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Design and Implementation of Multi-Segment LAN Infrastructure for Computer Laboratories

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A B S T R A C T

Educational computer laboratories require a reliable and well-structured network infrastructure to support learning activities and efficient resource management. However, many laboratory networks are still implemented using a single network segment, which can lead to high broadcast traffic and reduced network performance as the number of connected devices increases. This study proposes the design and implementation of a multi-segment Local Area Network (LAN) infrastructure based on institutional needs in an educational computer laboratory environment. The proposed network architecture consists of four laboratory rooms with a total of 160 computers, where each laboratory operates within a different IP network segment while remaining interconnected through routing mechanisms. Network devices such as the MikroTik RB750Gr3 hEX router are used to manage gateway functions, DHCP services, and network address translation (NAT) for internet connectivity. The implementation is evaluated through connectivity tests between laboratory networks and internet access tests. The results show that all laboratory networks successfully communicate with each other without packet loss and demonstrate low latency values, indicating stable network performance. In addition, internet connectivity tests confirm that all laboratory networks can access external resources reliably. These findings demonstrate that the proposed multi-segment LAN infrastructure improves network organization, scalability, and manageability within educational computer laboratory environments.

INTRODUCTION

Computer laboratories play an essential role in supporting technology-based learning activities in educational institutions. Various academic activities such as programming practice, network configuration, multimedia processing, and data analysis rely heavily on the availability of stable and well-managed network infrastructure. As the number of connected devices in educational laboratories continues to grow, managing network performance and stability becomes an increasingly important challenge[1].

In many educational environments, laboratory computers are often connected within a single local area network (LAN) infrastructure. While this approach simplifies network deployment, it can lead to several operational problems when the number of devices increases significantly. High broadcast traffic, network congestion, and difficulties in network management are among the most common issues found in large-scale laboratory networks[2]. These problems may negatively affect the quality of learning activities that depend on reliable network connectivity.

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One approach to addressing these challenges is the implementation of network segmentation, where the network is divided into several smaller segments based on operational requirements. Network segmentation helps reduce broadcast domains, improve traffic management, and enhance network security. By separating devices into different network segments, administrators can manage network resources more efficiently while maintaining system stability[3].
Several studies have explored the implementation of segmented networks to improve network performance and security in organizational environments. However, most existing research focuses primarily on enterprise or data center networks, while relatively limited attention has been given to the implementation of multi-segment LAN infrastructures in educational computer laboratory environments, particularly those that must accommodate a large number of client devices distributed across multiple laboratory rooms[4].

In addition, previous studies often emphasize either network segmentation or centralized network management without fully addressing the need for inter-laboratory connectivity within segmented network architectures. In educational institutions, laboratories often require both network isolation for performance management and connectivity for resource sharing and collaborative learning activities[5].

Therefore, this study proposes the design and implementation of a multi-segment LAN network infrastructure for educational computer laboratories based on institutional needs. The proposed approach divides the network into multiple segments corresponding to different laboratory rooms while maintaining connectivity between segments through routing mechanisms. This architecture aims to improve network performance, enhance network management efficiency, and support scalable network expansion within the institutional environment.

The objective of this research is to design and evaluate a multi-segment LAN architecture that supports multiple computer laboratories with interconnected network segments. The study also analyzes network connectivity and performance to assess the effectiveness of the proposed network infrastructure in supporting educational computing environments.

METHOD

Research Design

This study applies a network design and implementation approach to develop a multi-segment LAN infrastructure in educational computer laboratories. The research focuses on designing a segmented network architecture that allows each laboratory to operate within its own network segment while maintaining connectivity between laboratories.

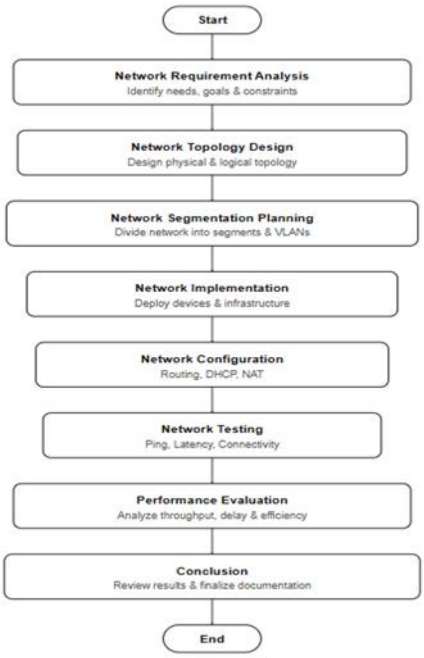

Fig 1. Research Methodology Flowchart

The research process consists of several stages, including network requirement analysis, network topology design, network implementation, and network performance evaluation. These stages ensure that the proposed network infrastructure can effectively support laboratory activities while maintaining stable network performance.

To ensure a systematic development of the proposed network infrastructure, this study follows several structured research stages. Each stage is designed to support the planning, development, and evaluation of the multi-segment LAN architecture implemented in the educational computer laboratory environment. The stages begin with identifying the network requirements of the laboratory environment, followed by designing the network architecture based on the identified needs. After the design phase, the network infrastructure is implemented through the configuration of networking devices and addressing schemes. The implemented network is then tested to verify connectivity, latency, and overall functionality. Finally, the network performance is evaluated to determine the effectiveness of the proposed architecture in supporting laboratory operations.

Table 1. Research Stages

Stage	Description
Requirement Analysis	Identification of laboratory network needs including number of devices and connectivity requirements
Network Design	Designing a segmented LAN architecture for multiple laboratories
Implementation	Configuring routers, switches, and IP addressing scheme
Testing	Conducting connectivity and latency tests
Evaluation	Analyzing network performance and stability

Network Environment

The study was conducted in a computer laboratory environment consisting of four laboratory rooms. Each laboratory contains 40 personal computers, resulting in a total of 160 computers connected to the network infrastructure. Each laboratory room is equipped with one router and one unmanaged switch to distribute network connectivity to all computers in the room. The router used in each laboratory is MikroTik RB750Gr3 hEX, which functions as the gateway for the laboratory network and manages several network services such as Dynamic Host Configuration Protocol (DHCP), Network Address Translation (NAT), and routing. The routers in each laboratory are connected through the institutional network backbone, allowing the laboratory networks to communicate with one another while maintaining separate network segments.

The use of a dedicated router in each laboratory is an important design consideration in supporting the implementation of a multi-segment LAN infrastructure. Unlike a network that relies solely on switches, the presence of routers enables the separation of network segments through different IP subnets while still allowing controlled communication between them. This segmentation helps reduce broadcast traffic within the network and improves overall network performance, particularly in environments with a large number of connected devices such as computer laboratories.

Furthermore, routers provide advanced network management capabilities including routing control, network address translation (NAT), and dynamic host configuration protocol (DHCP) services. These features allow each laboratory network to operate independently while maintaining connectivity with other laboratory networks and external internet services. By using routers such as the MikroTik RB750Gr3 hEX in each laboratory, the network infrastructure becomes more flexible, scalable, and easier to manage. This design also simplifies troubleshooting and network maintenance because each laboratory network can be monitored and configured separately without affecting other segments.

Table 2. Network Devices Used in the Laboratory Infrastructure

Device Type	Model	Function	Quantity
Router	MikroTik RB750Gr3 hEX	Gateway, routing, DHCP, NAT	4
Switch	Unmanaged Switch	Network distribution to PCs	4
Personal Computer	Desktop PC	Client devices in laboratories	160

Network Architecture Design

The network architecture proposed in this study adopts a multi-segment LAN design, where each laboratory operates in a different IP network segment. This approach aims to reduce broadcast traffic, improve network management efficiency, and maintain network stability when a large number of devices are connected.Each laboratory network uses a private IPv4

Class C address with a different network ID. This configuration creates separate broadcast domains for each laboratory while allowing inter-network communication through routing mechanisms.

The proposed network infrastructure adopts a multi-segment LAN architecture in which each laboratory operates within a separate network segment. This segmentation reduces broadcast traffic and improves network management efficiency. Although the networks are logically separated, routing mechanisms allow communication between laboratories. The overall architecture of the proposed network infrastructure is illustrated in Figure 2.

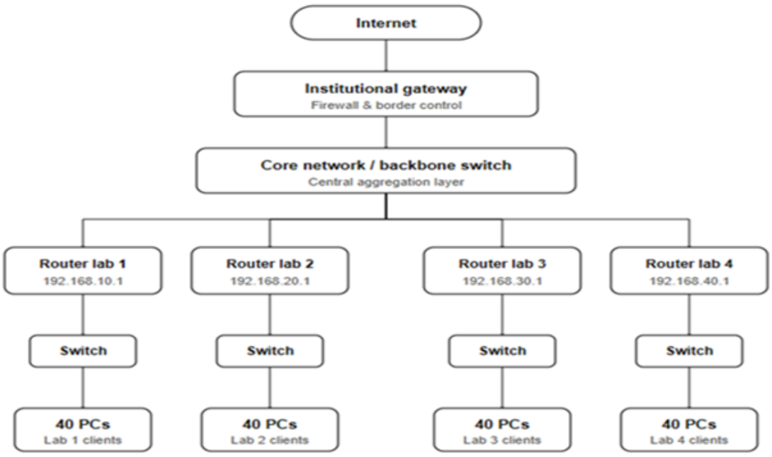

Fig 2. Multi-Segment LAN Architecture for Educational Computer Laboratories

To support the implementation of the multi-segment LAN architecture, each laboratory network is assigned a different IPv4 Class C network segment. This addressing scheme allows logical separation between laboratory networks while maintaining connectivity through routing mechanisms. Each laboratory network is configured using a /26 subnet mask to accommodate the number of connected devices while allowing additional addresses for network management. The addressing scheme used in this study is presented in Table 3.

Table 3. The network addressing scheme

Laboratory	Network Address	Subnet Mask	Gateway	Number of Computers
Laboratory 1	192.168.10.0/26	255.255.255.192	192.168.10.1	40
Laboratory 2	192.168.20.0/26	255.255.255.192	192.168.20.1	40
Laboratory 3	192.168.30.0/26	255.255.255.192	192.168.30.1	40
Laboratory 4	192.168.40.0/26	255.255.255.192	192.168.40.1	40

Network Implementation

The network implementation stage involves configuring routers and switches to support segmented network operation and inter-laboratory communication. After the network architecture was designed, the next stage involved implementing the proposed infrastructure in the laboratory environment. The implementation process focused on configuring the network devices in each laboratory to support segmented network communication while maintaining connectivity between laboratories and external networks. Each laboratory network was configured using a dedicated router to manage local network services and inter-network communication.

The routers used in this implementation were MikroTik RB750Gr3 hEX devices installed in each laboratory. These routers were configured to function as gateways for their respective network segments. The configuration process included assigning IP addresses to router interfaces, defining subnet parameters based on the addressing scheme, and establishing routing paths to enable communication between the laboratory networks.

In addition to basic interface configuration, each router was configured with Dynamic Host Configuration Protocol (DHCP) services to automatically assign IP addresses to client devices within the laboratory network. The DHCP server distributes IP addresses, subnet masks, default gateway information, and DNS settings to connected computers, thereby simplifying network management and reducing the need for manual configuration on each client device.

To enable internet connectivity for all laboratory computers, Network Address Translation (NAT) was configured on the routers. NAT allows multiple internal private IP addresses within the laboratory networks to access external networks through a single public IP address. This mechanism ensures efficient use of public IP resources while maintaining secure communication between internal and external networks.

Furthermore, routing mechanisms were implemented to allow communication between different laboratory network segments. Static routing entries were configured on each router to define the paths to other laboratory networks. Through this routing configuration, computers located in one laboratory can communicate with devices in other laboratories when necessary, while still maintaining logical separation between network segments. The implementation of these configurations ensures that the multi-segment LAN infrastructure operates efficiently, supports inter-laboratory communication, and provides stable internet connectivity for all computers within the educational laboratory environment.

Table 4. Router Configuration Parameters

Parameter	Description	Configuration
Router Device	Router used in each laboratory	MikroTik RB750Gr3 hEX
Interface IP Address	Default gateway address for each laboratory network	192.168.x.1
Subnet Mask	Network segmentation mask	255.255.255.192 (/26)
DHCP Server	Automatic IP address assignment for client PCs	Enabled
DHCP Range	Range of IP addresses assigned to client devices	192.168.x.10 – 192.168.x.62
NAT	Internet access for internal networks	Masquerade
Routing	Interconnection between laboratory networks	Static Routing

Table 4 presents the main configuration parameters applied to the routers in each laboratory network. The table describes the networking device used, the essential network configuration parameters, and the mechanisms that support communication within and between laboratory segments. The routers deployed in this study serve as the primary gateway devices that manage network traffic, distribute IP addresses, and regulate connectivity between internal networks and external internet services.

The configuration parameters include the assignment of gateway IP addresses, subnet mask settings, and DHCP server configuration for automatic IP address allocation to client computers. In addition, Network Address Translation (NAT) is implemented to enable internal private networks to access external internet resources efficiently. Static routing rules are also configured to establish communication paths between the different laboratory network segments.
By defining these configuration parameters, the proposed network infrastructure can operate in a structured and manageable manner. Furthermore, documenting the router configuration in this form provides clarity regarding the network implementation process and enables other researchers or network administrators to replicate the configuration in similar educational laboratory environments.

Network Testing and Evaluation

After the network infrastructure was implemented, a series of tests were conducted to evaluate the performance and functionality of the proposed multi-segment LAN architecture. The testing phase aimed to ensure that the network configuration operated as expected, that communication between laboratory networks functioned properly, and that internet connectivity was stable for all connected devices. Several evaluation methods were used in this study, including connectivity testing, latency measurement, and internet access verification.

The first stage of testing involved connectivity verification using the ping test. This test was performed to determine whether devices within the same laboratory network and across different laboratory segments could communicate successfully. The ping test sends Internet Control Message Protocol (ICMP) packets from one host to another and measures whether a response is received. Successful responses indicate that the routing configuration between network segments is functioning correctly.

The second evaluation focused on latency measurement, which represents the time required for a data packet to travel from a source device to a destination device and return to the sender. Latency values were observed during ping tests conducted between computers located in different laboratory networks as well as between laboratory computers and external internet hosts. Lower latency values indicate more efficient network communication and better overall network performance.

The final testing stage involved verifying internet connectivity for all laboratory networks. Each laboratory computer was tested to ensure that it could access external internet resources through the configured gateway. This test confirmed that the routers correctly implemented network address translation (NAT) and routing mechanisms, enabling internal private networks to communicate with external internet servers. Through these testing procedures, the functionality and performance of the implemented multi-segment LAN infrastructure could be evaluated comprehensively. The results of these tests provide insights into the effectiveness of the proposed network design in supporting reliable communication within educational computer laboratory environments.

RESULTS AND DISCUSSION

Results

The connectivity test results show that all laboratory networks are able to communicate successfully with other laboratory segments. The ping tests produced an average latency of approximately 1 ms with no packet loss, indicating that the routing configuration between network segments operates effectively. Furthermore, internet connectivity tests demonstrate that all laboratory networks can access external internet hosts with stable latency values ranging from 18 to 20 ms. These results confirm that the implemented network architecture successfully supports both internal communication between laboratory networks and external internet access.

Table 5. Inter-Laboratory Connectivity Test Results

Source Laboratory	Destination Laboratory	Destination IP	Packets Sent	Packets Received	Packet Loss	Average Latency (ms)	Status
Laboratory 1	Laboratory 2	192.168.20.10	4	4	0%	1 ms	Connected
Laboratory 1	Laboratory 3	192.168.30.10	4	4	0%	1 ms	Connected
Laboratory 1	Laboratory 4	192.168.40.10	4	4	0%	1 ms	Connected
Laboratory 2	Laboratory 3	192.168.30.10	4	4	0%	1 ms	Connected
Laboratory 2	Laboratory 4	192.168.40.10	4	4	0%	1 ms	Connected
Laboratory 3	Laboratory 4	192.168.40.10	4	4	0%	1 ms	Connected

Table 5 presents the results of the inter-laboratory connectivity tests conducted using the ping command. The tests were performed between computers located in different laboratory network segments to verify the effectiveness of the routing configuration. The results show that all laboratory networks successfully communicated with each other without packet loss. Each test transmitted four ICMP packets and received all responses, indicating stable network connectivity. The observed average latency was approximately 1 ms, which demonstrates that the implemented multi-segment LAN architecture provides efficient communication between laboratory networks. These results confirm that the routing configuration between network segments functions properly and supports reliable data transmission within the laboratory infrastructure.

Table 6. Internet Connectivity Test Results

Laboratory	Destination Host	Destination IP	Packets Sent	Packets Received	Packet Loss	Average Latency (ms)	Status
Laboratory 1	google.com	8.8.8.8	4	4	0%	18 ms	Connected
Laboratory 2	google.com	8.8.8.8	4	4	0%	19 ms	Connected
Laboratory 3	google.com	8.8.8.8	4	4	0%	20 ms	Connected
Laboratory 4	google.com	8.8.8.8	4	4	0%	19 ms	Connected

Table 6 presents the results of the internet connectivity tests conducted from each laboratory network to an external internet host. The tests were performed using the ping command to verify that the configured network infrastructure successfully provides internet access for all laboratory segments. The results indicate that all laboratories were able to reach the destination host without packet loss, demonstrating stable external connectivity. Each test transmitted four ICMP packets and received all responses successfully. The average latency ranged between 18 ms and 20 ms, which indicates a stable and responsive internet connection for all laboratory networks. These results confirm that the implemented routing and network address translation (NAT) configurations function correctly, enabling internal private networks to communicate with external internet resources.

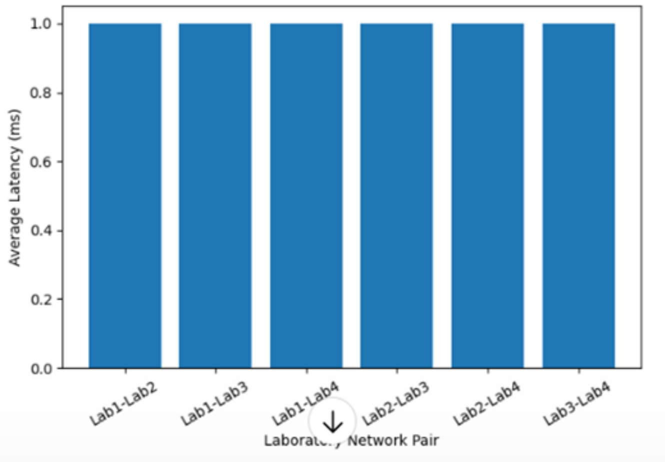

Fig 3. Average Latency Between Laboratory Networks

Figure 3 illustrates the average latency observed during connectivity tests between laboratory network segments. The results show that the communication between laboratory networks operates with very low latency, averaging approximately 1 ms for all inter-laboratory connections. This indicates that the routing configuration implemented in the multi-segment LAN architecture functions efficiently and supports fast communication between network segments. The low latency values also demonstrate that the proposed network infrastructure is capable of supporting educational laboratory activities that require stable and responsive network connectivity.

Discussion

The results indicate that the proposed multi-segment LAN architecture operates effectively in the educational laboratory environment. Inter-laboratory connectivity tests show successful communication between all network segments with no packet loss and very low latency, demonstrating that the routing configuration functions properly. Internet connectivity tests also confirm that all laboratory networks can access external resources with stable latency ranging from 18 ms to 20 ms, which is adequate for common laboratory activities such as online learning and accessing web-based resources. In addition, the use of different IP subnets for each laboratory helps reduce broadcast traffic and improves overall network organization. Overall, the implemented multi-segment network design enhances network manageability, scalability, and reliability within the institutional laboratory infrastructure.

CONCLUSION

This study proposed and implemented a multi-segment LAN infrastructure for educational computer laboratories consisting of four laboratory rooms with a total of 160 computers. Each laboratory operates within a different IP network segment while remaining interconnected through routing mechanisms using routers such as the MikroTik RB750Gr3 hEX. The testing results show that the network architecture provides stable communication between laboratory networks and reliable internet connectivity, with no packet loss and low latency values during connectivity tests. These findings indicate that the proposed multi-segment LAN design improves network organization, scalability, and manageability, making it suitable for supporting network infrastructure needs in educational laboratory environments.

REFERENCES

Journal Article

[1] N. Feamster and J. Rexford, “Why (and How) Networks Should Run Themselves,” *arXiv preprint arXiv:1710.11583*, 2017.
DOI/Link: https://doi.org/10.48550/arXiv.1710.11583

[2] A. S. Tanenbaum and D. J. Wetherall, *Computer Networks*, 5th ed. Boston, MA, USA: Pearson Education, 2011. DOI/Link: Computer Networks 5th Edition

[3] P. Oppenheimer, *Top-Down Network Design*, 3rd ed. Indianapolis, IN, USA: Cisco Press, 2010. DOI/Link: Top-Down Network Design

[4] T. Dreibholz, M. Becke, F. Adhari, and T. Rathgeb, “Challenges and Approaches for Network Performance Evaluation in Distributed Systems,” *International Journal of Network Management*, vol. 28, no. 6, 2018. DOI: https://doi.org/10.1002/nem.2031

[5] K. Kontovasilis, K. Psychas, and C. Xenakis, “Network Segmentation Approaches for Educational and Organizational Environments,” *International Journal of Advanced Computer Science and Applications*, vol. 7, no. 9, pp. 150–156, 2016.DOI/Link: https://doi.org/10.14569/IJACSA.2016.070920
[6] Vianingrum, M. H., & Zulherry, A. (2026). Implementasi Sistem Pendukung Keputusan Untuk Menganalisis Tingkat Kepuasan Pengguna E-Learning Menggunakan Metode End User Computing Satisfaction (EUCS) Di SMK Multi Karya. Hello World Jurnal Ilmu Komputer, 5(1), 77-84.
[7] Lubis, I. Q., & Zulherry, A. (2026). Implementasi Keamanan Website Dari Serangan Cross Site Request Forgery Menggunakan Algoritma HMAC-SHA256 Pada Framework Laravel. Hello World Jurnal Ilmu Komputer, 5(1), 47-58.
[8] Zulherry, A., Sari, I. P., & Basri, M. (2026). Perancangan dan Implementasi Segmentasi LAN pada Infrastruktur Jaringan Skala Menengah. Hello World Jurnal Ilmu Komputer, 4(4).
[9] Zulherry, A., Riadi, I., & Umar, R. (2026). Anomaly Detection in Cloud Device-Based Information Technology Infrastructure Using Isolation Forest Algorithm. Journal Of Informatics And Telecommunication Engineering 9 (2)
[10] Zulherry, A., Basri, M., & Yusnandar, W. (2025). Implementation of Private Cloud Infrastructure as a Service Using Proxmox VE Based on the Network Development Life Cycle (NDLC) Approach. Altafani: Jurnal Pengabdian Masyarakat, 1(1).
[11] Zulherry, A., & Gunawan, M. (2025). Development of an Android-Based Smart Health Monitoring Device for Heartbeat Detection. Al'adzkiya International of Computer Science and Information Technology (AIoCSIT) Journal, 6(2), 75-79.
[12] Sari, I.P., Zulherry, A., Basri, M., & Hayani W. (2025). Pembelajaran Pemrograman berbasis Machine Learning sebagai Upaya Peningkatan Computational Thinking. Jurnal Penelitian, Pendidikan dan Pengajaran: JPPP 6 (3), 245-250
[13] Bisono, A. T., & Zulherry, A. (2025). Analisis sentimen game Genshin Impact untuk mengetahui reaksi dan harapan pemain menggunakan metode Naïve Bayes. sudo Jurnal Teknik Informatika, 4(2), 183-193.
[14] Basri, M., & Zulherry, A. (2025). Analysis of the Impact of Gambling and Online Loans in the Perspective of Informatics, Islam, and Kemuhammadiyahan. Ar-Rasyid: Jurnal Pendidikan Agama Islam, 5(1), 65-73.
[15] Asadel, A., & Zulherry, A. (2025). Detecting Zero-Width Characters Obfuscated in Phishing URLs using the XGBOOST Algorithm. Hanif Journal of Information Systems 3 (1), 43-53
[16] Zulherry, A., Sari, I.P., & Basri, M. (2025). Perancangan Aplikasi Monitoring Kehadiran Pegawai Menggunakan RFID. sudo Jurnal Teknik Informatika 4 (4), 378-384
[17] Ichsan, A., Zulherry, A., Lubis, T. A., & Shahnaz, B. A. Z. (2025). Utilization of Mobile Applications to Speed Up The Search for Android-Based Index Places. IJATCoS: Indonesian Journal of Applied Technology. Computer and Science, 2(1).
[18] Amada, E.P., & Zulherry, A. (2025). Klasterisasi Minat Dan Bakat Siswa Menggunakan Metode X-Means Berbasis Web: Studi Kasus SMA Negeri 1 Hamparan Perak. sudo Jurnal Teknik Informatika 4 (4), 276-283.
[19] Zulherry, A., Ramadhani, F., & Satria, A. (2024). Klasifikasi Data Tracer Study Dengan Pemanfaatan Data Mining Menggunakan Algoritma Support Vector Machine dan Neural Network. Portal Riset dan Inovasi Sistem Perangkat Lunak 2 (1), 45-54
[20] Zulherry, A. (2023). Decision making for network security with simple additive weighting method. Journal of Intelligent Decision Support System (IDSS), 6(3), 155-159.
[21] Zulherry, A., Gunawan, T. S., & Wanayumini, W. (2021). Analisis Hasil Pendukung Keputusan Mendapatkan Rumah Dinas Perusahaan Menggunakan Metode Analytical Hierarchy Process (AHP) dan Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). Jurnal Media Informatika Budidarma, 5(2), 695-704.

Book
[22] Purba, A. M. V., Pradipta, R., Zulherry, A., Sari, I. P., Ansya, Y. A. U., Basri, M., ... & Darnilasari, A. (2026). Pengetahuan Dasar Komputer. Yayasan Kita Menulis.
[23] Kaban, R., Rachman, A. I., Sari, I. P., Zulherry, A., Basri, M., Fadilah, N., ... & Ahyuna, A. (2026). Pengantar Artificial Intelligence, Machine Learning, dan Big Data. Yayasan Kita Menulis.
[24] Tarigan, I. M. B., Sari, I. P., Zulherry, A., Ansya, Y. A. U., Laman, E. G., Saputra, E. M., ... & Damayanti, E. (2026). Fondasi Matematika untuk Ilmu Komputer dan Implementasinya dalam Pendidikan. Yayasan Kita Menulis.
[25] Irfan, A. P., Susanto, C., Sari, I. P., Zulherry, A., Ansya, Y. A. U., Dewi, I. K., ... & Mubarak, R. (2026). Sistem Informasi Modern untuk Era Digital. Yayasan Kita Menulis.

[26] Wahyuddin S, Indah Purnama Sari, Samuel Hasudungan Tampubolon Andi Zulherry, Butsiarah, Taufik, George Morris William Tangka Rahmad Bahri, Mhd. Basri, Raemon Syaljumairi, Robbi Rahim Muharman Lubis, Baso Ali, Sirmayanti, Janner Simarmata. Cloud Computing: Referensi Lengkap. Medan: Yayasan Kita Menulis, 2025, pp.248.