

Research Article

The evaluation of biochemistry practicum based on several parameters of laboratory services in chemistry department Universitas Negeri Surabaya during the even semester

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Abstract

This study was conducted to evaluate laboratory management during biochemistry practicum activities and to build laboratory information for the internal and external community of Universitas Negeri Surabaya (Unesa) in 2023 through several aspects, namely infrastructure, tools, materials, and PLP/laboratory services. A descriptive-qualitative approach is used with a questionnaire for all biochemistry practitioners. The result shows that all aspects of biochemistry practicum activities obtain percentages sequentially of 89%, 90%, 93%, and 90%, which are included in the excellent category, so it can be concluded that all practitioners are highly satisfied with laboratory services during practicum. However, improvements to the deficiencies still need to be made so that the following practicum activities run better and optimally.

Introduction

Based on the nature of science, chemistry is an experimental science that not only requires the ability to read and listen but also needs to carry out supporting activities, namely practicum (Addiin et al. 2014) as an embodiment of the balance of theory and skills. According to Limatahu et al. (2017), students' skills can increase if they are directly involved in scientific activities, for example, during practicum in the laboratory. In addition, two essential things in chemistry learning are closely related: chemistry as a product (knowledge in the form of facts, concepts, theories, and principles) and chemistry as a process (scientific work) can be achieved by students through practicums that meet the standards. Security and materials that have gone through a review of related academics (Hairida, 2018; Maison et al. 2020; Redhana and Suardana, 2021; Sudiana and Suja, 2021). One of the practicum subjects in the Chemistry Department of Unesa is biochemistry.

During the practicum activities, there were several deficiencies in optimizing laboratory functions as the primary support for practicum activities based on direct complaints experienced by several practicums, including limited infrastructure and material equipment, as well as related practicum assistant services. For this reason, a written and periodic assessment is needed so that the practicum that will be held in the next period is more optimal, considering the previous evaluation (Sastria et al. 2018).

In addition to optimizing laboratory functions, evaluation is carried out to assess whether the practicum activities that have been carried out are still within the appropriate scope or deviations have occurred from the initial principles determined previously, so an evaluation is carried out to measure the feasibility of a practicum design and the implementation method of the design. Evaluation can also be used to measure the impact of programs being implemented as well as potential factors influencing the level of program benefits and the distribution of program benefits produced (Susilaningsih, 2012; Kanyamuna et al. 2018) to build a laboratory



information system for internal users as well as external agencies, in this case, Universitas Negeri Surabaya, in order to be able to find out the laboratory evaluation parameters so that later they can be universally accessed by the wider community. The practicum evaluation instrument uses a questionnaire that includes several laboratory service parameters, namely facilities and infrastructure, equipment and materials in the laboratory, and practicum and laboratory assistant services, with a total of 48 respondents who are all biochemistry practitioners in 2023.

Method

Subjects

The subjects in this study were all biochemistry course practitioners, totaling 48 students of S1 Chemistry at Universitas Negeri Surabaya (Unesa) Class of 2021.

Table 1. Questionnaire scale (Supriyatna and Maria, 2017)

Scale	Explanation
1	Very Unsatisfying
2	Not Satisfying
3	Satisfying
4	Very Satisfying

General Procedure

This research uses a descriptive qualitative approach that shows laboratory quality, including several management elements at the Unesa's Biochemistry Laboratory. The data collection method uses a questionnaire aimed at all practitioners who have carried out biochemistry practicum for one semester. Widoyoko (2016) explains that a questionnaire is a data collection method in the form of a set of written statements or questions to respondents to then respond according to what happened in the field, which aims as an assessment of the feasibility of laboratory function services during the practicum (Purnomo and Palupi, 2016). The range of scores in the questionnaire uses a Likert scale arranged in the form of a statement and is followed by choice of responses that indicate the level (Widoyoko, 2016). The scales used in the questionnaire are shown in Table 1. The percentage results obtained are then interpreted according to the criteria stated in following Table 2.

Table 2. Percentage interpretation criteria (Ratnapuri, 2010; Riduwan, 2010)

Percentage (%)	Level of Satisfaction
0 - 20	Very Less
21 - 40	Less
41 - 60	Enough
61 - 80	High
81 - 100	Very High

Data Analysis

All respondents' data from filling out the questionnaire will be grouped based on the mean answers and analyzed descriptively and qualitatively using a formula (Agustina et al. 2019):

$$\text{Value} = \frac{\text{gain score}}{\text{maximal score}} \times 100\%$$

Results and Discussion

The laboratory has an essential role in the learning process, in this case, the scientific branch of biochemistry. Through learning in the laboratory, students' knowledge will become more balanced between theory and practice. In addition, Emda (2017) explains that the function of the laboratory includes three things, namely, the role of the laboratory in solving problems related to the cognitive, affective, and psychomotor domains. The second function is an educational method that includes observational and experimental methods and a means

of carrying out various types of research so that individuals with scientific character are formed. Efforts to improve the quality of practicum activities require an excellent laboratory operational management system with predetermined standards, including security and several laboratory quality parameters (Ratnapuri, 2010).

Internationally, standards have been set for each laboratory management system developed by ISO, which aim to ensure conformity to some of the characteristics desired by service users, such as quality, safety, reliability, efficiency, and reproducibility (WHO, 2011). With a good management system, the next step is to ensure the effective use of the laboratory as one of the requirements for the smooth running of learning and practicum activities, or, in another sense, it has a significant impact on the quality of the practicum activities themselves, where the level of effectiveness is influenced by many factors, including the availability of facilities. have good quality and quantity and also require good laboratory management competence (Samiasih et al. 2013).

Table 3. Results of biochemistry practicum evaluation

Number	Assessment Category	Average (%)
1	Laboratory Infrastructure	89%
2	Laboratory Equipment	90%
3	Laboratory Materials	93%
4	Laboratory Services (by lab assistant and Co-Assistant)	90%

Several parameters determining the quality and effectiveness of laboratory standards include facilities and infrastructure, the availability of tools and materials, and the level of service for practicum assistants and laboratory assistants. To find out whether these four parameters have been appropriately fulfilled or not, evaluations are carried out routinely and openly by all relevant parties so that they can be used as a benchmark for the success of the laboratory in carrying out its optimal function as the primary medium for laboratory skills development activities. The evaluation results are then analyzed as a positive reflection step for other activities (Shinde, 2022). Table 3 below shows the results of the evaluation of the biochemistry practicum with 48 respondents.

Laboratory Infrastructure

According to Yuliarti et al. (2017), laboratory facilities are all needed in the teaching and learning process to maximize efficiency and effectiveness and achieve the desired goals, including all equipment used directly in laboratory activities. In comparison, infrastructure is all components that indirectly support the course of the activity process in the laboratory. Laboratory facilities and infrastructure standards include laboratory rooms, facilities, tools, and materials that support the learning process (Marifatun, 2021).

Based on the data obtained, the parameter of laboratory facilities gets a percentage of 89%, which means it meets excellent criteria. The Unesa's Biochemistry Laboratory has adequate facilities and infrastructure for practicum activities, namely a large room, a wide lab table that can accommodate all practitioners, an open and free road access; in other words, the practitioner does not feel cramped and has difficulty walking or changing places, as well as air circulation that is wide open and faces directly to nature. The location of the laboratory, which is far from residential areas, can also minimize the risk of unwanted things happening. Likewise, the location of the sink is considered appropriate because it is located at each end of the practicum table so that the practitioner can use it comfortably and does not need to queue. In addition, Unesa's biochemistry laboratory is also equipped with a first aid kit as a first aid measure.

The advantages of the Unesa biochemistry laboratory described previously are inseparable from several shortcomings that still need to be addressed. Some of them are the flow of water in specific sinks that is not as smooth as the condition of the sinks, which sometimes causes flooding when practitioners use them simultaneously and require a large volume of water. This issue is generally caused by the disposal of wastewater from washing in the sink, which may contain materials that can cause damage to the water flow pipes. To mitigate this problem, it is essential to pay more attention to the water quality and pressure of the water flow, where strong water pressure is important at each tap, especially in the sink or washing tubs. Wastewater that contains chemicals that may affect the water installation should be neutralized first, or a designated disposal site should be provided to prevent interference with the smooth flow of water pipes. It is also considerable to provide a backup water tank to ensure a continuous water supply at any time the water flow becomes blocked up again (Mariyanti et al. 2020).

In addition, the existence of K3 tools that are not yet fully available is also a factor for the Unesa Chemistry Laboratory to make improvements. Complaint boxes also need to be provided in subsequent activities as a follow-up evaluation, and trash bins placed on each practicum table to make it easier for the practitioner to dispose of the trash (Galuh, 2022).

Laboratory Equipments

The aspect of laboratory equipment shows the results of the percentage of practitioner satisfaction of 90%, which indicates that the level of satisfaction of practitioners with laboratory services is excellent, which is supported by the facts on the ground, namely that during the practicum process, the Unesa Biochemistry Laboratory provided all the equipment needed by students properly, ranging from minor equipment such as test tubes, measuring flasks, and beakers to large ones, namely incubators, water baths and autoclaves. In addition, there are also essential chemical instruments to support student practicum activities, namely UV-Vis spectrophotometers, FTIR, and others. Not only in terms of the availability of tools, but the Unesa's biochemistry laboratory also equips each of these tools with valid SOPs. It is installed on the side of the tool, making it easier for practitioners to use the tool.

In addition to the availability of SOPs, Unesa's biochemistry laboratory also provides maximum care for all laboratory equipment, where all laboratory equipment is stored in a unique glass cabinet and placed regularly according to its type so that it is not mixed with other tools. Every time the practitioner finishes using the equipment, the practitioner must clean it by rinsing it with soap and distilled water if necessary, then dry it and put it back in the tool cupboard to keep the equipment functioning normally. However, sometimes there are still some tools that are moldy or broken until they cannot be reused, which is most likely caused by rinsing the tools that are not clean enough so that equipment that is stored in a closed environment can grow fungus. The use of tools by practitioners who are not careful is also a factor in the equipment being broken and unable to function normally. This phenomenon can also be an evaluation for all laboratory users to be more careful when using laboratory equipment and for laboratory staff to tighten regulations related to laboratory equipment management (Jufriyah et al. 2009).

Apart from this, there are some deficiencies in the procurement of equipment at the Unesa Biochemistry Laboratory, including the number or quantity of tools that can still be added, because laboratory users are not only students who receive biochemistry courses but also final year students, especially equipment that has an expensive price but is really needed, namely micropipettes and volume pipettes, which are still limited. To overcome this situation, laboratory management can increase the budget to purchase more equipment that has a high priority. In addition, periodic calibration needs to be carried out for specific equipment such as GC-MS, UV-Vis spectrophotometer, analytical balance, and measuring flask to maintain the accuracy of the calculations (Habibie, 2013; Firdaus et al. 2020).

Laboratory Materials

The principle of storing chemicals based on a compatibility matrix is to pay attention to the properties and groups of chemicals, where there are chemicals that may and may not be paired with other groups of chemicals because they will react (Dinda, 2019). According to Hall (1994), accident cases in history have occurred due to errors in the chemical storage system, which was arranged only based on the alphabet without regard to the characteristics and properties of each material, thus triggering reactions between chemicals, primarily reactive and flammable chemicals. Burnt. To minimize work accidents, the things that must be considered are: (1) have complete inventory data of all chemicals, then categorize them into several parts such as acids, bases, oxidizers, and flammables. (2) Perform further grouping based on the previous division. (3) Determine the storage arrangements for chemicals that have been grouped based on chemical properties and compatibility, then separate the different groups of materials by providing a specific partition or distance. (4) Limiting access to the chemical storage area, where access is only owned by selected laboratory assistants or laboratory staff responsible for laboratory management or students permitted to use this access for research purposes or activities related to lectures, including practicum.

In its application, the Unesa's biochemistry laboratory has managed chemicals in these four aspects, both in terms of the availability of sufficient and complete materials and grouping, storage, and access to the materials themselves. This result is evidenced by the data obtained, showing a percentage of 93% or being included in the excellent category. This achievement is supported by the fact that the Unesa's biochemistry laboratory has

available and complete chemicals to support practicum needs. However, there are still certain chemicals whose quantities are running out, so it is necessary to re-stock the laboratory management staff. Apart from the aspect of availability, the storage of chemicals at the Unesa's biochemistry laboratory is entirely appropriate, where corrosive, flammable, or reactive materials will be placed in specific cabinets parallel to each other, while other chemical materials in the form of solids or essential ingredients are placed in another cupboard alphabetically, which still needs to be fixed because chemicals should be placed not only based on the alphabet but also based on their characteristics. Laboratory assistants can also make some rules for practitioners to always return any materials that have been used to their original place (Kemendikbud, 2018).

The next aspect is periodic control related to the shelf life of materials, which has been carried out properly by the Unesa's biochemistry laboratory. A few days before the practicum activities officially started, laboratory assistants and practicum assistants coordinated to inspect all chemicals, including materials used during practicums. Chemicals whose shelf life has expired will be recorded, and further action will be taken, while no longer available chemicals will be budgeted to purchase new materials (Ramadhani, 2020).

Laboratory Services (by Lab Assistant and Co-Assistant)

In a laboratory system, not only are physical facilities the primary support for practicum learning, but the contribution of laboratory managers such as laboratory assistants and practicum assistants also has an enormous contribution to the continuity of the practicum process. Maknun (2015) defines practicum assistants as laboratory staff to guide and serve students during practicum within a particular time. According to Rahmawati & Hidayah (2017), laboratory staff abilities or competencies in the form of managerial and individual abilities, which include planning, organizing, implementing, and evaluating all learning activities in the laboratory, are needed to hold responsibility and control of all activities in the laboratory related to practicum. Competence includes experience and understanding of facts and concepts, increasing skills, and teaching behavior and attitudes, where attitudes are also determined by students' attitudes in the practicum process.

The implementation of the practicum assistant duties at the Unesa's biochemistry laboratory will work together with the laboratory assistant to prepare all practicum needs, such as tools and materials, provide pre-practical assistance during practicum and post-activity to the practicum to explain the direction of practicum goals, related scientific theory, work steps, practice examining objects, paying attention to every way of working, always being careful, and compiling reports. This critical role requires practicum assistants to master scientific material, the basics of theory and the learning process, how tools work according to SOPs, and calculations in making all the reagents needed during practicum (Raharjo, 2021).

Based on the data obtained, the PLP/labor service aspect reaches a percentage of 90%. It is included in the excellent category, meaning that practitioners are highly satisfied with the services of laboratory and biochemistry practicum assistants at Unesa. This excellent percentage gain is supported by field facts, where laboratory assistants and practicum assistants have properly provided assistance to all practicums, including the procurement of equipment and the operation of instrumentation to support practicum needs. In this aspect, the practicum assistant has been equipped with intensive mastery of the tool. Then, before the official practicum begins, the practicum assistant will practice operating the tool in all practicums. The practitioner will then record all the essential things and summarize them to make them easier to remember.

Another aspect is the attitude of the practicum assistant in serving the practicum, both during pre-practicum and post-practicum. Pre-to-post practicum assistance is held using a two-way discussion method between the practicum assistant and the students, where the practicum assistant will first explain the work steps and other matters related to the practicum that they have explored through the practicum guidebook and other references. The practicum assistant will explain the additional points on the practicum topic. After that, the practicum assistant will invite the practitioner to ask questions or argue according to the practicum title to be carried out. This also includes when practicums are carried out, where practicum assistants collaborate with laboratory assistants to explaining procedures, providing directions, including warnings to be careful using tools and chemicals, and maintaining attitudes during practicums. In addition, the practicum assistant will also assist in interpreting the data that will later be obtained, such as the theory underlying the practicum, data accuracy based on testing samples for each practicum group, as well as evaluating the results for later analysis if there is a discrepancy between the practicum results and theory (Tim Dosen Program Studi Ilmu Gizi, 2014; Rahmayadi et al. 2021).

Conclusion

Based on the results of the analysis, all aspects of the evaluation of biochemistry practicum activities, which include infrastructure, tools, materials and PLP/laboratory services, respectively, obtained percentages of 89%, 90%, 93%, and 90%, which are included in the excellent category, or it can be said that students have a high level of satisfaction with laboratory services in these four aspects. However, several things still must be fixed by the Biochemistry Laboratory so that the practicum activities for the next period will be better and more optimal.

Conflict of Interests

The author (s) declares that there is no conflict of interest in this research and manuscript.

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