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The Readiness of Biology Laboratories to Support Practical Work in State High Schools throughout Tegal Regency

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Abstract

This study aimed to analyze the readiness of biology laboratories to support practical work in State High Schools throughout Tegal Regency. The readiness refers to the availability of all things that can support practical activities including the readiness of infrastructure facilities and laboratory management. This study used a quantitative descriptive research design. The population in this study is all independent biology laboratories in State High Schools throughout Tegal Regency that used for practical works. The sampling technique used is saturation sampling. This study has been done at biology laboratory of SMA Negeri 1 Bojong, SMA Negeri 1 Kramat, SMA Negeri 1 Warureja, SMA Negeri 1 Balapulang, SMA Negeri 1 Pangkah, SMA Negeri 1 Slawi, SMA Negeri 2 Slawi, SMA Negeri 3 Slawi, dan SMA Negeri 1 Pagerbarang. The data were obtained using the observation method, questionnaire, and interview with reference to *Permendiknas* Number 24 the Year 2007, *Permendiknas* Number 26 the Year 2008, and *Permendikbud* Number 24 the Year 2016. Further, the data were analyzed using descriptive statistics. The result of the study shows that the readiness of infrastructure facilities and management successively scored 58.5% and 62.8% which is belonged to sufficient criteria. The conclusion of this study is the biology laboratories in State High Schools throughout Tegal Regency is ready enough to support biological practical work with an average readiness of 60.52%.

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INTRODUCTION

The competency standard of graduates for primary and secondary education according to *Permendikbud* Number 20 the Year 2016 include the dimension of attitudes, knowledge, and skills. Practical work enables students to study biology through direct observation and experimentation on symptoms and processes which is conducted by paying attention to work safety in the laboratory, finding and solving new problems through the scientific method, instilling and developing scientific attitudes, and practicing scientific thinking skills.

The practical work should be carried out in the laboratory because the laboratory has facilities and special equipment that are not available in the classroom. In the laboratory, students can develop their ability to hypothesize, use tools, measure, analyze, interpret, and make a conclusion. Feyzioglu (2009) stated that science process skills are more often taught in the laboratory through practical work. Laboratory applications aimed to enhance students' science process and problem-solving skills and their interest in and attitudes toward scientific approaches in accordance with the objectives of basic science education (Hofstein & Naaman, 2007).

The existence of a biology laboratory, the infrastructure facilities, and its management are important to support practical work. The science laboratory with adequate equipment is one of the variables that determine students' academic outcomes (Olufunke, 2012). Musah & Umar (2017) found that there was a significant relationship between biology facility availability and utilization, and students' academic achievement. An adequate laboratory and good infrastructure facilities also have a good influence on students' process skills (Jack, 2013). Therefore, the school laboratory must be equipped with adequate infrastructure facilities to facilitate the teacher in conducting practical work so that the students can have an appropriate skill. The standards of infrastructure facilities of biology laboratory in Senior High School are regulated in *Permendiknas* Number 24 the Year 2007. The existing laboratories and infrastructure facilities need to be managed properly so that they can be used in accordance with their procurement objectives. School laboratory management personnel have responsibility for laboratory effectiveness and efficiency including facilities, equipment, and materials needed for practical work. The standards of school/madrasah laboratory management personnel are regulated in *Permendiknas* Number 26 the Year 2008.

According to the data of *Kemendikbud* (2016), from eleven State High School in Tegal Regency, only nine of them had independent biology laboratory, while the rest are shared laboratory which means that one laboratory is used for physics, chemistry, and biology practical work. Preliminary observation in 2018 showed that ten high schools already have independent biology laboratories. Ideally, each Senior High School should have three science laboratories in accordance with *Permendiknas* Number 24 the Year 2007, which is biology, physics, and chemistry laboratory. The problem which is analyzed in this study is the readiness of biology laboratories in State High Schools throughout Tegal Regency to support practical work. The purpose of this study is analyzing the readiness of biology laboratories to support practical work in State High Schools throughout Tegal Regency. The readiness that would be discussed is about the availability of all things that can support practical work, including the readiness of infrastructure and readiness of laboratory management. In this study, the laboratory is limited to an independent biology laboratory room which is an indoor laboratory functioning as a place for biology learning activities which is conducted by practical work and requires special equipment (*Permendiknas* Number 24 the Year 2007). The practical work referred to in this study is a biological practical work that are carried out in the laboratory room and in accordance with Permendikbud Number 24 the Year 2016.

RESEARCH METHOD

The study used a quantitative descriptive research design. The population in this study are all independent biology laboratories in State High Schools throughout Tegal Regency that used for practical work. The sampling technique used is saturation sampling. The sample in this study are biology laboratory at SMA Negeri 1 Bojong, SMA Negeri 1 Kramat, SMA Negeri 1 Warureja, SMA Negeri 1 Balapulang, SMA Negeri 1 Pangkah, SMA Negeri 1 Slawi, SMA Negeri 2 Slawi, SMA Negeri 3 Slawi, and SMA Negeri 1 Pagerbarang. The study was conducted from February to March 2018. The data collected in this study are the readiness of laboratory infrastructure data with the reference to *Permendiknas* Number 24 the Year 2007 and 2013 Curriculum Requirements in accordance with KI and KD in Permendikbud Number 24 the Year 2016 as well as the readiness of laboratory management personnel in managing the laboratory according to *Permendiknas* Number 26 the Year 2008.

The readiness of the infrastructure that is measured includes the design of the laboratory and the availability of laboratory facilities which are divided into three dimensions, namely availability, ratio, and suitability of the description. Laboratory management readiness that is measured is the performance of the laboratory management personnel with the dimensions of designing activities and developing the laboratory, scheduling and recording laboratory use, provision and maintenance. The data were collected using questionnaire, observation, and interview method. Further, the data were analyzed using descriptive statistics.

Infrastructure facilities are declared to be ready if the score is >60% of the readiness criteria in line with *Permendiknas* Number 24 the Year 2007 and practical work requirements based on *Permendikbud* Number 24 the Year 2016. Laboratory management is revealed to be ready if the score is >70% from the criteria of *Permendiknas* Number 26 the Year 2008. A laboratory is stated to be ready if the mean score of the readiness of infrastructure and management is at least 65%.

RESULTS AND DISCUSSION

The Readiness of Biology Laboratory Infrastructure Facilities

The result of the laboratory infrastructure facilities scores are obtained from the observation which includes laboratory design, furniture, teaching aids, equipment, and materials based on the availability, ratio, and suitability for the description. The readiness of biological laboratory infrastructure facilities scores in each State High School throughout Tegal Regency is presented in Figure 1. Based on the figure, it can be seen that SMA Negeri 1 Balapulang has the highest level of the infrastructure readiness (score 68.6%) while the SMA Negeri 1 Slawi has the lowest readiness level (score 46%) compared to nine other schools.

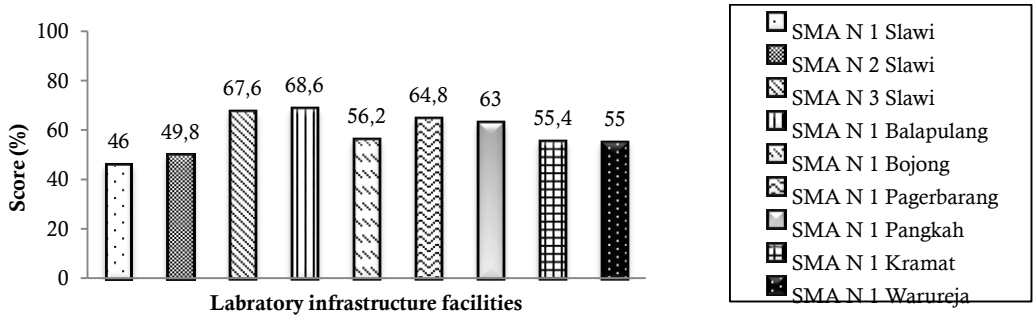

Figure 1 The readiness of biology laboratory infrastructure facilities in State High Schools throughout Tegal Regency

The location and layout of the laboratory at SMA Negeri 1 Pangkah and SMA Negeri 1 Warureja are in accordance with the standards. The advantage of the two laboratories if they are compared with other laboratories is that the location of the laboratory that fulfills the standards. Each biology laboratory already has a practice room, preparation room, and storage room that their space is in accordance with the standards except for the SMA Negeri 1 Slawi which does not have a preparation room. According to Kertiasa (2006), ideally, school laboratories consist of the practicum room, preparation room, and storage room. The capacity of the room is sufficient to accommodate students of one class around 32-34 students. It also meets the minimum ratio of the room so that the students can move freely in carrying out the practicum. All biology laboratories in Tegal Regency except the laboratory of SMA Negeri 1 Slawi and SMA Negeri 3 Slawi had two laboratory doors. One door is used as a student entrance and the other is used as an emergency door to make it easier for the students to come out of the room if a disaster happens (CLEAPSS, 2009).

All laboratories in State High Schools throughout Tegal Regency already have sink furniture, equipment cabinets, material cabinets, student tables and chairs with good number and condition. Students' tables generally still use wooden table and have not used a permanent table except in the laboratory of SMA Negeri 2 Slawi and SMA Negeri 3 Slawi. The table should be made watertight so that the liquid spilled when practical work going is easy to clean. The electricity box is also not available on each student's table, it may happen because the majority of schools still use a monocular microscope so that they do not need electricity and only rely on the room light. The fire extinguisher is already available in seven laboratories while first aid kit is only available in four laboratories so that when an accident occurs in the experiment and the student is injured the student must go to the *UKS* room.

The score of readiness of teaching aids shows the condition is quite ready to supporting practical activities. The role of props is quite important in biological practical work because it can concretize the subject matter so that students can more easily understand. All laboratories already have teaching aids such as models of human skeletons, models of the human body, anatomy of animals and plants preparations. Teaching aids available in five or more schools are images/models of the human respiratory system, images/models of the human blood circulation system, images/models of human expenditure systems. The availability of genetic props such as chromosome, DNA, RNA, and Mendel inheritance has not been achieved in all laboratories except the laboratory of SMA Negeri 2 Slawi, SMA Negeri 1 Balapulang, and SMA Negeri 1 Bojong. Images or models of the human body system are available in each school, but animal body systems are not available yet in every school. Animal and plant preserved preparations are only available in five laboratories, and preparations are made by students so that they are still simple and there is no information on species names or classification.

The level of the readiness of the biology laboratory equipment in State High Schools throughout Tegal Regency is sufficient with a score of 52.8%. The equipment that is available in each laboratory is a monocular microscope, object glass, cover glass, beaker, pipette, test tube, test tube brush, preparation box, mortar and pestle, tripod, burner, wire gauze, analytical balance, respirometer, and test tube rack. The number of equipment is enough to be used by students in one class, but the beaker is only available in two to three sizes with amounts that do not match the ratio of students need. The equipment that is available in five or more schools is a binocular stereo microscope, microscope maintenance equipment, petri dish, funnel, test tube clamp, Erlenmeyer flask, measuring cup, thermometer, dissecting set, and genetic button.

The score of the readiness of practical work materials in the biology laboratory in State High Schools throughout Tegal Regency shows 42.2%, which means that it is sufficient compared to the criteria but cannot be said to be ready. The materials that are available in State High Schools throughout Tegal Regency are ethanol, iodine, Benedict and biuret. Other materials such as HCl, glucose, universal indicators, NaOH, filter paper, and blood lancet are only available in five or more schools. The materials that should be used for practical work are partially not available and this

condition can lead to constraint during the practicum. Based on the information from the laboratory assistant, the chemicals such as sulfuric acid, HCl, KOH, and MnSO4 which are available in the chemistry laboratory, they are usually taken and used if the teacher needs to carry out practical work so that the activity can be carried out.

Laboratory equipment and practicum materials in SMA Negeri 3 Slawi laboratory are more complete when compared to other laboratories but not 100% in accordance with the standards and the needs of the 2013 Curriculum. Laboratory equipment that is available in SMA Negeri 3 Slawi laboratory and not available yet in other laboratories such as soil temperature thermometer, rotary hygrometer, inoculation needle, weight gain, and body thermometer with a sufficient amount for each group. Materials available in SMA Negeri 3 Slawi laboratory are generally available in other laboratories except for sulfuric acid. Equipment and materials are stored in the equipment and materials cabinet according to the type.

The readiness percentage of biology laboratory facilities is different from one school to another. From the nine laboratories, there are only four laboratories that show the prepared criteria for the aspects of laboratory infrastructure while the other laboratories show sufficient criteria. The readiness of infrastructure facilities is influenced by the procurement and maintenance process that is carried out by the laboratory manager. The central government has provided laboratory facilities to schools through an incidental dropping system. The facilities provided by the government are sometimes not in accordance with the needs, for example, the government drops the test tube even though the number of the test tube is already high in schools while other facilities are still not available. The facilities that have been received should be maintained properly so that they can be used for a long time. Procurement of laboratory facilities in State High Schools throughout Tegal Regency does not only depend on the government support, it means that the schools, in this case, the laboratory managers and the head of the facilities also strive to fulfill the facilities which are needed by the teachers. The limitation of laboratory facilities and infrastructure are due to the limited *BOS* fund which is budgeted by the schools for the purchase of laboratory facilities. Incomplete laboratory facilities can create constraints in practical works because the activities cannot be conducted if there are no equipment and materials which are needed by the students and the teacher (Dewi et al., 2014).

The availability of facilities in biology laboratories in State High Schools throughout Tegal Regency has not met the standards stated in *Permendiknas* Number 24 the Year 2007 and the needs of the 2013 Curriculum. This is also experienced by biology laboratories of State High Schools in Brebes and in Denpasar City with the percentage of each availability is 67.40% and 80.56% (Indriastuti et al., 2013; Mastika et al., 2014). The availability percentage of laboratory facilities in State High Schools throughout Tegal Regency is the lowest when compared to Brebes and Denpasar City. The readiness criteria used in the study of Indriastuti et al. (2013) and Mastika et al. (2014) is *Permendiknas* Number 24 Year 2007 which is based on its completeness only, in contrast to the readiness criteria in this study, namely *Permendiknas* Number 24 Year 2007 and being adapted to the needs of the 2013 Curriculum and paying attention to the availability, ratio, and description that is in accordance with the standards.

Based on the interview result with biology teachers, the intensity of the use of biology laboratories in State High Schools throughout Tegal Regency only reaches 44.3% compared to the number of practicum stated in the 2013 Curriculum in accordance with *Permendikbud* Number 59 the Year 2014. Practical work that ha not been implemented include the practicum of bacterial culture, frog muscle contraction, blood type test, smear blood, blood cell count, blood pressure measure, lung capacity measure, and urine test. The practical works cannot be conducted because of the unavailability of equipment and practicum materials which are needed. According to Olajide et al. (2017), the availability of laboratory infrastructure facilities is directly proportional to the use of these facilities. Katcha & Wushishi (2015) also stated that the implementation of practical work depends on the availability of laboratory equipment that will be used and the ability of the teacher to use the

laboratory equipment effectively and efficiently. The fulfillment of infrastructure facilities should be adjusted to the needs of the practicum that will be carried out annually in accordance with the curriculum that applies to the principles of need, smoothly, and on time (Wiratma & Subagja, 2014). The availability of infrastructure needed and its use are expected to improve students' academic performance, this is in line with the research of Ihejiamazu & Ochui (2016) which states that students who use laboratory tools in learning show better academic performance than students who do not use laboratory equipment.

The Readiness of Biology Laboratory Management

The readiness of biological laboratory management data obtained through questionnaires on biology laboratory management performance that are filled by the biology teachers and observations using observation sheets of biology laboratory management performance. The readiness of biology laboratory management scores is presented in Figure 2.

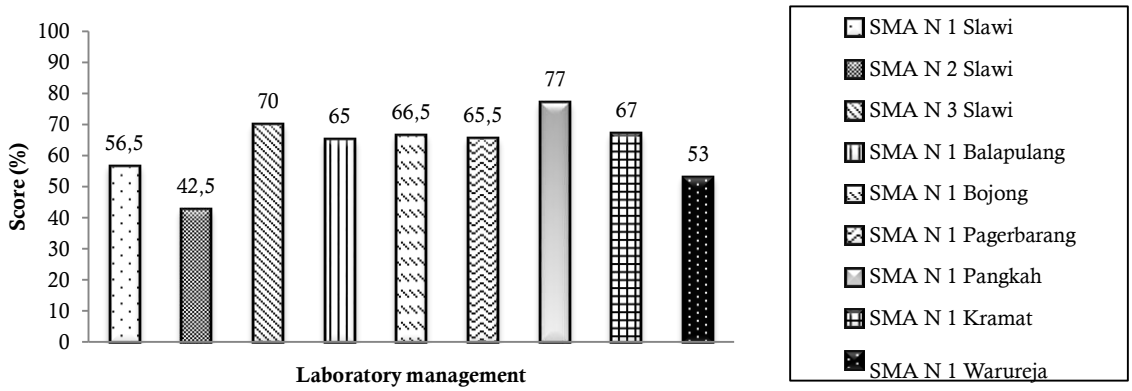

Figure 2 The Readiness of biology laboratory management in State High Schools throughout Tegal Regency

The readiness of biology laboratory management level in State High Schools throughout Tegal Regency is included in the sufficient category. All laboratories do not have a complete laboratory management organization consisting of the head of the laboratory, laboratory assistant, and technician. Each laboratory already has a head of the laboratory and laboratory assistant but does not have a technician. The head of the laboratory in State High Schools throughout Tegal Regency manages all available laboratories in each school so there is no specifically head of the laboratory for biology laboratory. Laboratory personnel is taken from the *TU* (administration) staffs so that their duties are concurrent and do not work optimally. The task of the laboratory management personnel is regulated in *Permendiknas* Number 26 the Year 2008, but in reality, the laboratory management personnel of State High Schools throughout Tegal Regency do not have a clear task. It means that there is no job description for each laboratory management staff. The task distribution of technician and laboratory assistant should be the responsibility of the head laboratory which includes formulating the details of the task, determining the work schedule, supervising, and making periodic reports (Direktorat Pembinaan Tenaga Kependidikan Pendidikan Dasar dan Menengah, 2017).

The schedule of laboratory use and the use of laboratory equipment are rarely found in the field. Many schedules were valid a few years ago and there is no new schedule. In general, the schedule of laboratory use setting is only done by coordinating between biology teachers when they are going to conduct a practicum. Scheduling of practical works is the head of the laboratory responsibility at the beginning of the year by adjusting the academic calendar and the teacher schedule that has been determined.

Laboratory assistants in laboratories of State High Schools throughout Tegal Regency have not been able to inventory equipment and materials properly. Inventory sheets are already available in all schools, but the inventory is only related to furniture and it is rarely done so the inventory found in the field is an inventory several years ago. The performance in conducting an inventory of equipment and materials should include labeling equipment and materials; making an inventory list; checking the condition of equipment and materials at the end of the month and listing equipment and materials that need to be replaced or purchased (Anggraeni et al., 2013).

Provision of equipment and materials has been done well by the laboratory manager. The manager together with the biology teacher proposes the procurement of equipment and materials according to the needs. The proposal is submitted to the school leadership in the field of infrastructure to be submitted in the school budget activity plan (*RKAS*). The limitation of fund causes the demand cannot be fully fulfilled so that the equipment and materials are considered not in accordance with the needs. The process of procuring equipment and materials is also carried out by dropping directly from the central government which is incidental, besides that the equipment and materials received are not in accordance with the needs but it must be accepted by the school.

Work safety in the laboratory is an important factor that must be considered to minimize the risk of accidents. The rules and procedures for emergency handling need to be prepared so that the use of laboratory takes place safely and prevents an accident during the practicum, but not all the laboratories have both of them.

The arrangement of the location of the practicum equipment and materials in the laboratory of State High Schools throughout Tegal Regency is quite good. The equipment and materials needed for practical works are placed in a cabinet that is available in the practicum room with the reason that they are easily accessible during the practicum. The equipment and materials have been grouped according to their type, but there are several laboratories that still classify metal equipment with fragile equipment and solid materials with liquid materials. The arrangement of practicum equipment and materials depends on the facilities in the laboratory, for example, a storage space, preparation room and cabinet, and the interests of laboratory users.

The manager's performance in terms of maintenance and repair of equipment is still not good. The schedule or report of the maintenance and repair are not yet available in each laboratory. Some equipment in the laboratory such as microscopes that have been damaged and do not function properly is not repaired and only stored in a warehouse. The process of maintaining facilities should be carried out routinely by the cooperation between the users and managers so that the available facilities are maintained in their integrity and cleanliness. The routine equipment maintenance can be done by always cleaning and checking the completeness before and after the equipment are used (Raharjo, 2017).

The process of destroying the equipment and materials that have been damaged is done by the laboratory assistant together with the head of the laboratory. Based on the interview result, the equipment that has been damaged is usually collected and stored for later being destroyed at any time when the storage is full. The process of destroying equipment and materials in the laboratory is not written in the official report or not formally administered. The damaged equipment is dumped in a rubbish dump while the material is thrown away into a sewer or buried in the ground.

The manager's performance in making a report at the end of the month/semester/year is still very lacking because the manager has not understood yet about his duties and responsibilities. Periodic and ongoing performance evaluations haven't been implemented too so that there is no improvement or increase in performance. The head of the laboratory should have the managerial competence that is routine and periodically becoming a reviewer and cross-checks the reports that have been made by the manager and suggesting the improvement that must be done (*Permendiknas* Number 26 the Year 2008).

The existence of a laboratory manager is needed in laboratory management so that the laboratory is well managed and makes it easy for the teachers to organize practicum activities. According to the Direktorat Pembinaan Tenaga Kependidikan Pendidikan Dasar dan Menengah (2017), the existence of school laboratory personnel is an integral part of learning activities whose function is to provide services to help in achieving the education goals in schools. The arrangement and management of the laboratory require its own skills and art that can be developed after understanding its components so that it is expected for the laboratory manager to have attended training and obtained a certificate. The head of the laboratories in State High Schools throughout Tegal Regency already have a training certificate for the head of the laboratory with a 300-hour pattern at the high school/vocational level meaning that they have been aware of their respective duties and responsibilities.

CONCLUSION

The readiness of biology laboratories to supporting practical activities in State High Schools throughout Tegal Regency belonged to sufficient criteria referring to *Permendiknas* Number 24 the Year 2007, *Permendiknas* Number 26 the Year 2008 and the need for 2013 Curriculum with an average readiness of 60.52%. The level of readiness of the laboratory in providing facilities and infrastructure has a score of 58.5% which means that it is sufficient, while the readiness of the laboratory management gains a score of 62.8% which is included insufficient category.

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