

Analysis of Problem in Utilizing School Laboratories in the Chemistry Learning

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Abstract—School laboratory facilities are one of the supporting facilities in the teaching and learning process. Laboratory conditions must be the suitability with the standards set by the government. The purpose of this study was to analyze the problem of the students in laboratory use in chemistry learning. The problems studied in this research were related to the problems of the students when using laboratories in chemistry learning. This research used a qualitative descriptive approach, with the sample used were students from several high schools in Aceh Barat Daya district. Data collection using questionnaires, interviews, and observation sheets. The results of this study indicate that the use of laboratories in chemistry learning activities in the schools has not been optimal. Laboratory facilities, as well as supporting facilities and infrastructure for practicum activities, are not yet fully available. The absence of competent laboratory assistants in designing the implementation of practicum in the laboratory. The solution offered in answering the above problems is by providing training to the teachers and laboratory assistants on basic laboratory techniques and laboratory management techniques as well as developing motivation of teachers and students in conducting practicum activities by providing practical training in accordance with the expected competencies.

Keywords—school laboratory, practicum, chemistry learning

I. INTRODUCTION

Laboratories are a place for educational and research activities involving laboratory equipment and hazardous materials [1]. Working in a laboratory relates to the dangers of chemicals and equipment in it. The utilization of school laboratories aims to improve student skills, especially in learning chemistry. Lack of skills in managing the laboratory can be a problem in the learning process besides the limited tools and materials and the unavailability of competent laboratory staff resulting in a low level of student understanding of the lesson concepts.

In the 2013 Curriculum, the laboratory is an integral part of teaching and learning activities, especially in chemistry learning. Not only do students have to attend to the teacher's teaching, but they also have to seek further information about

the knowledge they are learning through a scientific approach. By utilization of a laboratory, the chemistry learning process that uses observing, questioning, trying, processing, and presenting activities can run optimally. From this point of view, a laboratory is important to achieve the objectives of chemistry education in the 2013 curriculum. Laboratory rooms are spaces that allow communication and collaboration between students and teachers [2]. The laboratory is part of the learning facility. Each school must have at least one environmentally friendly laboratory building unit. Laboratory facilities must be optimally used by teachers and students in improving the quality of learning. The chemical laboratory serves as an educational infrastructure that is used as a place to conduct experiments or research on chemical properties and changes. The laboratory serves as a place to solve problems, explore facts, train abilities, scientific skills, and develop scientific attitudes. There are three roles and functions of the laboratory, namely as (1) learning resources, meaning that the laboratory is used to solve problems related to the cognitive, affective and psychomotor domains or to conduct experiments; (2) educational methods, including observational methods and experimental methods; and (3) research facilities, a place for conducting various studies to form students' personal scientific attitude. The laboratory in the science learning process has a function in achieving several learning objectives. Cognitive goals are concerned with learning the development process, skills, concepts, and increasing understanding of the scientific method [3].

The purpose of this study is to analyze the constraints of students in laboratory use in chemistry learning. The problems studied in this study were related to the constraints of students in using laboratories in chemistry learning.

II. METHODS

The approach used in this research design is a qualitative descriptive approach using the survey method. The survey method was used in problem mapping in utilizing laboratories in several sample schools, including facilities and infrastructure based on the National Education Standards (SNP) on facilities

and infrastructure adapted to National Education Standards. The implementation of this research was at three senior high schools, Aceh Barat Daya. The study's population was senior high schools in Aceh Barat Daya district, consisting of 13 (thirteen) public high schools and two private high schools. The sample used in this study was determined by a non-probability sampling type purposive sampling technique. As for the consideration of the sampling, it was seen from the school facilities based on observations. Three schools were selected as samples, namely schools that had the most complete facilities in Aceh Barat Daya District.

Therefore, researchers will act as data collectors and as active instruments to collect data in the field. As the main data collection tool, the presence of researchers in the field is very important and is needed optimally. Qualitative researchers as human instruments, function to determine the focus of research, select data source informants, collect data, assess data quality, analyze data, interpret data and draw conclusions on findings. The data needed in this study are data related to constraints on laboratory use. The data collection instruments used in this study were questionnaire responses (from teachers, principals, and students), interviews, and observation sheets for the facilities. The questionnaire used is in the form of questions and statements. The questionnaire contains questions aimed at school principals using the open type questionnaire. A questionnaire was intended for students using a closed questionnaire type. While the questionnaire contained statements intended for chemistry subject teachers using a closed questionnaire type.

In this study, researchers used a structured interview format which is used in collecting data. The researcher had prepared guidelines containing the questions to ask. Interviews were intended for laboratory heads and chemistry subject-teachers to obtain in-depth data. This study also used observation sheets to record data from observations. The observation sheet in this study was a *checklist* that aims to observe the completeness of laboratory facilities in each school studied.

The data obtained were then analyzed descriptively by describing the respondents' answers related to this study regarding the constraints and alternative solutions. The results of data analysis obtained regarding the condition and utilization of school laboratories in Aceh Barat Daya include, among others, an overview of the carrying capacity of the facilities, the intensity of use, the obstacles faced by the teacher in using the laboratory, and alternative solutions.

III. RESULTS AND DISCUSSION

The result of the study was the responses from questionnaires given to the principals, teachers, and students. The response from the principals obtains information about facilities in the 3 sample schools in Aceh Barat Daya district. It shows that the percentage of schools A and B have facilities that are categorized as good, while school C is in a poor category. The score of the questionnaire responses in schools A and B was 62.5% and school C had 37.5%. This is due to the

lack of facilities and infrastructure in the laboratory to carry out practicum. Based on the principal's statement, it is shown that there was no urgency in carrying out chemistry lab work for students. Principals A, B, and C have the same answer stating no specific budget available to support chemistry lab activities in the laboratory. All school principals continue to monitor the implementation of chemistry practicum, which is usually obtained from the head of the Laboratory and then submitted to the principal. According to these school principals, chemistry subject teachers have their Frequency schedules in carrying out practicum activities in the laboratory. The teacher's responses were analyzed by referring to the range of negative-questionnaire alternatives that were sorted based on the prioritized problem. The teacher responses can be seen in Table 1 below.

TABLE I. TEACHER RESPONSES

Problems	Schools		
	A	B	C
Facilities			
Poor laboratory conditions	6	3	1
Unavailability of practicum equipment	4	4	5
Unavailability of practicum materials	3	5	6
Supporting facilities (water, ventilation, gas etc.) are inadequate	6	7	2
Curriculum			
The allocation of practicum time is inadequate	4	2	7
There is no practical exam in the national exam, practicum is considered not important	4	9	10
Implementation			
Lack of readiness of laboratory assistants in preparing practicum tools and materials	3	1	3
Lack of teacher readiness in guiding practicum activities in the laboratory	3	8	4
Teacher readiness to carry out practicum activities	4	6	9
The teacher is unable to compile student worksheets for practicum activities	4	10	8

Research data was also obtained by distributing questionnaires to chemistry subject teachers in each sample school. Teacher responses are made based on priority problems. The results of the teacher's responses can be seen in Table 1.

Based on the data in the table, it can be seen that the order is the main problem (based on the priority scale) in the use of laboratories in sample schools. For example, in school A it is found that the problems on a scale of 3 are not the availability of materials for practicum, lack of readiness of laboratory assistants, and lack of teachers in guiding to do practicums; followed by a scale of 4, namely the lack of teachers' skill to do the practicum. As for the number of chemistry teachers, there are 2 people. Two of whom are undergraduate graduates from the college (LPTK) in Aceh and one person is a bachelor's graduate at a science faculty from a University in Aceh. The main problem is that they did not have any laboratory assistants, which causes laboratory utilization did not run well.

Based on the results obtained at school B, the use of laboratories is still carried out by combining the functions of each laboratory, namely combining chemistry, physics, and biology laboratories, which make the utilization and management of laboratories more difficult.

Another problem is the lack of teacher readiness. This is due to the small number of teachers who do not match the total teaching load and rooms. Time allocation for teaching and doing a practicum in the laboratory is a little constrained. The number of teachers teaching chemistry at school B is two, each of whom is a graduate from one of the college (LPTK) in Aceh. The problems that occur in school C are the minimal supporting facilities and the lack of teacher' readiness in guiding practicum.

The distribution of student response questionnaires in each research school involved 10 students. The results of the analysis were obtained for each of the 3 schools. School A was in a good category, school B was 67% in the good category and school C was in a good category.

The percentage of 58% in the good category. Based on the results of observations of chemical laboratory facilities and infrastructure for SMA in Aceh Barat Daya, the results of data analysis were obtained regarding furniture, educational equipment, educational media, other equipment, and consumables. The percentage suitability ratios and descriptions for each school were as shown in Table 2 below.

TABLE II. PERCENTAGE OF CONFORMITY RATIO AND DESCRIPTION OF FACILITIES AND INFRASTRUCTURE IN THE LABORATORY

Item Type	Results obtained (%)					
	SNP Ratio Compatibilities			SNP Description Compatibilities		
	A	B	C	A	B	C
Furniture	80	60	60	50	40	30
Educational Equipment	85,7	62,8	37,1	74,2	57,1	45,7
Educational Media	100	100	100	100	100	100
Other Equipment	100	83,3	66,6	100	66,6	66,6
Consumables material	83,3	33,3	16,6	50	33,3	16,6
Total Percentage	89,8	67,9	56,0	74,8	59,4	51,8

Based on the results in Table 2 above, it is then seen the suitability of the ratio and description according to the suitability standard of laboratory facilities. This suitability aims to see the suitability of facilities and infrastructure in the schools that are the research sample. The results of the ratio suitability criteria and description suitability criteria can be seen in Table 3 below.

TABLE III. RATIO AND CONFORMITY CRITERIA FOR DESCRIPTIONS OF FACILITIES AND INFRASTRUCTURE IN THE LABORATORY

Sample	% Ratio Compatibility	Information	% Description Compatibility	Information
A	89,80	Very good	74,85	Fairly good
B	67,90	Fairly good	59,42	Poor
C	56,09	Poor	51,80	Very poor

Based on Table 3, it can be seen that the availability of facilities in each school is based on the suitability ratio in school A of 89, 80% with very good information, school B was 67.90% with fairly good information and school C was 56.09% with poor information. Table 4 shows that the suitability of the description for each sample school laboratory is school A: 74.85% with fairly good information, school B of 59.42% with poor information, and school C 51, 80% with very poor information. Based on the review above, there are several obstacles faced by schools A, B, and C, namely: (1) Laboratory facilities and facilities that support practicum activities are not maximized; (2) Incomplete procedures for adequate practicum guidance; (3) Absence of laboratory assistants in managing the laboratory; (4) Students' lack of understanding of practical worksheets; (5) Insufficient inventory from the government for equipment procurement in laboratories.

Practice or practicum is a form of teaching and learning activities that are intended to strengthen mastery of applicable material. Through independent, guided activities and the use of adequate practice/practicum facilities as an integral part of the practicum implementation system, it is hoped that the learning objectives can be achieved well [4]. The main inhibiting factor for practicum in research is insufficient laboratory facilities and infrastructure to support practicum activities. Limited facilities and infrastructure for material tools have caused the implementation of practicum on several topics/materials for chemistry lab work not being carried out. This becomes one of the factors inhibiting the running of the practicum. However, the limitations of these tools and materials can be overcome by teachers by carrying out chemistry lab work in groups and rotation [5]. The availability of tools and materials will determine the implementation of practicum in the laboratory. The implementation of practicum in the laboratory depends on the availability of tools and materials that will be used in the implementation of the practicum [6]. The existence of a chemical laboratory in secondary schools is a necessity in modern science education, it is necessary to provide tools and materials for good practice and laboratory management materials so that the implementation of chemistry learning can run optimally. Utilization of a good laboratory can provide efficient time savings on practicum activities, research data collection activities, analysis, and evaluation [7].

The next problem is the lack of teacher readiness, this is due to the lack of time allocation for teachers to prepare material tools and worksheets for practicum [8]. Lack of time in carrying out practicum becomes an inhibiting factor for the course of chemistry practicum. This lack of time is caused because the time allocated to the curriculum does not pay

attention to real conditions in the field. This is under the rules in the 2013 curriculum, where the chemistry learning process must be maximized to pursue the material first [9].

In the strategy of implementing the practicum, the existence of a laboratory assistant is very important, especially in preparing the tools and materials that will be used by the practicum. This shows the important role of laboratory assistants, especially in preparing practicum tools and materials, tidying the tools back into place. However, in the three schools where the research conducted, there was no laboratory assistant so that every teacher had to prepare tools and materials and tidy up again after using the tools. The absence of a laboratory assistant is one of the obstacles to the implementation of practicum, technical laboratory management assisted by a good laboratory assistant will create optimal laboratory utilization in supporting student understanding [10]. The solution that can be offered to answer the above problems is to provide human resources through training for teachers in the field of chemistry and laboratory assistants on laboratory management and an understanding of basic techniques in modifying a practicum activity with tools and materials that are easier to obtain or tools and materials from the surrounding environment [11].

For schools, they should be able to operate a special budget for activities and the provision of material equipment in the laboratory. For the government to be able to contribute to the school in the form of educational assistance that can be used for the implementation of chemistry practicum activities so that the achievement of skills in chemistry subjects will be even better in the future. This research can be continued in further studies based on the solutions obtained from this research to overcome teacher obstacles in carrying out practicum activities.

IV. CONCLUSION

Problems in the use of laboratories for practicum activities in schools are the inadequate laboratory facilities, as well as supporting facilities and infrastructure for practicum activities, incomplete procedures for adequate practicum guides, and the absence of compatible laboratory assistants in designing practicum implementation in the laboratory, lack of student understanding use of student worksheets as well as a lack of inventory from the government for the procurement of laboratory equipment in schools. The solution offered in answering the above problems is by providing training to teachers and laboratory assistants on basic laboratory techniques and laboratory management techniques as well as fostering motivation of teachers and students in carrying out

practicum activities by providing simple but interesting practicum supplies.

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REFERENCES

- [1] V. Potkonjak, "Virtual laboratories for education in science, technology, and engineering," *J Computers & Education*, vol. 96, pp. 309-327, 2016.
- [2] S. Rahmityati, "The Effectiveness of Laboratory Use In Madrasah Aliyah In Yogyakarta," *Jurnal Penelitian dan Evaluasi Pendidikan*, vol. 11, pp. 88-100, 2008.
- [3] T.T. Lee, K.T. Wong, N. Daud, I. Zainol, D.M.I. Muhamad, and Hartono, "Chemistry laboratory management techniques massive open online course: Development and evaluation on students' perception," *J. of Science Mathematics and Technology*, vol. 7, pp. 50- 64, 2020.
- [4] L.A. Pereira, A.B. Pavan, V.C. Brito, and S.A. Junior, "Teaching Laboratory Management Principles and Practices Through Mentorship and Graduated Responsibility: The Assistant Medical Directorship," *Academic Pathology Vol. 3*, Department of Pathology, School of Medicine, Huntsman Cancer Institute, University of Utah, Salt Lake City, UT, USA, October 21, pp. 1-10, 2016.
- [5] A.L. Antes, A. Kuykendall, and J.D. Bois, "The lab management practices of "Research Exemplars" that foster research rigor and regulatory compliance: A qualitative study of successful principal investigators," *PLoS ONE*, vol. 14, pp. 1-29, 2019.
- [6] H. Arnous and Z. Ayoubi, "Inquiry Level of the Undergraduate Chemistry Laboratory Manuals in Lebanon," *J. of Social Sciences*, vol. 7, pp. 13-22, 2018.
- [7] T. Demircioglu and S. Ucar, "Investigating the Effect of Argument-Driven Inquiry in Laboratory Instruction," *J. Educational Sciences: Theory & Practice*, vol. 15, pp. 267-283, 2015.
- [8] K. Steve, S. Rosemarie, and B. William, "Green Schools as Learning Laboratories? Teachers' Perceptions of Their First Year in a New Green Middle School," *J. of Sustainability Education*, vol. 7, pp. 1-15, 2015.
- [9] J. Husnaini, "Effects of guided inquiry virtual and physical laboratories on conceptual understanding, inquiry performance, scientific inquiry self-efficacy, and enjoyment," *J Physical Review Physics Education Research*. vol. 3, pp. 1-16, 2019.
- [10] S.H. Tültüce and S. Çeçen, "Scrutinizing Practicum for a More Powerful Teacher Education: A Longitudinal Study with Pre-service Teachers," *J. Educational Sciences: Theory & Practice*, vol. 16, pp. 127-151, 2016.
- [11] A. Hofstein, "The Laboratory in Chemistry Education: Thirty Years of Experience with Developments, Implementation and Research," *Chemistry Education: Research And Practice*, vol. 5, pp. 247-264, 2014.