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# Implementation of EVE-NG in Increasing the Effectiveness of Project-Based Learning in the Network Computer Engineering Technology Study Program

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## ABSTRACT

The increasing demand for practical skills in computer networks has made hands-on learning a crucial element in information technology education. This study focuses on evaluating the usability of EVE-NG, a network simulation platform, to optimize project-based learning for students in the Computer Engineering and Network Program (TRKJ) at Politeknik Negeri Tanah Laut. The students, in their third semester, were selected as respondents, as they were enrolled in the Computer Networks 3 course, which is relevant to the practical use of EVE-NG. A usability analysis was conducted using five key indicators: Learnability, Memorability, Efficiency, Errors, and Satisfaction, assessed through questionnaires.

The findings revealed that EVE-NG performs adequately across all indicators, with average scores ranging from 2.82 to 3.04, indicating good usability overall. Learnability and Memorability were rated as "good," though some users reported challenges in adapting to certain interface elements. Efficiency was rated "fair," with some feedback highlighting the need to improve workflow speed. The Errors indicator showed relatively low user mistakes, suggesting that the system is generally intuitive, although some interface ambiguities remain. Satisfaction received the highest score, reflecting user contentment with the platform, though improvements in system speed and interface clarity were suggested.

The results provide essential insights into the current usability of EVE-NG and offer recommendations for further enhancements. With targeted improvements, EVE-NG can offer a more efficient and user-friendly experience, better supporting practical, real-world network simulation tasks in educational settings.

## INTRODUCTION

Education in the field of information technology, especially computer networks, requires a practical and hands-on approach to prepare students with skills that are in line with industry demands. The Computer Network Engineering Technology (TRKJ) Study Program at Tanah Laut State Polytechnic aims to equip students with a solid theoretical understanding and applicable practical skills. The project-based learning (PBL) method is a learning process that directly involves students in creating projects. Basically, this learning model helps students acquire problem-solving skills in carrying out projects that can produce something (Sari, Angreni, Studi, Guru, & Dasar, 2018). However, its implementation is often hampered by limited resources, especially in terms of network hardware.

The obstacle faced by the TRKJ Study Program is the insufficient number of network hardware available for the number of students. This is due to the relatively expensive cost of network equipment and the diversity of network platforms used in the industry. These limitations hinder students' ability to gain valuable implementation experience, which is a key component in project-based learning.

In overcoming these challenges, the implementation of EVE-NG (Emulated Virtual Environment-Next Generation) as a network simulation platform is a promising solution. The software called Eve-NG (Emulated Virtual Environment—Next Generation) is a network and security emulator that can emulate various products. There is the ability to simulate various products, such as Mikrotik routers, Cisco, Cisco Nexus Datacenter, Juniper Switch VQFX, Juniper Router vMX, and Juniper Firewall vSRX. In addition, it has the ability to create checkpoint firewall lab, paloalto, and various other products (Reza Fachrur Rozi, Nandang, & Pratama, 2021) .EVE-NG allows students to design, implement, and test network configurations in a secure and controlled virtual environment (Reza Fachrur Rozi, Nurhayati, & Arandiant Rozano, 2024). With EVE-NG, students can gain practical experience that is close to the reality of the working world without requiring a large investment in physical hardware. Because EVE-NG is easy to use to support network learning (Korniyenko & Galata, 2019). The practicums that can be done include the implementation of addressing, static routing, dynamic routing and several applications in computer networks (Rahardja, 2022). In the study (Putro, Hatta, & Efendi, 2022) conducted an evaluation and analysis of several network simulation applications,

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to find out which applications are more efficient to use in learning computer networks, seen from the application's capabilities in configuring IP Address, Subnetting, Routing. The results of this study indicate that the application (1) Cisco Packet Tracer is ranked first with a score of 89.1%, (2) Boson Netsim is ranked second with a score of 86.6%, (3) GNS3 is ranked third with a score of 85.4%, (4) EVE-NG is ranked fourth or lowest with a score of 83.3%.

When using an emulator or simulator locally, not everyone can do it due to hardware limitations (Supriadi, Putra, & Davika, 2022). To overcome the problem of hardware limitations, creating a LAN infrastructure network laboratory that can be accessed remotely is one of them (Rustiana, Pratama, Mudabbir, Fahmi, & Rofei, 2022).

This study aims to optimize project-based learning with the hope that when students use EVE-NG remotely, students can face real situations in a safe and controlled virtual environment. Then evaluate the effectiveness of using EVE-NG in project-based learning. To find out how optimal the use of EVE-NG is, an evaluation of effectiveness and efficiency will be used (Zarish, Habib, & Islam, 2019). This evaluation will also be very useful, as one of the bases for the next stage of research, namely improving the functionality of EVE-NG. The evaluation is carried out to determine the use of technology or applications that are run using usability analysis.

Usability analysis is a user testing method that provides a fast and simple but reliable measuring tool(Zarish et al., 2019). The evaluation was conducted to determine whether the EVE-NG system is easy to use or not, how quickly users understand and use the website, and whether users still experience problems or difficulties when using it. In this study, the usability system scale (SUS) was used because: (1) the evaluation process is easier for respondents to understand, (2) it describes maximum results by involving a small sample, and (3) it can be seen clearly between applications that can and cannot be used "are the advantages of the usability scale system itself (Suyanto & Ependi, 2019). To conduct application evaluations, SUS also has a clear calculation tool, according to Sauro. Thus, the evaluation value produced has a truth value and can be accounted for (Ependi, Putra, & Panjaitan, 2019).

## LITERATURE REVIEW

This section reviews various scientific knowledge that supports the implementation of this research, using the literature study method as a data collection technique. Research data is taken from journals, articles, and other relevant sources. Literature studies are used as a basis for conducting this research. The following is a summary of the literature used in this study:

1. Research conducted by (Reza Fachrur Rozi et al., 2021) using EVE-NG to implement Emulated Virtual Environment Simulation – New Generation (Eve-NG) (Case Study at SMKN 1 Buah Dua Sumedang – SMK PK) with static routing can lighten the performance of the router processor because processing is spread across each router and can also save bandwidth because no bandwidth is wasted when packet exchange occurs.
2. (Qin, 2023)successfully simulated network security hardware such as firewalls, web firewalls, logging platforms, but also built an infrastructure environment for network attacks and defenses.
3. This study (Andi & Dian, 2022) uses EVE-NG to simulate the implementation of the VRRP (Virtual Router Redundancy Protocol) protocol in sharing network loads (load sharing) on VLAN topologies. The results show that the use of VRRP increases network availability and ensures that connections remain stable even if one of the routers fails.
4. (Oliveira, 2020)discusses the benefits of using EVE-NG, a network emulator that allows simulation of multi-vendor network environments through a browser without the need for heavy software installation. This study develops a network simulation model between organizational units in different regions, using BGP, IPSec, and OSPF protocols to analyze and optimize network performance, while supporting organizational training and decision-making.
5. The importance of network virtualization in an increasingly connected world, with a focus on the use of EVE-NG as a free tool for simulating networks. This virtualization allows testing network configurations in a secure environment, reducing physical infrastructure costs, and increasing efficiency and flexibility in network management. This study designs and configures an enterprise network using EVE-NG to meet functional needs (Fornés, Tutor, Martínez, & Oscar, 2023).

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## METHOD

In implementing EVE-NG in this study, the method used is shown in Figure 1 below.

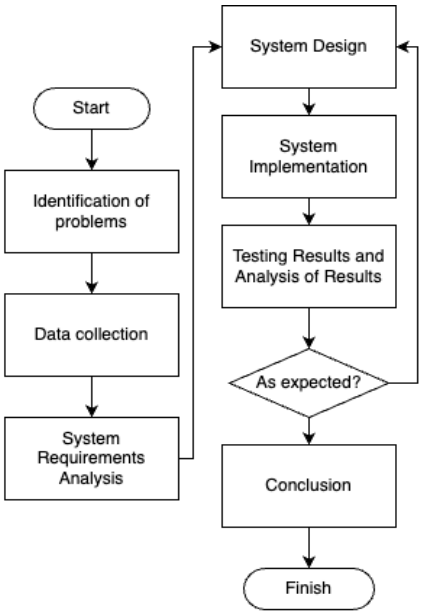


Figure 1. Research methods

**Problem Identification**

The constraint faced by the TRKJ Study Program is the inadequacy of the number of network hardware available for the number of students. This is due to the relatively expensive cost of network equipment and the diversity of network platforms used in the industry. This limitation hinders students' ability to gain valuable implementation experience, which is a key component in project-based learning.

Data Collection and System Requirements Analysis

The data collection method in this study was carried out through a literature study aimed at obtaining the system specifications needed in implementing EVE-NG. This literature study includes a review of various relevant reference sources related to infrastructure needs, both hardware and software. The main focus of this section is to identify hardware specifications that support optimal EVE-NG performance, as well as to understand the characteristics and features of the EVE-NG software to be developed and implemented. With this approach, the data obtained will be the basis for designing a system that suits your needs.

System Design

The design carried out includes the development of network infrastructure and topology that will be used as a basis for implementing EVE-NG. This design stage includes identifying system needs, selecting relevant infrastructure components, and creating a network topology scheme that is adapted according to learning needs and practical testing. The results of this design will be the basis for implementing and evaluating the effectiveness of EVE-NG implementation in teaching and learning activities.

System Implementation

After the design stage is complete, the research team continues with the implementation or development process of the EVE-NG system according to the specifications that have been set. This implementation includes the installation of the required hardware and software, as well as the configuration of the previously designed network topology. After the system is built, a thorough test is carried out to ensure that the system functions as expected and supports the effectiveness of project-based learning. This test includes testing the performance, stability, and ease of use of the EVE-NG system in computer network simulations and practices.

Testing and Analysis of Results

The results of the system testing are then analyzed in depth to evaluate the effectiveness of EVE-NG implementation in supporting project-based learning. The evaluation was conducted by distributing questionnaires to two classes in the Computer Network Engineering Technology Study Program, consisting of 3rd semester students in the Computer Network 3 course with a total of 65 respondents. This questionnaire was designed to measure the extent to which the use of EVE-NG was able to improve students' understanding of computer network concepts, ease of use, and practical benefits in network simulations. Based on the results of this evaluation, the research team can provide recommendations for improvements or further development of the EVE-NG system if necessary, to ensure that the system is increasingly effective and relevant to learning needs. Furthermore, in determining the number of samples

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taken as respondents using the Slovin formula, as follows (Umar;, 2010):

$$n = \frac{N}{1 + N\,(e)^2} \qquad (1)$$

Description:
n: Sample Size
N: Population Size
e: Percentage of tolerable sampling error, for example 5% or 0.05

Based on the formula, the number of samples is as follows:

$$n = \frac{65}{1 + 65\,(0{,}05)^2} = 55{,}914$$

Thus, the sample in this study was 53 student respondents in semester 3. Using the Slovin formula to obtain a sample of 56 respondents. Where respondents choose one of the five answer choices provided, namely strongly disagree (STS), disagree (TS), neutral (N), agree (S), strongly agree (SS), with a score range on positive items of 1-5. The questions in the questionnaire are listed in Table 1.

The main instrument used is a questionnaire designed based on five main indicators of usability testing, namely Learnability, Memorability, Efficiency, Errors, and Satisfaction. Each of these indicators was chosen because of its relevance in measuring user experience and effectiveness in using EVE-NG. The Learnability indicator measures the extent to which new users can complete basic tasks on their first use. This aims to assess how intuitive the interface and initial functionality of the platform are for users who are not familiar with EVE-NG.

The Memorability indicator, on the other hand, focuses on the user's ability to remember how to use the platform after not accessing it for a certain period of time. This test is important because it helps to understand whether users can easily recall the steps required to complete a task after a time lag. This is closely related to the interface design that supports repeated use and consistency of the user experience.

The Efficiency indicator measures the speed and ease with which participants achieve a specific goal using EVE-NG. It aims to assess the extent to which the interface facilitates the completion of tasks quickly and effectively. This criterion is essential for identifying aspects that may hinder user workflow and reduce productivity. In addition, an analysis of the Errors indicator was conducted to understand the level of errors made by users when using the system, including errors caused by ambiguity in menus or other interface elements.

Finally, the Satisfaction indicator measures the level of user satisfaction with EVE-NG. This criterion not only includes positive statements from users but also captures criticism and suggestions regarding aspects that need to be improved. By combining these five indicators into a questionnaire, researchers can obtain more comprehensive and accurate data regarding user experience. This questionnaire provides a reliable picture of user interaction with EVE-NG, so that it can be a basis for future system improvements.

Table 1. Coding and Questionnaire Statement Items

| Indicator | Code | Statements in the questionnaire |
|---|---|---|
| **Learnability (A)** | (A1) | EVE-NG can be learned easily |
| | (A2) | I can easily and quickly use EVE-NG |
| | (A3) | I can easily use EVE-NG |
| | (A4) | I can easily understand and comprehend EVE-NG |
| | (A5) | Without written instructions or manual books, I can learn to use EVE-NG |
| **Memorability (B)** | (B1) | I can easily remember how to use EVE-NG |
| | (B2) | I can easily find out and use the features on EVE-NG |
| | (B3) | I feel easy whenever using EVE-NG |
| **Efficiency (C)** | (C1) | I can quickly complete the case studies given on EVE-NG |
| | (C2) | I can easily complete the case studies given on EVE-NG |
| | (C3) | I can immediately complete the case studies given on EVE-NG |
| **Errors (D)** | (D1) | I did not find any errors when completing the case studies using EVE-NG |
| | (D2) | I did not find any menus that were errors or did not match their functions |
| | (D3) | I can find the features and menus I was looking for on EVE-NG |
| **Satisfaction (E)** | (E1) | I am happy with the interface design on EVE-NG |
| | (E2) | I feel comfortable using EVE-NG |
| | (E3) | The appearance and layout of the content are comfortable to look at |
| | (E4) | EVE-NG meets my expectations when I complete the case studies given |

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## RESULT

### EVE-NG Installation Results

In this study, the network infrastructure was successfully initialized and implemented using EVE-NG as an emulator. EVE-NG was chosen because of its advantages in simulating various types of network devices, such as servers, workstations, routers, switches, and network security devices. This emulator supports realistic and complex network topology modeling, making it very appropriate for this study. In this case, the selection of EVE-NG was based on its flexibility and capability that can accommodate various simulation needs of network devices from various vendors and platforms.

The preparation stage begins with the installation of the hardware and software needed to run EVE-NG. At this stage, all hardware components are configured to ensure compatibility and optimal performance. In addition, software installation includes setting up an operating system that supports the simulator and other supporting software. After the basic infrastructure is installed, the initial configuration is carried out to ensure that EVE-NG is ready to be used for testing various network scenarios. This preparation stage is very crucial because it determines the success of the network implementation that will be tested in the next stage.

The next step is planning and creating a network topology specifically designed to support multiplatform routing scenarios. This topology involves various network devices operating on different platforms, ranging from routers, switches, to servers. The main focus of this topology is the ability to route between platforms, so that each device in the topology is set to be able to communicate with other devices using standard routing protocols. With the help of EVE-NG, each virtual device can be flexibly connected, allowing network designers to customize the topology according to testing needs.

During the configuration process, the various devices available in EVE-NG are optimally utilized. Each device is configured to perform its specific task, and routing protocols such as OSPF (Open Shortest Path First) or BGP (Border Gateway Protocol) are enabled to ensure smooth communication between devices. This configuration stage involves setting IP addresses, configuring routing, and implementing network security policies. The entire process is carried out to ensure that different devices can communicate smoothly, regardless of differences in platforms and device vendors.

Connectivity testing is carried out using the ICMP (Internet Control Message Protocol) protocol by sending ping packets from one device to another. This test aims to verify that each device in the topology can communicate with each other properly. In addition, checking the response time and packet loss is also carried out to measure the quality of connectivity between devices. From the test results, it can be seen that all devices can communicate well, showing low latency and no significant packet loss.

The test results show that the network infrastructure built using EVE-NG is able to support multiplatform routing configurations efficiently. The use of ICMP as a connectivity verification tool has proven effective in detecting any problems that may arise during testing. With stable connectivity and smooth routing configurations, this study has successfully proven that complex network topologies can be built and tested using EVE-NG with very satisfactory results.

Overall, EVE-NG is a reliable and adequate tool for designing, modeling, and testing complex network topologies, especially in multiplatform routing scenarios. The emulator's ability to simulate various devices and network protocols makes it the right choice for network simulation purposes. Thus, this study makes an important contribution in underlining the effectiveness of EVE-NG as a comprehensive and reliable simulation platform in the development of more advanced network infrastructures in the future.

### Respondent Sample Results

This study used a purposive sampling method (Dolores & Tongco, 2007) in distributing questionnaires to obtain respondents. This method was chosen because it provides flexibility for researchers to selectively determine respondents who meet certain criteria that are relevant to the research objectives. The selection of respondents based on specific criteria is very important to ensure that the data collected has high relevance and provides an accurate picture of the use of EVE-NG among students who are the target of the study. This method was chosen because it allows researchers to set specific criteria that must be met by respondents to ensure that the data obtained is accurate and relevant.

The main criteria in this study were 3rd semester students in the Computer and Network Engineering Study Program (TRKJ), who had specifically never used EVE-NG before. The selection of these 3rd semester students was not without reason, but because they were taking the Computer Network 3 course this semester. This course is closely related to complex network concepts, so the use of EVE-NG as a network simulation tool is relevant in the context of their learning.

In addition, 3rd semester students are considered to be at the right stage to explore and learn to use network simulation tools such as EVE-NG. With the background of the courses they take, it is expected that they will be able to provide significant feedback regarding ease of use, efficiency, and challenges that may be faced when using the EVE-NG platform. The match between their academic background and the use of EVE-NG is a strong basis for selecting them as respondents for this study. As new users who have never interacted with EVE-NG, 3rd semester students can

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provide an objective picture of the level of difficulty or ease in learning this system. This also opens up opportunities for researchers to identify potential obstacles that may be faced by new users and how their first experience can be optimized. The data collected through questionnaires from these respondents is expected to provide useful insights for further improvements in the use of EVE-NG in academic environments.

Table 2. Number of Sample Respondents

| Gender | Frequency |
|---|---|
| **Male** | 33 |
| **Female** | 20 |
| **Total** | 53 |

Table 2 in this study shows the distribution of the number of respondents involved in filling out the questionnaire, as well as their distribution based on predetermined criteria. This table provides a clear visualization of the number of students who participated and provided responses, thus providing a deeper picture of the population representation in this study. The use of purposive sampling not only strengthens the validity of the results, but also ensures that the perspectives obtained are truly relevant to the context of EVE-NG use in academic environments.

**Usability Testing Results**

To see the usability testing using descriptive statistical calculations, where the results of the questionnaire question category indicators use the average and are divided into five categories and assessment ranges as in table 4.

Table 3. Categories and Rating Ranges

| Interval | Categories |
|---|---|
| **0 < 1** | Very Bad |
| **1 < 2** | Quite Bad |
| **2 < 3** | Good |
| **3 < 4** | Quite Good |
| **4 =< 5** | Very Good |

If the average value of usability testing is in the range of 0 to less than 1, then EVE-NG is categorized as very bad. Furthermore, if it is in the range of 1 to less than 2, EVE-NG is considered to have a fairly bad assessment. For a range of values 2 to less than 3, EVE-NG is considered quite good, while in the range of 3 to less than 4, EVE-NG is said to be good. EVE-NG will be declared very good if it gets a value in the range of 4 to 5. This value grouping helps in identifying the quality and performance of EVE-NG based on the results of usability testing. In addition, these results are also strengthened by the analysis of qualitative data obtained from the transcription of open-ended questions, which provide deeper insights into the user experience. The combination of quantitative assessment and qualitative data provides a more comprehensive picture of the quality and user satisfaction with the EVE-NG being tested.

Table 4. Total Average of Each Usability Indicator

| Indicator | Code | Average |
|---|---|---|
| **Learnability (A)** | (A1) | 2,963 |
| | (A2) | 2,775 |
| | (A3) | 3,116 |
| | (A4) | 3,004 |
| | (A5) | 3,078 |
| **Memorability (B)** | (B1) | 2,923 |
| | (B2) | 2,714 |
| | (B3) | 2,849 |
| **Efficiency (C)** | (C1) | 2,736 |
| | (C2) | 3 |
| | (C3) | 3,337 |
| **Errors (D)** | (D1) | 2,887 |
| | (D2) | 2,908 |
| | (D3) | 2,998 |
| **Satisfaction (E)** | (E1) | 3,019 |
| | (E2) | 2,794 |
| | (E3) | 3,167 |
| | (E4) | 3,21 |

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Based on the results of the usability testing of EVE-NG, five main indicators were identified, namely Learnability, Memorability, Efficiency, Errors, and Satisfaction. Each indicator received an average value ranging from 2 to 4 as shown in Table 4, indicating that EVE-NG performed quite well in terms of ease of use and overall user experience. Overall, the results of this test provide important insights into the quality of the interface and functionality of the EVE-NG system, which can provide a relatively positive user experience although there are still some areas that can be improved.

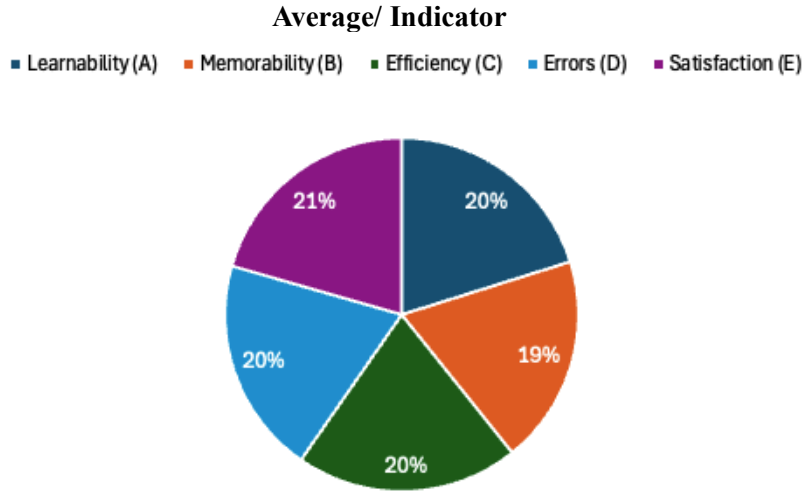


Figure 2. Average/ Indicator

Based on Figure 2, the Learnability indicator received an average score of 2.98, which places it in the "good" category. This indicates that EVE-NG is quite easy to learn for new users, especially for those who are not familiar with the platform. However, some users indicated that some interface elements require initial adaptation before they can feel comfortable using it. Although the system is designed to be intuitive, there are elements that can be further simplified to improve the user experience, especially in the early stages of interaction with the system.

Memorability received an average score of 2.82, also in the "good" category. This indicates that users are generally able to remember how to use EVE-NG even after not accessing it for some time. However, some users reported challenges in remembering the location of certain menus or functions, especially if they rarely use the platform. Although the EVE-NG interface is designed to support ease of repeated use, there are certain aspects that can be improved to make it easier for users to find the features they need.

In the Efficiency indicator, the average score obtained was 3.02, which falls into the "fairly good" category. This indicates that users can achieve their goals with a sufficient level of efficiency. However, some users noted that there were aspects of the interface that could slow down the workflow, which in turn affected the speed and effectiveness of the system. Overall, however, the system was considered to be quite easy to use and supported good task completion, with potential for further optimization to be more efficient.

The Errors indicator showed an average score of 2.93, indicating a relatively low error rate during EVE-NG use. This means that users generally do not make frequent errors when interacting with the system. However, there are still some areas where the interface can be ambiguous, leading users to make avoidable errors. Further refinement of this interface could reduce user errors and improve the clarity of interactions, especially in terms of navigation and menu selection.

The Satisfaction indicator received the highest average score, at 3.04, which places it in the “fair” category. Users were overall satisfied with the system offered by EVE-NG, although there were some areas that they highlighted for further improvement, such as increasing the speed of the system and simplifying the interface. This level of satisfaction reflects that while users had some minor complaints, they still felt that EVE-NG provided an adequate experience in terms of usability and functionality.

Qualitative data analysis of the open-ended question transcripts provided further context to the quantitative results. While some users expressed positive feedback regarding EVE-NG’s flexibility and simulation capabilities, they also noted that the interface navigation and system response times could be improved. Combining quantitative and qualitative data allows for a more comprehensive understanding of what works well and what areas need improvement from a user perspective.

Overall, the results of this usability study provide a fairly clear picture of how EVE-NG works to support its users. While it is already at a good level, there is still room for improvement in several areas, especially in terms of increasing efficiency and reducing interface errors. The combination of quantitative assessment results and qualitative insights from users provides recommendations that can be taken for future development of EVE-NG to better meet the needs of its users.

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## DISCUSSION

In this study, the test results obtained showed that EVE-NG was successfully used to build and implement complex network infrastructure. The selection of EVE-NG as a simulation platform was based on its superior ability to simulate various network devices, such as routers, switches, servers, workstations, and security devices. This advantage makes EVE-NG the right tool for modeling realistic network topologies in various network simulation scenarios, especially in multiplatform routing configurations. In addition, EVE-NG's flexibility in supporting various devices from various vendors and platforms is the main reason why this emulator is used in research.

The initial installation and configuration process of EVE-NG involves comprehensive hardware and software settings to ensure compatibility and optimal performance. This stage is very crucial, because the right configuration at the initial stage will determine the success of the network simulation. After the basic infrastructure is installed, the initial software configuration is carried out to ensure that the emulator is ready to use in various network test scenarios. The operating system settings and other supporting software are also adjusted to support various needs in realistic network device simulations.

The next important step is designing a network topology to support multiplatform routing scenarios. The designed topology includes devices running on various platforms and must be able to communicate with each other. The configuration process involves setting up standard routing, such as OSPF (Open Shortest Path First) or BGP (Border Gateway Protocol), which allows different devices to communicate efficiently. EVE-NG's ability to enable flexibility in network topology greatly supports the success of this simulation, because each device can be connected and configured virtually as needed.

Furthermore, connectivity testing is carried out using the ICMP (Internet Control Message Protocol) protocol to verify the smooth communication between devices in the topology. By sending ping packets from one device to another, the quality of connectivity is tested based on response time and packet loss. The test results show that all devices can communicate with each other without significant obstacles, with low latency and without significant packet loss. This confirms that the routing configuration is running well and the network topology that is built is stable.

The results of this test show that EVE-NG is able to support complex network simulation scenarios, especially for multiplatform routing configurations. The use of the ICMP protocol as a connectivity verification tool has proven effective in detecting potential problems, as well as ensuring that all devices in the topology can function as expected. The stability and reliability of connectivity between devices are indicators of the success of the testing process.

In addition, this study also provides insight into the capabilities of EVE-NG as a reliable simulation platform. Its advantages in supporting various protocols and network devices, both in terms of routing and security, indicate that this emulator is the right choice for research and development of network infrastructure. This study has successfully proven that network simulations with high levels of complexity can be implemented and tested efficiently using EVE-NG.

Overall, the effectiveness and flexibility of EVE-NG as a network emulator with satisfactory results from this test, EVE-NG has proven to be a very adequate platform for designing, modeling, and testing network topologies, especially in scenarios that require multiplatform routing. This is a strong foundation for further development in the future.

## CONCLUSION

Based on the results of the usability testing of EVE-NG, it can be concluded that overall this platform shows quite good performance in supporting users. The five main indicators tested—Learnability, Memorability, Efficiency, Errors, and Satisfaction—give an overview that EVE-NG is quite adequate in terms of ease of use and user experience, although there are some areas that still need improvement.

The Learnability and Memorability indicators show that EVE-NG is quite easy to learn and remember, especially for new users, although some interface elements still need further adaptation and simplification. Users reported challenges in remembering the location of certain menus or features, indicating that improvements in the layout of the interface would improve user comfort, especially for those who rarely access the platform.

In terms of Efficiency and Errors, EVE-NG has shown good performance in supporting task completion with a low error rate. However, some aspects of the interface that slow down the user's workflow need to be optimized to improve efficiency and reduce the potential for errors. Improvements in navigation and clarity of features would be very helpful in streamlining the workflow and minimizing ambiguity in use.

The Satisfaction indicator, which scored the highest, reflects a good level of user satisfaction with the platform, although some improvements related to system speed and interface are still needed. Overall, the results of this study indicate that EVE-NG is already at a good level, but with further improvements, the platform can be more optimal in supporting users, especially in the context of more complex and efficient network simulations.

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