OPTIMIZATION OF THE USE OF SCANNING ELECTRON MICROSCOPY (SEM) EQUIPMENT IN THE CHEMICAL ENGINEERING DEPARTMENT OF LHOKSEUMAWE STATE POLYTECHNIC

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ABSTRACT

The purpose of this training is to optimize the use of chemical engineering laboratory equipment, namely Scanning Electro Microscopy (SEM), to improve the understanding and experience of students of the Lhokseumawe State Polytechnic, Department of Chemical Engineering. The methods used in this community service activity are intensive training, preparation of efficient usage protocols, and integration of SEM analysis results in research and teaching projects. At the end of this training activity, a question and answer session and assistance in the use of the tool were held to strengthen students' understanding of the training provided. Community service activities on optimizing the use of the Scanning Electro Microscopy (SEM) tool have been running well and optimally, and training participants stated that they were able to operate the tool and understand how to analyze samples using the Scanning Electro Microscopy (SEM) tool.

Keywords:*Laboratory,SEM,Chemistry,Optimization*

1. INTRODUCTION

The use of modern technology in education and research is the key to improving the quality of human resources, especially in the field of engineering. One of the most important tools in material analysis is Scanning Electron Microscopy (SEM). SEM provides the ability to visualize the microstructure and analysis of material composition with high resolution, making it an essential tool in research in chemical engineering departments [1].

In the Chemical Engineering Department of Lhokseumawe State Polytechnic, the use of SEM has great potential to support the learning and research process. However, even though this tool is available, its use is often not optimal. Several factors that contribute to this include the lack of adequate training for users, limitations in standard operating procedures, and the lack of integration of analysis results into the curriculum and research activities. This condition results in low student understanding of SEM applications and the potential for material analysis that can be carried out.

Therefore, this community service aims to identify and develop strategies for optimizing the use of SEM in the Chemical Engineering Department of Lhokseumawe State Polytechnic. The main focus of this community service includes improving user skills through intensive training, developing efficient usage protocols, and integrating SEM analysis results into research and teaching projects. It is hoped that these steps can improve students' abilities in conducting material analysis, as well as encourage more innovative and relevant research [2].

With this optimization, it is expected that SEM will not only be an analysis tool, but also a driver of collaboration between students and lecturers in research projects, as well as improving the quality of research results produced. This is in line with the goal of Lhokseumawe State Polytechnic to

produce competent graduates who are ready to face challenges in the industrial world. Through this service, we are committed to making a meaningful contribution in maximizing the use of SEM, so that it can function effectively in supporting education and research in this department.

Some of the reasons underlying this urgency are as follows:

1. Improving the Quality of Education: By maximizing the use of SEM, studentswill gain a better understanding of material analysis. This is important to prepare them to face challenges in the industry, where in-depth analytical skills are needed.

2. Developing Student Competence: Optimizing SEM through training and standard operating procedures will improve students' practical skills. This is very important in producing graduates who are ready to work and able to contribute significantly in the field of chemical engineering [3].

3. Innovation in Research: SEM is an essential tool for research in the field of materials. By increasing the use of SEM, the department can produce more innovative and relevant research, thereby improving academic reputation and contribution to the development of science.

4. Integration of Analysis Results into the Curriculum: Through this service, SEM analysis results can be integrated into teaching materials, making learning more contextual and applicable. This will encourage student interest and involvement in research.

5. Supporting Institutional Policy: Optimizing the use of SEM is in line with the vision of Lhokseumawe State Polytechnic to improve the quality of education and research. Thus, this article will contribute to the achievement of institutional goals.

6. Readiness to Face the Industrial Era 4.0: In today's digital and automation era, the ability to use sophisticated tools such as SEM is very important. This optimization will help students understand the latest technology that is relevant to industrial developments [4].

METHOD

This section describes several stages of the community service implementation process, starting with identifying needs, socialization and training, as well as assistance in using the Scanning Electron Microscopy (SEM) tool.
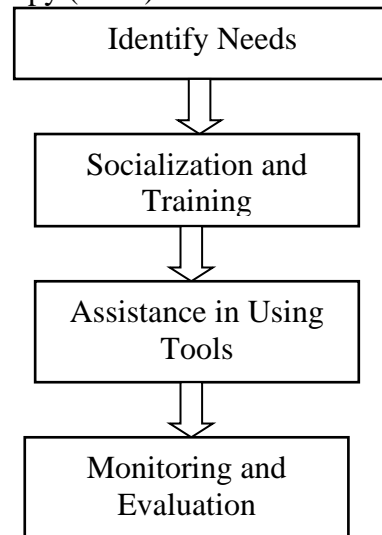

Figure 1. Flowchart of Community Service Stages

Implementation Method

1. Needs Identification

o Conduct an initial survey to identify the level of students' understanding and skills related to SEM usage.

o Collect information on local industry needs that can be facilitated by SEM usage.

2. Socialization and Training

o Conduct socialization sessions on SEM tools, their functions, and applications in the fields of chemistry and materials.

o Conduct technical training on SEM usage for students including sampling techniques, tool operation, and result analysis.

3. Assistance in Using Tools

o Provide direct assistance when new users conduct research using SEM.

o Provide guidance in interpreting data and results obtained from SEM.

4. Monitoring and Evaluation

o Prepare an evaluation form to measure the increase in user understanding and ability after training and assistance.

o Conduct periodic evaluations to evaluate the use of SEM tools in research conducted by students.

RESULTS AND DISCUSSION

1. Results

After the training was carried out for students majoring in Chemical Engineering, Lhokseumawe State Polytechnic, the community service provided a questionnaire to determine the participants' responses to the implementation of this community service. What was measured was the level of satisfaction and understanding of the material presented. The results of the average response of participants after the training using a scale of 4 as follows:
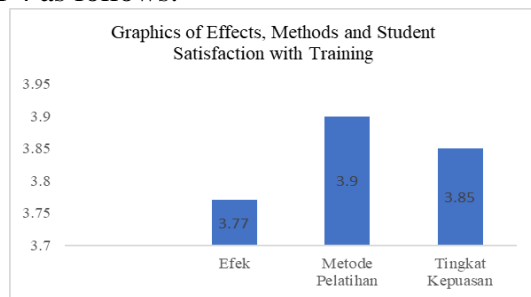

Figure 2 Graph of Effects, Methods and Student Satisfaction towards SEM Training

Based on the results of responses and analysis of participant assessments of student service activities, it was found that: a. This training has an effect or impact on the participants as a whole. b. The methods used by the service providers during the training were very good so that students were satisfied with this training.
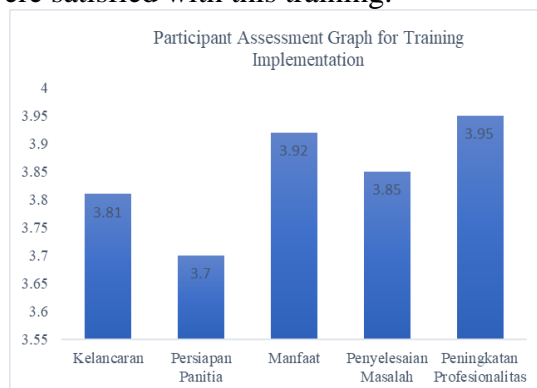

Figure 3 Participant Assessment Graph for Training Implementation

Based on the results of responses and analysis of participant assessments of the impact of community service activities, it was found that: a. Participants participated in the training smoothly. b. The preparation provided by the committee can help participants to participate in this activity smoothly. c. This training is useful for students in increasing their ability to analyze materials well. d. This training can overcome difficulties in understanding morphological analysis and material composition. e. This training can improve students' professionalism in operating SEM equipment properly and correctly.

2. Discussion

Through the socialization and training held, participants showed a significant increase in understanding of the working principles and applications of SEM. Before the training, most participants only had basic knowledge of the tool. However, after the training, 90% of participants were able to explain the functions including morphological analysis and material composition and the benefits of SEM in research well. This activity is expected to provide a positive contribution to the development of human resources and support research and industry in the field of chemical engineering through optimizing the use of SEM tools. Increased knowledge and skills of laboratory users about the use of SEM. Increased number of research utilizing SEM tools at the Lhokseumawe State Polytechnic. Establishment of good cooperation with local industries in terms of analysis and research.

Figure 4. SEM Equipment Use Training Activities for Students

Through questionnaires and direct Q&A with training participants, it was shown that 90% of participants were satisfied with the training and more confident in using SEM for their research and also the provision of knowledge to enter the world of work in the future, because the material they received was detailed and focused on the use of tools and their applications. They also expect continuity in mentoring activities and further training. The hope for the future is that cooperation can be established with two local industries that ask for assistance in material analysis using SEM. This shows that the industry is starting to realize the benefits of SEM tools in the research and development process of their products with correct and accurate product analysis.

CONCLUSION

Community service activities that focus on optimizing the use of Scanning Electron Microscope (SEM) tools in the Chemical Engineering Laboratory of Lhokseumawe State Polytechnic have shown positive results. The increase in knowledge and skills of SEM tool users is a benchmark after training and socialization. It is hoped that this effort can continue with similar community service programs and further training, so that the use of SEM and other laboratory tools can continue to increase for the advancement of education and industrial development in Lhokseumawe.

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