implemented, and the rules are often violated meaning that best practices are not uniformly followed. The main issue that exist in Nepal in terms of cyber security is low level of awareness and improper continuous training. As it was earlier mentioned both the individuals and organizations are not privileged to current, reliable cyber security education, hence the relative vulnerability to new emerging cyber threats. Furthermore, there is no awareness campaign developed and implemented for different areas to educate the population how to address the threats which are common in the Nepali digital environment. Hence awareness programs are general and hardly address specific cybercrime related issues in Nepal. Such a state of affairs requires public attention and the creation of relevant empirical-based cyber security awareness campaigns.

C. Data Driven Approaches

There is a lot of potential that can be achieved with the help of data science approaches to promote cyber security awareness in Nepal through integrating concepts of data science and utilize the data, and investigate the behavioural patterns of users and provide them with accurate security measures. These approaches utilize data analytics and real-time monitoring, machine learning to enhance cyber security practice among the populace and firms. Machine learning algorithms have the capability of herein helping identify areas of security risks and predicting the possible threats. When given large sets of data from the user's activities, the machine learning models can learn from these user activities and clearly identify patterns that can raise a red flag for phishing, malware or even a possible suspect insider threat. For instance, if the user tends to click on the links that look shady, or accesses the namely unsecured site, machine learning algorithms can alert the observer to such activity and give an instant feedback or even a warning.

Thus in Nepali context, it is possible to come across such mischievous attacks like mere phishing or con scams which are frequently witnessed here, by following such systems effectively. User behavior analytics means the process of monitoring activities of specific users or teams in an organization. Based on discovering what specific activities users perform within digital systems, User behavior analytics has potential to detect behaviors that are endangering the system, for example when individuals set poor passwords or share confidential data. This information can be applied in creating availing cyber security training that target perception gaps unless they are serving as part of general training. Given that, in most cases, the knowledge of the use of digital tools and the ability to navigate the internet is limited for at least 40% of the population in Nepal, hence, User behavior analytics can present a good way of education that would not include useless general information and inherent principles and rules of digital usage one should learn but would target the major issues a certain user faces or has

already encountered and could solve or avoid not being familiar with. This learning could be beneficial for personal cyber security training since platforms may identify the user and determine their learning style and their exposure to the risks. Data analytics can create programs to give warnings at any threat to the users or the administrators to minimize on the attacks. A survey among the Nepalese students and employees reveals that they and other people is interested in cyber security issues, as the knowledge void can be filled by machine learning, behavior analysis, and individualized learning.

D. Barries and Challenges in Nepal

The process of using data driven supporting measures to spread cyber security awareness in Nepal has several major challenges and hurdles that can be attributed to the infrastructure, lack of knowledge, culture and regulatory issues. Another reason that must be considered in Nepal is the relatively weak development of digital infrastructure. Internet connection is gradually improving, but problems remain, especially in the rural areas, where fast internet connection cannot be guaranteed. Such systems can hardly be implemented in real-time monitoring arrangements or in continuous cyber security education, for example, through the use of persuasive data. Further, most organizations especially the SMEs are unable to implement complex technology such as the machine learning models or behavior analytics because of reasons such as financial limitations and outdated IT structure. One of the biggest challenges, perhaps the biggest challenge of all is low level of Computer literacy in the general population. There is a low literacy level of cyber security among the populace of Nepal especially those in the rural areas due to low level of computer literacy. They not only lack awareness among members of society, but also in businesses where the employees may not be in a position to discern legitimate emails and scams, phishing attempts, malware, or any other type of cyber-attack. If these basic requirements are poorly fulfilled, data-driven interventions will be far from providing effective solutions to increase cyber security awareness.

Lack of adoption of cyber security measures is also instigated by cultural aspects. Some of the challenges include; Nepalese user's negligence towards digital security since most users do not perceive cyber threats as imminent. Moreover, reliance on conventional approaches and face-to-face communication can also be the barrier for using digital security practices. Therefore, even if there are statistically informed strategies, there will likely be evoke significant resistance from human and/or organizations. The cyber security regulation in Nepal is emerging, and the policies have not progressed towards data-supported security. Challenges may consist of infrastructure problems, lack of computer usage skills, cultural barriers and regulatory factors; all of which should be overcome in the process of implementing technology.

Result and Discussion

Analysis of the findings identified the following: In Nepal, there exists a critical lacking of basic knowledge and practice concerning cyber security among not only the public but also organizations. Machine learning techniques, behavior analytics and person-centric training are outlined as promising solutions to enhance cyber security awareness, regardless of infra-structure and policy constraints.

A. Findings

Nepal too can employ machine learning, behavioural analysis to name but a few, as data background driven cyber security actions. The developed strategies are useful for risk detection in the network, making notifications, and enhancing cyber security awareness. Nevertheless, the practical application of these strategies in Nepal may be problematic because of the infrastructural limitations in Nepal, outdated technology, policy gaps and culture in the IT sector is shown in table 1.

TABLE 1. FINDINGS ON DATA-DRIVEN CYBER SECURITY AWARENESS STRATEGIES IN NEPAL

Findings	Description	Implication for Nepal
Low Cyber security Awareness	Significant gaps in cyber security knowledge among the general public and organizations.	Urgent need for targeted awareness programs.
Effectiveness of Data-Driven Approaches	Machine learning and behavioral analytics have been successfully used to improve cyber security awareness globally.	These strategies can be adapted to improve Nepal's cyber security awareness.
Challenges in Digital Literacy	High levels of digital illiteracy among the population.	Requires tailored educational initiatives and training programs.
Infrastructure Limitations	Limited internet connectivity and outdated technological infrastructure in rural areas.	Need for investment in digital infrastructure to support advanced cyber security tools.
Regulatory Gaps	Lack of comprehensive cyber security laws and data privacy regulations.	Stronger regulatory frameworks are needed to support data-driven cyber security initiatives.
Public-Private Partnerships	Collaboration between government agencies, cyber security firms, and organizations enhances awareness efforts.	Encourages the development of cost-effective, scalable cyber security solutions.

B. Comparative Analysis

The comparative analysis compares effective data-based cyber security approaches in other countries and determines their applicability to the Nepali environment. For Instance, the Indian and Sri Lankan context, with similar digitisation levels, have employed machine learning to forecast cyber threats and behavioural analytics to enhance user consciousness. These are mainly focused on numerous particularized resources regarding training and exact threats to give efficient solutions to the particular weakness. On the other hand, some of the key issues that adversative Nepal comprises a low level of digitalization, low cyber security literacy, and inadequate policies. Nevertheless, experiences of such countries seem to prove how such nations have benefited from establishing Public-Private Partnerships, integrated and targeted education activities, and building on existing facilities. The analysis comparing these approaches also finds out practical strategies to fill the existing gaps in the Nepali context and empower the domestic populace with data.

C. Recommendations

For effective implementation of cyber security in Nepal and especially in addressing the problem of awareness, initiatives need to be instituted by the government together with relevant organizations and cyber security firms that embrace data analysis approach. Different government departments should extend expertise on improving digital services across the country particularly for the rural areas to support the many new and complex cyber security measures including the use of clinical machine learning and behavioural analytics. The ones requesting coverage extension across the states with high speed internet as well as executing national cyber security strategies shall influence these. The government should also enhance cyber security policies such as data protective laws, to compel various forms of companies to employ sound cyber security measures. Another way is to create a national cyber security awareness program still in conjunction with the cyber security firms to pass more information about threats, risks and safe practices online.

Cyber security firms have a crucial part in this endeavor because they offer solutions that are affordable according to the Nepalese context. They can help the government to establish cyber security monitoring tools and a mechanism based on machine learning algorithms that will recognize cyber threats. These firms can also provide cyber security awareness training sessions to companies on how best they can identify cyber threats. They should engage with the government agencies to coordinate general awareness on cyber security to the public and organizations to create awareness on new threats as well as the most appropriate measures to take. Cybercrime Organizations especially the small and medium enterprises should be urged to adopt data-based practices cyber security in partnerships between the public and private sectors. Small boosts in cash subsidies or tax preferences may be offered to businesses in exchange for their implementing high-level cyber-security arrangements within organizations. It strongly suggests that organizations should establish employee training programs, improve their digital skills, and promote more cooperation to improve Nepals cyber security and consequently decrease the number of threats.

Conclusion and Future Work

The application of quantitative measures to promote cyber security in Nepalese institutions is an outstanding solution to tackle the increasing cyber threats. By employing machine learning techniques, behavioral analysis and flexible approaches to learning, the above-mentioned strategies may enrich ways Nepalis and organizations understand and address cyber threats. However, for these approaches to be implemented, the following barriers need to be addressed; infrastructure constrains, lack of computer literacy, and policy constraints. In the future, all stakeholders including the government, cyber security companies and organizations should cultivate an environment that encourages data driven solutions, access to and the creation of affordable tools, and awareness about cyber security risks prevalent in the society.

For future research several measures can be taken as lo next steps from the findings of present study: First, it is needed to work on national cyber security strategy that includes scientific approaches and methods. This should involve enhancing curriculum development and implementation of cyber security education in school, colleges and other institutions making a knowledgeable society. Collaboration between public and private sectors, real-time monitoring systems, and adaptive learning models can enhance cyber security awareness and resilience in Nepal, addressing infrastructure gaps and enhancing cyber security training.

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