The contribution of physics media laboratory management towards physics education courses

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Abstract. This study aims to examine the external factors of a laboratory as the core of the learning process. Two questions arise and become the focus of the research as follows: (1) How is the management of physics learning media laboratory of Physics Education Study Program in Universitas Negeri Jakarta and (2) How much is the contribution of the laboratory to the learning process of physics education courses. In this study, a descriptive quantitative and qualitative instructional design is utilised. The laboratory standard referred to the Indonesian Education minister’s regulation, Likert scale to see the management of the laboratory, and descriptive analysis to know the contribution of laboratory management with integrated courses of physics education courses. The research findings show that the physics learning media laboratory has met the government standard with a value 83.2% for its management. As for the contribution, the laboratory has contributed approximately 50% of physics education courses which are integrated with the laboratory. These research outcomes hopefully can be used by teachers and laboratories to enhance its management and contribution to university courses and other education facilities.

1. Introduction

Physics Education students are prospective teachers who are prepared to be a learning agent. A teacher does not only have a responsibility to teach in the classroom but also to be a facilitator in laboratory activities at school.

Teachers nowadays are faced with the standard requirement that must be fulfilled based on the regulation of the Ministry of National Education No.16, 2007. One of these requirements is the Standard Professional Competence where teachers are required to use all potential to help students develop themselves so that they can creatively explore information and become active in the learning process [1].

Laboratory management skill will help the teacher to achieve learning objectives as laboratories are venues in teaching and learning science [2]. The progress of the education curriculum requires a teacher to not only master class teaching and material, but also laboratory skills both in managing and implementing experiments. With the curriculum demands, students will need to prepare and trained to have laboratory management skills [3].
Laboratory management dimensions consist of laboratory organisation, administration and safety. Whereas laboratory administration includes the inventory of laboratory equipment and facilities, laboratory use, borrowed laboratory equipment and laboratory equipment maintenance) [4].

Education quality is influenced by learning activities carried out by teachers and students both in class, laboratory, workshops, and other learning outcomes that transpire in the form of average learning outcome achieved by students in one semester [5].

The learning process activities in physics education courses include psychomotor aspects such as observation, experimentation, training, and testing of knowledge concepts which can be supported by the laboratory. An experiment in a physics laboratory has shown that student’s attitude and cognition improvement changed in educational settings of a physics laboratory [6]. Subsequently, the contribution of integrated learning media laboratories needs to be assessed for its contribution.

Laboratories and other types of equipment are essential infrastructure facilities to support the learning process at school as stated in the Government Regulation number 19, 2005 in which concern the national education standard section 42 paragraph (2) and section 43 paragraph (1) and (2). Laboratories are a place to apply scientific theory, analytical testing, verification of trials, research, et al. by using tools which are the completeness of facilities with adequate quantity and quality [7]. Laboratory activities have long had a central role in the science curriculum, and science educators have suggested benefits of engaging laboratory activities to students. [8]. It is therefore not exaggerating when said that a laboratory is a place of scientific applications which are the core of the learning process [9].

Based on the results of observations, questionnaires, and surveys of 100 students are found that there were several subjects in physics education study program which are integrated with the physics learning media laboratory.

Consequently, the authors want to examine the contribution of laboratory management to physics education courses. Thus include the participation of the laboratory to the learning process of physics education courses which require direct and in-depth applications.

This research aims to examine the external factors of the learning process. As a result, several questions arise and become the focus of the study as follows: (1) How is the management of physics learning media laboratory of Physics Education Study Program, Universitas Negeri Jakarta (2) How significant is the contribution of the laboratory to the learning process of physics education courses.

2. Methods
This study uses a descriptive method with a linear quantitative and circular qualitative approach. Both this approach can be used together since it is carried out on the same subject [10]. The data collection is obtained through direct interviews, indirect observation and documentation. These data collection techniques are used for different purposes in which interviews to collect information from written questions, observations to collect data from other researches, and documentation to collect information in the form of notes, images, agendas [10].

The data collected will then be analysed using data validity techniques, namely, criteria of trust degree and information. The trust degree criteria are obtained by using the triangulation method, which is testing the validity of data by checking the data obtained from several sources. On the other hand, the explanation criteria will be achieved through detailed description examination techniques [11].

2.1. The Data Collection
This study was conducted in the laboratory of physics learning media FMIPA Universitas Negeri Jakarta using a purposive sampling technique which is a technique chosen based on specific objectives [12]. Sixty-seven physics education students participated in the data collection. Based on the formula from Tarro Yamane only 66 students that satisfy the requirement and hence can join in the data collection [13].
2.2. The Collected Data
This study aims to understand how is the management of Physics Learning Media Laboratory of Physics Education Program and how significant is the contribution of the laboratory to the learning process of physics education courses. Three sections are covered in this segment which are the laboratory standard, physics learning media laboratory management, and courses analysis. The standard laboratory data was collected based on the results of interviews, observations and questionnaires of the laboratory users. The Physics Learning Media Laboratory management data were collected by surveys from laboratory staff and related lectures in courses integrated with learning media laboratories. The courses analysis sections are collected in two ways. First, by noting the laboratory usage for one semester in each course from the laboratory user books and students interview, and the second by analysing the lecturer tools or semester lecture design.

3. Result and Discussion
3.1. Laboratory standard
The laboratory standard as stated in the Ministry of National Education no.24, 2007 can accommodate a minimum of one study group with a minimum ratio of 2.4 m²/student, has sustained facilities, with adequate lighting to read books and to observe experimental objects, equipped with furniture, educational equipment and media, and consumable material. From the government regulation, it can be summarised into four criteria which are: minimum area, capacity, lighting, facilities and infrastructure. Table 1 shows the response on the condition of the physics learning media Universitas Negeri Jakarta.

| No. | Criteria                     | Score (%) |
|-----|------------------------------|-----------|
| 1   | Minimum area                 | 100       |
| 2   | Capacity                     | 100       |
| 3   | Lighting                     | 100       |
| 4   | Facilities and infrastructure| 88.3      |

Based on Table 1, it can be concluded that the condition of the Physics Learning Media Laboratory has met the Government Regulation Standard with a 100% achievement for the minimum area, capacity, and lighting criteria, and 88.3% for facilities and infrastructure criteria.

These achievement result from the cleanliness and neatness of the laboratory, which includes the maintenance and placement of tools and materials. An excellent laboratory has a suitable arrangement of laboratory tools and materials. This placement can clear more area of the laboratory hence create a more substantial feel of the laboratory with sufficient lighting. As for the facilities and infrastructure criteria, Physics Learning Media Laboratory has a score of 88.3%. These criteria are based on the types and number of tools, materials, and media which are equipped in the laboratory. Table 2 shows the availability of tools, materials, and physics media in Physics Learning Media Laboratory.

| Component           | Score | Types | Number |
|---------------------|-------|-------|--------|
| Tools               | 100   | 100   |        |
| Material            | 60    | 70    |        |
| Physics Media       | 100   | 100   |        |

Based on Table 2 it can be concluded that the physics learning media laboratory has a proper type, and a sufficient number of tools since the laboratory has tools such as physics kits, physics props, ICT-based devices which are available with different topics such as mechanics, optics, heat, electricity,
magnetism, waves, renewable energy, and sound. Therefore, the tools component can meet the maximum standard of 100%.

The score of the availability of material is 60% for types and 70% for number because physics learning media rarely use consumables. Moreover, the laboratory designs are not for chemical experiments such as liquid or gas. The physics Media component has a score of 100% since it has media such as books, e-modules, modules, books, and posters. Overall the laboratory users state that the laboratory conditions were considered good with a sufficient amount of tools, materials, and media.

3.2. Physics Learning Media Laboratory Management

Physics Learning Media Laboratory is also equipped with organisation, administration, and laboratory safety. These criteria can be seen in Table 3.

| ASPECT               | SCORE |
|----------------------|-------|
| Laboratory Organization | 90%   |
| Laboratory Administration | 90%   |
| Laboratory Safety     | 70%   |

Based on Table 3, it can be concluded that the overall physics learning media laboratory management has an average score of 83.2%, which means very good. With a score of 90% for both laboratory organisation and administration, and 70% for laboratory work safety. Each management aspect has different indicators. The organisation indicators are the program for one semester, laboratory assistant recruitment and training.

The administration indicator are laboratory specifications, laboratory rules, student attendance list, daily activity book, the tools schedule and usage list, the tools, materials, and items inventory list, equipment maintenance and repair schedules, request form/ submission of tools, materials and goods, borrowed tools, materials, and proper structures, replacement card tools, handover cards, practicum submission report list and score and tools user’s manual.

The laboratory safety includes several indicators, namely standard operating laboratory procedures, standard operational practicum procedures, first medical equipment and portable hydrant, and work safety instructions.

3.3. Courses Analysis

Courses analysis include the analysis of courses which integrated with learning media laboratories. By using user books and student interview, it can be seen that Physics Learning Media Laboratory is used majority by three courses with a frequency of 4-5 times in a month or about 3 hours a week as shown in Figure 1.
At the beginning of every semester, the lecturers will coordinate with the person in charge of the laboratory regarding the use and the schedule of the use of Physics Learning Media Laboratory. Three courses analysed are Laboratory Management, Development of Learning Media, and Teaching Skills. Each of these courses uses laboratory as a place to conduct physics experiment. By examining the courses, we know how significant is the contribution of laboratory management to the learning process of Physics Education courses.

The courses analysis includes the analysing of lecturer tools or semester lecture design and laboratory uses observation for one semester. Based on the results of the investigation, we obtained core competencies which are integrated with each of the courses. Proper laboratory management is expected to be able to meet the needs of physics education students to understand the lecture material. The percentage of core competencies that can be facilitated by Physics Learning Media Laboratory is shown in Figure 2.

Figure 1. The use of physics Learning Media Laboratory Histogram

Figure 2. Facilitate core competencies

Figure 2 shows that the laboratory has contributed around 50% of the core competencies of each of the three courses. The three courses are explained as follows:
3.3.1. The Laboratory Management Course.
The laboratory management courses carry out activities to train students the use and management of teaching aids/kit. The core competencies of the laboratory management course are (1) laboratory and its functions, (2) laboratory administrations (3) physics laboratory standards (4) operation of laboratory supporting devices, and (5) laboratory work safety.

The physics learning media laboratory helps to bring real experience to students. From the five core competencies mentioned before, three of them are used in an integrated manner with the Physics Learning Media Laboratory. These competencies are the laboratory administration competency, the operation of laboratory supporting devices competency, and laboratory work safety competency. The laboratory administrations core competency can be studied by understanding administrative formats which are available in the laboratory. The fourth competency which is the operation of laboratory supporting devices can be reviewed by using laboratory kits/teaching aids which are available in the laboratory. Lastly the safety core competencies of laboratory work are studied practically in physics learning media laboratory.

3.3.2. The Development of Learning Media Course.
In the Learning Media Development courses, students use laboratories to develop physics learning tools/media. The students create and test their tools using laboratory equipment and facilities. The core competencies of the Development of Learning Media Course are: (1) The definition and function of learning media, (2) The types and relationships between instructional media, (3) The analysis of the learning media development, (4) Developing a learning media, and (5) Testing the learning media.

From the five core competencies, three of them are carried out in the physics learning media laboratory. It was carried out in the laboratory because the physics learning media laboratories have dozens example of learning media that can be analysed, provide tooling facilities and documentary facilities when testing the learning media in learning. Accordingly, these three core competencies are The analysis of learning media development, developing a learning media, and testing the learning media.

3.3.3. Teaching Skills Course.
In Teaching Skills courses students use laboratory along with the tools and its facilities to practice microteaching. The core competencies are (1) 21st-century learning, (2) Microlearning, (3) Teaching skills, and (4) Developing microlearning tools. From the four core competencies, two of the competencies are integrated with physics learning media laboratory. These two competencies are teaching skills and developing microlearning tools. In teaching skills, students will practice teaching skills in the laboratory and in designing learning tools, can see examples of learning media devices in the laboratory that can be used in the classroom as teaching aids.

4. Conclusion
Research has been conducted to see the contribution of Physics Learning Media Laboratory to the learning process of physics education courses. The result of the laboratory standard according to the Ministry of National Education criteria is 100% for Minimum Area, Capacity, and Lightning, and 88.3% for facilities and infrastructure. The Physics Learning Media Laboratory management has an average score of 83.2% with 90% for both Laboratory Organization and Administration and 70% for Laboratory Safety. Based on the analysis of the course for each core competencies of courses, shows that the Laboratory contributed more than 50% of the learning process.

5. References
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