# MANAGEMENT INFORMATION SYSTEM MODEL TO INCREASE PERFORMANCE OF EDUCATIONAL LABORATORY

**Restu, Sriadhi, Gultom S., Baharuddin***

**Abstract:** The low performance of educational laboratories managed manually has a negative impact on the students' learning outcomes. This study aims to compare the performance of laboratories which implement the MISLab as the information systems management to the performance of laboratories managed manually. The study was conducted in 18 Vocational Schools in North Sumatera Province of Indonesia, involving 36 laboratory managers, 54 practicum teachers, and 90 students of educational laboratories. The finding of this study showed that the implementation of MISLab succeeded in improving the performance of educational laboratories with 88.45% achievement of ideal standard and contributed to the 55.52% performance improvement compared to manual laboratory management. The increased laboratory performance has a positive impact on increasing the satisfaction of laboratory managers and students as users, which will lead to enhanced learning effectiveness and achievement of learning outcomes.

**Keywords:** management information system, laboratory performance, satisfaction, laboratory management, learning management

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## Introduction

Laboratory inventory goods and equipment are the vital components that determine the practicum learning process. For Technology Vocational High School, which is full of practical laboratory learning, laboratory management must support the effectiveness of the practicum process(Sriadhi, 2016). The laboratory's ability to meet the users' needs is a measure of laboratory performance achievement. Over the years, scholars have highlighted the significance of laboratory training and how it influences the ability of schools to produce quality graduates. Furthermore, attempts have been made to examine how management systems can be used to

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improve laboratory performance. According to Taufik (2009), most learning institutions in developing nations have not been able to create and use effective laboratory management systems for educational activities. Research has shown that the manual management methods that have been adopted in some learning institutions can lower laboratory performance. Furthermore, the model can increase the risk of equipment damage and the reliability of information gathered in the labs (Xiaoping et al., 2009). Research further shows that the lack of efficient management systems in such institutions can adversely affect laboratory performance and make it impossible for the schools to produce excellent graduates(Sriadhi, 2017). Moreover, there is a need to develop a model for laboratory information systems that reflects on the needs of users. Such systems may be used as the basis for improving laboratory training and ensuring that students acquire the skills they need to succeed in the market (Agus et al., 2014). Hashim and Arufin (2013), Baharuddin and Dalle (2019), and Dalle et al. (2015), reported that Information Management systems could be used for various purposes in the education sector. The first major function is the classification of different items and parameters, such as procurement time, quantity, and instrument specifications. Second, learning institutions can use these systems to conduct forecasting operations. In particular, forecasting relates to different subjects such as life, inventory use, replacement, and maintenance (Hashim & Arifin, 2013). The third major purpose of the systems relates to the recording of laboratory performance. The documentation process entails measuring factors such as the Mean Absolute Deviation (MAD), Economic Order Quantity (EOQ), Economic Production Quantity (EPQ), Tracking Signal Range (TSR), and the Mean Square Error. In some cases, the models can be used to fulfill and track inventory transactions. Therefore, the systems are critical as they improve the performance of learning institutions and help enhance the results of graduates released to the market.

## Literature Review

Governments around the world have always accorded high priority to training and education. Furthermore, many countries have legal documents and laws that are meant to promote education (Krayneva, Bugaev, Zhuravleva, & Vojtovič, 2017). In recent years, the growth in the global population has led to an increase in the number of students in schools. A major effort has been made to enhance educational relevance, quality, and opportunities. In particular, the inability of the management to provide sufficient support systems has adversely affected the operations of schools and the nature of services that students get. In some cases, the learning institutions used the poorly managed and manual filing systems to store data (Sriadhi, 2017). The rising demand for up-to-date and reliable data by

international and local users has created a need to improve the existing management and support systems. Management Information Systems have been identified as one of the viable options that can be used to improve data management in learning institutions (Belas, Dvorský, Strnad, Valášková, & Cera, 2019). However, the actual uptake and implementation of the system have also been affected by a wide range of factors, including resource constraints and lack of training among the users. Despite this being the case, Management Information Systems remain a critical tool that can be used to generate reliable and quality information required to improve educational processes. Therefore, there is a need to explore how such systems can be adopted in laboratory processes in various training institutions.

Technology has been identified as one of the primary factors that can help improve and transform the Indonesian healthcare system. In particular, experts and the government believe that technology can help enhance the capability, capacity, and affordability of the nation's health system (Sriadhi, 2017). Therefore, hospitals have been working towards adopting innovative technologies to improve access to services and reduce the cost of services, especially among the remote communities. Although technology may not solve all the challenges within the Indonesian healthcare systems, it provides innovative ways for diagnosing conditions, delivering medicine, and monitoring patient's responses to therapy (Bujan, 2020). Furthermore, healthcare practitioners are using technology to exchange information and promote close collaboration with the government and the private sector. The process has helped in enhancing how data is used to make vital day to day decisions in the medical field (Kot & Ślusarczyk, 2014).

There is extensive literature highlighting how technological solutions have been used to improve the healthcare system (Sriadhi, 2017). Furthermore, literature shows that innovative solutions provide a basis for improving access to care and the quality of services delivered to patients. However, minimal attention has been directed towards the understanding of the use of management information systems in the educational laboratories. Moreover, there is insufficient evidence showing the extent to which the educational laboratories have used the management information systems to enhance the quality of care given to patients. Therefore, there is a need to conduct further investigations to examine how such systems have affected laboratory services in Indonesia. This study applies the management information system model of educational laboratory based on the users' needs, with the program modules of (a) Manager, (b) Coding and Numbering, (c) Circulation, (d) Maintenance, (e) Report. The information system is developed based on the multimedia, with the output in the form of text and 3D visualization, the data input system is done both manually and using the barcode scanning system. The use of this information system will allow the measurement of laboratory performance, including the aspects of the Coding System, Data Entry, Transaction, Output

System, Controlling, Report, and Security, which become the indicators of laboratory performance. Moreover, the study was done to compare how the adoption of the MISLab could change information management systems and increase the satisfaction level among managers, teachers, and students.

## Materials and Methods

The current study was done to examine the impact of laboratory information system management (MISLab) laboratory performance. The process entailed comparing the level of performance after the adoption of MISLab with that associated with the manual management system. MySQL based MISLab software is built by following the System Development Life Cycle (SDLC) method with four stages: (a) Investigation system, (b Analysis system, (c) Design system, and (d) Implementation system(Whitten, Bentley, & Dittman, 2001). The SDLC method is widely used in the design of information systems because it has a complete cycle based on the users' needs. The feasibility of this software is tested by Stub Testing, Unit Testing, Black Box Testing and White Box Testing, and Integration Testing. MISLab test results have a high degree of eligibility. This software has also been developed for inventory management(Sriadhi, 2016). The MISLab model was based on the multimedia and output shown below.


**Figure 1: Display inventory specification**

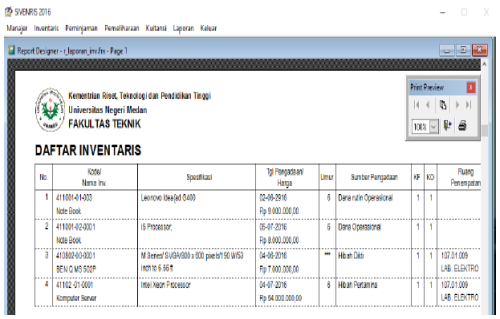


**Figure 2: Display inventory list**

MISLab was designed to identify in detail each inventory encoded in the form of detailed numbering along with a 3D image. The inventories provided extensive information about inventory equipment so that the quality of service can be improved by using this MISLab as the educational laboratory management.

The data and information were obtained directly from the primary source of 18 proportionally selected Vocational Schools of Technology in North Sumatra Province of Indonesia. From each school, two laboratory managers, three practicum teachers (users), and five students (users) were chosen. The overall respondents consisted of 36 laboratory managers, 54 teachers, and 90 students so that the total was 180 respondents. Laboratory performance data was obtained from

the laboratory managers by using the laboratory performance measurement instruments covering seven indicators: coding system, data entry, transaction, output system, controlling, reporting, security system(Sriadhi, 2016). MISLab usage satisfaction data was obtained from the laboratory staff as laboratory managers, teachers, and students as users. Satisfaction data was measured by using a valid and reliable questionnaire with the satisfaction indicators covering the aspects of the system workflow, service time speed, transaction accuracy, access quality information, and easy (friendly) system.

This study was conducted to compare the laboratory performance in two conditions: before and after. The condition before was when the laboratory management is done manually, while the condition after was the condition when the laboratory management applied the MISLab and is measured after seven months of its use. The satisfaction variable after the condition was measured after the MISLab has been used for seven months. The analysis of laboratory performance data using descriptive statistics was done by calculating the average score of performance under the manual management condition (before). The score was then compared to the implementation of MISLab (after), to find out the score gained and its interpretation. The formula for calculating the gained score is:

$$3. \quad \Delta x = \Sigma (Xa\text{-}Xb) \qquad (1.1)$$

The data analysis of satisfaction was done by comparative statistic using t-test (one mean) with mean ideal at least 80% ($\mu \geq 20.00$), using the formula:

$$4. \quad t = \frac{x - I\_}{s/a\hat{}\_n} \qquad (1.2)$$

The tests used a one-tail test with t (α; n-1) each for the laboratory manager respondents, practicum teachers, and students.

## Results and Discussion

### *Educational Laboratory Performance*

The results of laboratory performance measurements obtained from the managers indicated substantial differences, with a gained score exceeding 50% between the manual laboratory management and the management system using the MISLab, as shown in Table 1.

**Table 1: The description of data on the performance score of educational laboratories in vocational schools**

| No | | Aspects | Performance Indicators | Before (Manual) | | After (MISLab) | | Delta |
|---|---|---|---|---|---|---|---|---|
| | | | | score | mean | score | mean | |
| A | 1 | Coding of inventory | Variance of inventory | 43.20 | | 84.25 | | |
| | 2 | | Group of inventories | 21.40 | | 83.50 | | |
| | 3 | | Inventory name | 82.40 | | 95.45 | | |
| | 4 | | Production time | 53.60 | 40.56 | 98.25 | 88.17 | 47.61 |
| | 5 | | Corporate | 12.40 | | 86.35 | | |
| | 6 | | Specification | 32.50 | | 82.50 | | |
| | 7 | | Numbering | 46.20 | | 92.58 | | |
| | 8 | | Detail profile | 32.80 | | 82.50 | | |
| B | 1 | Data input | Time used | 21.20 | | 82.80 | | |
| | 2 | | Work resource | 12.60 | | 92.50 | | |
| | 3 | | Accurate of data | 32.50 | 28.13 | 82.50 | 85.35 | 57.23 |
| | 4 | | Documentation | 46.20 | | 83.60 | | |
| C | 1 | Transaction | Record | 46.80 | | 84.50 | | |
| | 2 | | Rent transaction | 58.60 | | 82.80 | | |
| | 3 | | Return transaction | 24.50 | | 76.50 | | |
| | 4 | | Circulation transaction | 25.80 | 33.95 | 83.60 | 83.33 | 49.38 |
| | 5 | | Check-recheck transaction | 24.50 | | 85.00 | | |
| | 6 | | Verification transaction | 23.50 | | 87.60 | | |
| D | 1 | Output | Action time | 21.50 | | 98.20 | 98.10 | |
| | 2 | | Accuracy | 35.00 | 28.25 | 98.00 | | 69.85 |
| E | 1 | Controlling | Allocation | 34.20 | | 83.50 | | |
| | 2 | | Reschedule | 22.15 | | 82.50 | | |
| | 3 | | Maintenance | 32.60 | 30.09 | 85.40 | 81.80 | 51.71 |
| | 4 | | Planning (use) | 31.40 | | 75.80 | | |
| F | 1 | Report | Finance report | 18.50 | | 82.50 | | |
| | 2 | | Inventory variance | 10.15 | | 95.25 | | |
| | 3 | | Group of inventories | 32.25 | 24.46 | 95.25 | 91.15 | 66.69 |
| | 4 | | Function of inventory | 41.25 | | 87.50 | | |
| | 5 | | Report per unit | 20.15 | | 95.25 | | |
| G | 1 | Security | Error protection | 18.45 | | 84.40 | 88.45 | 67.48 |
| | 2 | | Fail protection | 23.50 | 20.98 | 92.50 | | |
| TOTAL | | | | 31.67 | | 87.19 | | 55.52 |

From the data collected, it was apparent that the overall performance of manually managed educational laboratories only meets 31.67% of ideal standards to be achieved. Whereas, after applying the information management system using MISLab, 87.19% of ideal standards can be achieved. This means that the

implementation of system management using MISLab can improve the performance of 55.52%, which can be categorized as very high.

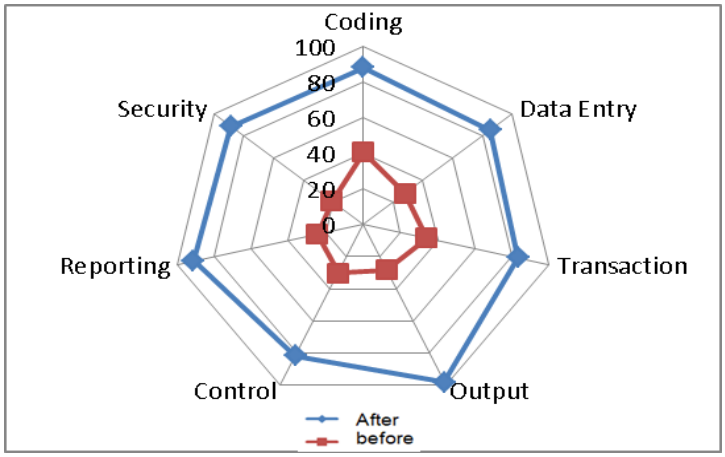


**Figure 3: Comparison of laboratory performance indicators**

Figure 3 shows that the management performance of manually managed educational laboratories is very low, especially in security, reporting, control, and output aspects, and overall laboratory performance is below 50% of the ideal standard. MISLab-based information systems had a high performance on all aspects of service indicators. The findings implied that the management of MISLab-based information systems improved the performance of educational laboratory services, which reaches an average of 87.19%, with an increase of 55.52% from manual management.
The outcome of the statistic calculations is shown in Table 2 below.

**Table 2: Summary of data analysis satisfaction used t-test**

| No | Respondent | n | x | t | $t_t$ |
|---|---|---|---|---|---|
| 1 | Lab. Manager and staffs | 36 | 20.94 | 2.99 | 2.03 |
| 2 | Teachers | 54 | 19.37 | -2.39 | 2.01 |
| 3 | Students | 90 | 20.59 | 2.52 | 1.99 |

Based on the results of statistical calculation, as shown in Table 2, it is apparent that the laboratory managers were satisfied with the implementation of the MISLab system as the mean $x_1$ was 20.94 and $t > t_t$, Furthermore, the group of practicum teachers ($X_2$), reported a mean $x_2$ of 18.19 with $t < t_t$. The results imply that the level of satisfaction with MISLab implementation among the teachers was not

significant. For the student group ($X_3$), the mean $x_3$ was 20.59 with $t > t_t$. The results indicated a high level of satisfaction with the use of using MISLab.

The analysis results of each performance indicator showed a low-security level in manual laboratory management. In the manual system, meet 20.98% of the ideal standard, followed by a 24.46% reporting system and 28.13% system output while the implementation of the MISLab-based management system can improve the performance up to 67.48%; 66.69% and 57.28% for the three indicators. In the manual laboratory management, the inventory security system is not prepared, be it the usage time record or calibration and maintenance time. This condition becomes the originator of equipment damage. While in the MISLab-based management system, all recorded data and warnings for maintenance will appear in the system, so that the appropriate management steps can be taken. Likewise, the reporting system is done manually without the standard format, while MISLab has provided complete and accurate reporting facilities based on the existing data. The output system on MISLab has also provided a very comprehensive facility, not only text and table data, but also visual data from the necessary information through the system.

The most urgent management aspect of being improved is on the reporting aspect based on the inventory type (10.15%), which has been difficult for the inventory laboratory equipment based on its type. By implementing the MISLab-based management system, the weakness can be corrected by 95.25% achievement, with an increase of 85.10%. This is understandable because by using MISLab, the inventory data collection is done in detail, starting from the inventory group, type, specification, name, and the order of equipment and space or the unit of placement of the equipment, which is all arranged in the database system. These data are then easy to be processed and able to produce reports quickly, accurately, and representatively. The system enables the accuracy of the performance achievement of 95.25%, which is near perfect. Besides, if the input data is done completely, the output system will also meet the needs. Similarly, other performance indicators are very low on the manual system and can be upgraded by the implementation of the MISLab management system. The manufacturer data and inventory specifications can be increased by 73.95%, 79.90% labor savings, 64% financing report, and 61.60% ideal standards.

## Discussion

The use of MISLab in healthcare facilities is a practice that has been adopted in many hospitals around the world. However, the actual impact of the systems in terms of laboratory performance and user satisfaction is not well elucidated. In the present study, the focus was on comparing laboratory performance in a setting where MISLab is used and facilities that rely on manual data management methods.

The results gathered during the study showed that there was a significant difference between MISLab and manual systems in terms of laboratory performance. In particular, the performance score in the MISLab-based system was twice as much as the figures recorded in the case of a manual model. The results are in agreement with findings from previous studies by Shang et al. (2008) and Godana and Ngugi (2014), where the management information systems have been linked to higher performance levels compared to the manual management methods. The difference may be attributed to the various benefits of the automated systems such as reduced cases of medical error, increased storage and processing capacity, and rapid access to accurate and reliable information (Godana & Ngugi, 2014). Furthermore, the MISLab system allows caregivers to exchange information that can be used to make evidence-based decisions during the care provision process.

The results of the current study also revealed the extent to which the implementation of management information systems could affect the ability of the caregivers to achieve performance standards. From the data collected, the overall performance of manually managed educational laboratory meets 31.67% of ideal standards to be achieved. In the case of the MISLab system, it was possible to achieve about 87.19% of ideal standards. The difference in the figure indicated the superiority of the MISLab system over the manual one. In recent years, hospitals and healthcare facilities have been working towards meeting set healthcare standards. The services offered in the laboratories can determine whether the quality of care standards will be met or not. The results of this study are in line with previous studies conducted by Shang et al. (2008), Godana and Ngugi (2014), Graciela (2013), and Taufik (2009). From the results of the current study, it is evident that healthcare organizations can utilize MISLab systems as a tool for improving healthcare quality and meeting quality standards.

The MISLab-based laboratory management system records the most optimal result on the output system indicator, which is from the aspect of velocity-time and accuracy data in lab equipment inventory service, reaching 98.10% from the ideal standard. The results indicated the advantages of the laboratory inventory management over the manual system that is linked to long turnover time and cumbersomeness. The results are supported by previous studies by Godana and Ngugi (2014) and Spyridakos et al. (2008), where it was reported that management information systems could improve the data management process in the laboratory systems. In particular, the researchers noted that the use of innovative systems in the model allows for rapid access and processing of data. Furthermore, Spyridakos et al. (2008) noted that the rapid manner in which information is relayed through the management information system means that healthcare practitioners can make timely decisions regarding the conditions of the patient.

The level of satisfaction with the information management methods used in the laboratory differed across the population samples. The analysis result of the

satisfaction level from the three groups above shows that the laboratory manager had a higher satisfaction level than the student group. This is understandable because managers realize the big support provided by the information system management using MISLab compared to manual management, while the students only use the laboratory for practicum. From the managers, all laboratory services should be prepared to provide students with optimal services as users, and the use of MISLab is really helpful for improving laboratory performance. Thus, this is quite understandable if the level of satisfaction of the laboratory managers is higher than the level of student satisfaction. In contrast, the level of teacher satisfaction cannot be considered as high, though it is not low. Teachers only use the laboratory to fulfill the obligation as a practicum instructor for the students, while the laboratory services are managed by the laboratory assistant. Teachers are not involved in the laboratory management, but more to the use of laboratory equipment prepared by the laboratory managers. Therefore, they may not have the same feeling about the management information system as the laboratory staff who use them on a day to day basis.

## Conclusion and Recommendations

Based on the results of the research analysis, it can be concluded that the application of an information management system using MISLab is able to improve laboratory performance with very high achievement, which is overall able to increase 55.52% compared to the manual laboratory management. Laboratory performance achievements using MISLab can meet 88.45% of ideal standards. Improving laboratory performance has a positive impact on the increase of satisfaction from the laboratory managers and the students as the users so that the satisfaction level of the two groups is high on the information system management using MISLab, although it is not the case with the group of practicum teachers. The increased performance of laboratories contributes to the improvement of the managers' and students' satisfaction. It will have a positive impact on improving the effectiveness of teaching practicum, which in turn will improve the students' learning outcomes. Although the study provides vital information regarding the use of management information systems in laboratories, it has certain limitations that should be taken into account. The first limitation is that the study population was obtained from a sample population of managers, teachers, and students from the North Sumatra Province, Indonesia. Therefore, generalizing the findings to a different population may be a challenge. Second, the purposeful selection of vocational schools of technology in the region may have introduced selection bias in the study. Finally, the nature of MISLab system adopted in the schools was not considered as one of the variables despite the fact that it could affect laboratory performance. The limitations notwithstanding, the study offers vital insights on the

importance of technology in laboratory operations. Therefore, there is a need for hospitals to utilize MISLab systems to improve performance and the quality of care given to patients. Second, healthcare practitioners should be trained on the importance of MISLab and how they can use the tool in the course of their work. In terms of research, further investigations are needed to assess how the nature and features of MISLab systems utilized in a hospital can affect laboratory performance and user satisfaction levels.

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## MODEL SYSTEMU INFORMACJI ZARZĄDZAJĄCEJ, BY ZWIĘKSZYĆ WYDAJNOŚĆ LABORATORIUM EDUKACYJNEGO

**Streszczenie**: Niska wydajność laboratoriów edukacyjnych zarządzanych ręcznie ma negatywny wpływ na wyniki uczenia się uczniów. Niniejsze badanie ma na celu porównanie wydajności laboratoriów wdrażających MISLab jako zarządzanie systemami informatycznymi z wydajnością laboratoriów zarządzanych ręcznie. Badanie zostało przeprowadzone w 18 szkołach zawodowych w prowincji North Sumatera w Indonezji, z udziałem 36 kierowników laboratoriów, 54 nauczycieli praktycznych i 90 uczniów laboratoriów edukacyjnych. Wyniki tego badania wykazały, że wdrożenie MISLab z powodzeniem poprawiło wydajność laboratoriów edukacyjnych, osiągając 88,45% osiągnięcia idealnego standardu i przyczyniło się do poprawy wydajności o 55,52% w porównaniu z ręcznym zarządzaniem laboratorium. Zwiększona wydajność laboratorium ma pozytywny wpływ na zwiększenie zadowolenia kierowników laboratorium i studentów

jako użytkowników, co doprowadzi do poprawy efektywności uczenia się i osiągania efektów uczenia się.

**Słowa kluczowe**: system informacji zarządczej, wydajność laboratorium, satysfakcja, zarządzanie laboratorium, zarządzanie uczeniem się

**增加管理信息系统模型 教育实验室的表现**

**摘要**:人工管理的教育实验室的绩效低下会对学生的学习成果产生负面影响。本研究旨在比较将 MISLab 作为信息系统管理的实验室的性能与手动管理的实验室的性能。这项研究是在印度尼西亚北苏门答腊省的 18 所职业学校中进行的，其中包括 36 名实验室经理，54 名实习教师和 90 名教育实验室的学生。这项研究的发现表明，MISLab 的实施成功地提高了教育实验室的绩效，达到了 88.45%的理想标准，与人工实验室管理相比，其绩效提高了 55.52%。实验室性能的提高对提高实验室管理者和学生作为用户的满意度具有积极影响，这将导致学习效率的提高和学习成果的实现。

**关键词**:管理信息系统实验室绩效满意度实验室管理学习管理