

# Management of Laboratory Empowerment and Development in Improving the Quality of High School Physics Learning System in Karawang Regency

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**Received:** 20 January 2023

**Accepted:** 15 April 2023

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**Citation:** Komala R, Rossa ATR, Gaffar MA, Mulyanto A (2023) Management of Laboratory Empowerment and Development in Improving the Quality of High School Physics Learning System in Karawang Regency. History of Medicine 9(1): 625-632. <https://doi.org/10.17720/2409-5834.v9.1.2023.068>

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## Abstract

This research is motivated by the phenomenon that the quality of Physics learning system in schools is still low. Physics learning has not taken place as a combination of critical thinking processes that produce reliable and valid information and laboratories in schools that have not been optimally empowered and developed. The purpose of this research is generally to describe and analyze as well as find solutions regarding empowerment management and laboratory development to improve the quality of the learning system. Specifically to describe and analyze the management of empowerment and development of laboratories to improve the quality of the Physics learning system in high schools which includes: (1) Planning, (2) Implementation, (3) Evaluation, (4) Follow-up, (5) Obstacles and (6) Solutions. the research method used is qualitative method. Data collection was done through observation, interviews, and documentation studies. Data analysis was carried out by collecting all information, reducing data, presenting data and drawing conclusions. The theories that support this research are Deming's Grand Theory of Quality Management, Laboratory Quality Management, and Operational Theory of quality theory. Supporting policies are Indonesian Law Number 20 of 2003 concerning the National Education System, Government Regulation Number 4 of 2022 concerning National Education Standards, Minister of Education and Culture Regulation Number 8 of 2018 concerning Operational Guidelines for Physical Special Allocation Funds for the Education Sector, Minister of Education and Culture Regulation Number 24 of 2007 concerning Facilities and Infrastructure Standards. The results showed that in general the management of empowerment and development of laboratories in improving the quality of the learning system in the two schools has been implemented but has not had an optimal impact. While specifically Labaoratorium Management ranging from planning, implementation, evaluation and follow-up in improving the quality of the Physics learning system. Obstacles in the implementation of laboratory empowerment and development management are the lack of certified human resources, the absence of an integrated information system and the lack of partnership activities with other parties involved in the development of laboratories and the low ability of students' process skills in Physics subjects. The solution to overcome the problems in the implementation of empowerment management and

laboratory development to improve the quality of the Physics learning system is to build partnerships with other parties, hold an integrated information system and optimize laboratory management activities through professional development of laboratories as a means of supporting learning or by implementing laboratory management with the concept of quality management.

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### Keywords

Quality Management, Laboratory Management, Learning Quality System.

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Improving the quality of human resources is one of the emphases of the objectives of education, as stated in Law No. 20 of 2003 concerning the objectives of National Education Chapter II Article 3 which reads: "National education functions to develop abilities and shape the character and civilization of a dignified nation in order to educate the nation, aims to develop the potential of students to become human beings who are faithful and devoted to God Almighty, have noble character, are knowledgeable, capable, creative, independent and become democratic and responsible citizens".

The learning outcomes referred to above in the current Indonesian education system are contained in Permendikbud Ristek Number 5 of 2022 concerning Graduate Competency Standards at the general secondary level, one of which is that students are able to demonstrate numeracy in reasoning using mathematical concepts, procedures, facts and tools to solve problems related to themselves, the immediate environment, the surrounding community, and the global community.

Such graduate competency standards can be realized from learning activities in each subject. However, there are special characteristics in Science subjects (Chemistry, Physics and Biology) in realizing the expected graduate competencies, this is related to the characteristics of Science subjects (Chemistry, Physics and Biology) which include products and processes. This has an impact on the importance of Science, especially Physics, teaching about designing and conducting experiments, scientific practicum, and / or solving problems related to substances, space, time, and

energy, this is in line with what is stated in Permendikbudristek Number 7 of 2022 concerning Content Standards at the General Secondary Level which is then also regulated in Permendikbudristek Number 16 of 2022 concerning Process Standards at the General Secondary Level which contains that: learning strategies must be designed to provide quality learning experiences that provide opportunities to apply material to real problems or contexts; encourage interaction and active participation of Learners and optimize the use of resources available in the Education Unit environment and / or in the community; and / or use information and communication technology devices.

Thus learning Physics must take place in accordance with the nature of Physics learning itself, which according to the Center for Curriculum and Bookkeeping of the Research and Development Agency of the Ministry of Education and Culture (2014) "Physics is (1) the process of obtaining information through empirical methods; (2) information obtained through investigations that have been organized logically and systematically; and (3) a combination of critical thinking processes that produce reliable and valid information".

Physics as a process / method of inquiry (inquiry methods) includes ways of thinking, attitudes, and steps of scientist activities to obtain scientific knowledge products, such as observation, measurement, formulating and testing hypotheses, collecting data, experimenting, and prediction.

Physics, emphasizes the application of process skills. Aspects of the scientific approach are

integrated in the process skills approach and the scientific method. According to Anderson in "The Basic Of Physics" (2016): "Physics is a natural science that studies matter and its motion through space and time, along with related concepts such as energy and force. Physics uses the scientific method to help uncover the basic principles that govern light and matter, and to discover the implications of those laws with a method for discovering knowledge about the natural world based on making predictions and testing them empirically".

Such a Physics learning process will not be achieved only by teaching in the classroom but must even be absolutely complemented by Practicum activities in the Laboratory, so that it will create the application of material to real problems or contexts and encourage the interaction and active participation of Learners by optimizing the use of resources available in the Education Unit environment such as laboratories. In Permendikbudristek Number 21 of 2022 concerning Educational Assessment Standards in Early Childhood Education, Basic Education Level, and Secondary Education Level it is stated that "The formulation of assessment objectives pays attention to alignment with learning objectives that refer to the curriculum used by the Education Unit". Currently, both the 2013 Curriculum and the Merdeka Belajar Curriculum which are being implemented at the high school education unit level mandate that in the Physics learning assessment process, graduate competencies are measured by cognitive, affective and psychomotor assessments which are mutually sustainable considering that Physics cannot be studied only for its products such as natural principles, theories or physical laws but must also measure the psychomotor aspects as measured by Performance / Practice Assessment.

With the existence of graduate competency standards, content standards, process standards and assessment standards contained in several

Permendikbudristek, Physics learning at the high school level should run well and be balanced both in the cognitive, affective and psychomotor domains and can produce students who are reliable in science literacy and able to apply Physics concepts to solve everyday life through scientific lines of thought, because Physics is part of science itself.

However, the 2018 National PISA (Program For International Student Assessment) Report states that "the trend of Indonesia's PISA scores and rankings is ranked 70 out of 78 participating countries for aspects of science literacy". Science literacy is the competence to explain a phenomenon scientifically, evaluate and design scientific questions, and interpret data and evidence scientifically as well in the fields of physical, life, earth, & intermediate sciences. It can be seen that the competencies tested on PISA for science literacy aspects are dominated by competencies in the field of Physics.

According to the 2018 National PISA (Program for International Student Assessment) Report on PISA participation for Indonesia from year to year, the composition of PISA students in grades 9 and 10 is increasing, while the proportion of students in grades 7-8 is decreasing. Thus, serious efforts are needed to improve the quality of physics learning at the high school level. In response to this, in Permendikbud Number 22 of 2020 concerning the Strategic Plan of the Ministry of Education and Culture for 2020-2024, the Ministry of Education and Culture has a target to increase the average score of PISA Science Results, namely 399 in 2021 and 402 in 2024. To support the improvement of science literacy, science learning activities, especially at the student level, are often inseparable from science learning activities related to laboratories for practicum / experiment activities.

In the Big Indonesian Dictionary (Poerwadarminta, 2002) "laboratory is defined as a place to conduct experiments (investigations and

so on)". According to (Decaprio, 2013) that: "Laboratories, which are often abbreviated as "labs", are places where scientific research, experiments, measurements, or scientific training are carried out. Schools as an educational institution are required to have supporting facilities and infrastructure for the learning process so as to achieve learning objectives.

Laboratories as a place for research, research, experiments, observations, and scientific testing have many functions in learning activities for that in Permendikbud Number 24 of 2007 concerning Facilities and Infrastructure Standards states that Schools must have a Physics Laboratory according to standards. However, in reality, according to the 2019 Information Data Center, the need for high school laboratories according to the National Education Standards is 67,475 but 30,359 are available and 37,116 are short or 55% short, in other words, the level of laboratory availability according to SNP is still low.

In addition, according to Preliminary Research conducted by researchers in 2021, the results showed that 72.7% of teachers stated that they faced difficulties in carrying out Physics practicum during learning and 27.3% stated otherwise; 81.8% of Physics Teachers stated that they had never conducted performance assessments in the Laboratory due to the poorly organized condition of the Laboratory and 95% of Physics Laboratories in Karawang Regency High Schools do not yet have a Laboratory Attendant and Head of Laboratroum and there are still many Physics laboratories that do not have complete practicum tools and materials.

With this background, it is deemed necessary to conduct research on the development and empowerment of Physics laboratories in schools in order to improve the quality of the quality of the high school Physics learning system in Karawang Regency.

### **Laboratory Empowerment and Development Management**

Laboratory management is an effort to manage the laboratory and is an inseparable part of daily laboratory activities. Laboratory organizations need to be directed and controlled systematically and transparently in order to be successful. Success can be achieved through the implementation and maintenance of a quality management system that is designed to always improve the effectiveness and efficiency of its work while considering the needs of all interested parties.

The purpose of management is to provide guidance to laboratory personnel to be able to carry out assigned tasks within limited time and resources. This includes the management of consumables, equipment, design of work procedures or SOPs, supervision of daily activities, training of old and new personnel and if possible also related to obtaining grants or assistance from external parties.

Laboratory development can be used to raise public awareness related to science knowledge. Laboratories are designed in such a way that they can become part of educational tourism or edu tourism that has the potential to arouse the interest of the younger generation to study science. The concept can be done by making the laboratory space transparent so that anyone can see or witness the activities and equipment or instrumentation in the laboratory.

Science is an empirical science, which is a science based on observation and experimentation (experiment). So, observation and experimentation are an integral part of science education. The laboratory used for these activities is called a school science laboratory. Actually, the notion of a laboratory is not limited to a room equipped with practicum equipment as is commonly found in schools, but the environment can also be utilized as a laboratory. Activities carried out in the laboratory do not always use laboratory equipment that is generally available, but can be through a utilization of simple tools.

Laboratory experiences are integrated with the nature of science that must be involved in every science program for every student. Science activities can include individual, small group, and large group experiences. Problem solving skills are intended in the context of laboratory research. Laboratory activities develop a wide variety of investigative, organizational, creative, and communication skills. Laboratories provide an optimal ground for motivating students as they experience what science is. Laboratory activities can improve student achievement in aspects of process skills.

According to Alsop, et al, empowerment is terminologically defined as the group or individual capacity to make effective choices, namely to make choices and then to transform their choices into desired actions and results. According to Noe in Suwatno, explaining that empowerment is giving responsibility and authority for work to make decisions regarding all product development and decision making.

Clutterbuck, et al. stated in his theory that "empowerment in terms of encouraging and allowing individuals to take personal responsibility for improving the way they do their jobs and contribute to the organization's goals". Based on this opinion, it shows that empowerment is intended as an encouragement and allowing individuals to take responsibility for improving the way they do their jobs and contributing to the achievement of organizational goals.

### **Quality of Physics Learning System**

A learning system is an organized combination of human elements, materials, facilities, equipment and procedures that interact to achieve a goal. In management principles, it is known that the results of a process are related to Man (HR), Method (Method / Strategy), Material (Natural Resources) and Money (Financing) and quality according to Deming is the suitability of the product to the expectations or needs of customers

in this case, students are customers who in the implementation of education in Indonesia are regulated in the National Education Standards (SNP).

Quality learning is a learning process that has been planned in accordance with existing procedures and also designs what will be taught to students later, with the aim of getting satisfactory results in accordance with what is desired. So the quality of the learning system is the implementation of learning in accordance with SNP and its relation to the empowerment and development of laboratories, the quality of the learning system will be reviewed from the competency standards of graduates, infrastructure standards, assessment standards, process standards and facilities for educators and education personnel.

### **Methodology**

This research is a type of case study research using a qualitative approach. Case study research is an in-depth study of events, environments, and certain situations that reveal or understand something. In this study, researchers wanted to reveal in depth about the management of empowerment and development of Physics Laboratories to improve the quality of the Physics learning system in high schools in Karawang Regency. The research subjects are the principal, vice principal for infrastructure and facilities, head of the laboratory, Physics teachers, administrative staff, and students.

### **Results and Discussion**

From the findings of the research conducted by the author, it can be seen that in general the management of empowerment and development of Physics laboratories in SMA Negeri 5 Karawang and SMA Negeri 3 Karawang includes planning, implementation, supervision and follow-up has been done well.

Planning is done by: (1) Preparing laboratory rooms and procuring laboratory equipment and materials in accordance with infrastructure

standards, making work programs based on quality standards agreed upon at the beginning of the school year which refer to management standards, process standards and quality standards for graduates at the high school level for Physics subjects. (2) Planning laboratory programs that can support the improvement of the quality of the high school physics learning system which includes the form of laboratory management activities and the form of effective and efficient practicum in learning physics. As well as making Standard Operating Procedures (SOP) laboratory. (3) Planning a practicum model that can improve students' science process skills when learning Physics in the laboratory. (4) Planning the provision of adequate laboratory facilities by inventorying laboratory equipment and materials as well as laboratory support tools and materials by adding IT equipment as a medium that facilitates an integrated laboratory information system and supporting elements in the implementation of virtual practicum or virtual practicum in the Physics laboratory. (5) Planning the provision of qualified laboratory management human resources accompanied by Job Description (job responsibilities) strengthened by a decree issued by the Head of SMA which is intended for all laboratory personnel. (6) Planning Physics laboratory development activities that involve many parties in the form of partnerships between Physics Laboratories with universities or related institutions that are bound through joint activity agreements in the form of training and technical guidance or workshops and seminars on Physics laboratories and Physics practicum that can improve the quality of Physics learning systems. Implementation is carried out by carrying out laboratory administration, practicum activities and integrated process skills assessment activities when Physics learning takes place in the Laboratory. The implementation of laboratory empowerment and development management in improving the quality of the Physics learning

system in SMA has been running and is well organized, the work program in the laboratory has been integrated with Physics learning in the KBM process in accordance with the laboratory use schedule, annual program, and semester program. practicum from preparation and implementation has been carried out well. Maintenance and work safety and security have been carried out well even though there are some tools that exist but have been anticipated well even though there are some tools that exist but have been anticipated in other ways. The activities carried out in this implementation stage are as follows: (1) Implement a laboratory program that can support the improvement of the quality of the high school physics learning system which includes the form of laboratory management activities and the form of effective and efficient practicum in learning physics. As well as making Standard Operating Procedures (SOP) laboratory. (2) Implementing a practicum model that can improve students' science process skills when learning Physics in the laboratory (3) Providing adequate laboratory facilities by inventorying laboratory tools and materials and laboratory supporting tools and materials by adding IT equipment as a medium that facilitates an integrated laboratory information system and supporting elements in the implementation of virtual practicum or virtual practicum in the Physics laboratory. (4) Carry out the provision of qualified laboratory management human resources accompanied by Job Description (job responsibilities) strengthened by a decree issued by the Head of SMA which is intended for all laboratory personnel. As well as education and training activities are needed for the Head of the Physics Laboratory, Physics Teachers and Laboratory Attendants so that all can be included in certified laboratory personnel.

## Conclusion

The solution in the management of laboratory empowerment and development in improving the

quality of the Physics learning system in Karawang Regency High School is to do (1) Complete laboratory management administration activities related to the administration of the Management Administration (Head of Laboratory and Technician) and Laboratory Equipment Administration and minutes of meeting activities in the Physics Laboratory. (2) Implement an effective and efficient practicum model. In this case, the practicum carried out is still often short of time during the activity which can be resolved by applying the inquiry learning model. (3) Implementing assistance activities during practicum using the peer tutor method so that subject teachers have partners in assisting students in all practicum activities starting from preparation, implementation and reporting. (4) Include laboratory assistants and laboratory heads in certification programs from government agencies or related universities. (5) Apply for additional laboratory assistants who help with Physics laboratory management activities which can be fulfilled through selection and recruitment of Physics Laboratory assistants from among students who are then given special training as has been implemented in Higher Education Laboratories. (6) Create and implement security procedures (safety) and Emergency Services - Evacuation Plan in the event of a work accident in the Physics Laboratory and procedures for handling practicum waste. (7) Provide an integrated information system between general laboratory information, laboratory administration activities, and laboratory activity information such as practicum schedules, virtual practicum information, and student practicum assessment record information that can be accessed by all Physics Laboratory users and stakeholders. (8) Implement partnership programs in the form of joint practicum activities, workshops, guidance and training for educators and education personnel related to the Physics Laboratory with related institutions, both private and state, such as

can be done through proposing the implementation of joint practicum activities, workshops, guidance and training in laboratory management with universities through the university community service program.

Based on the research results and analysis of the research results, it can be concluded that education must begin to pay attention to the effectiveness and efficiency of the laboratory as a means of supporting learning, proper laboratory management in the world of education is one of the important factors to improve the quality of education. Quality education is a source of national progress that determines competitiveness with other nations. Especially the improvement of mastery of science where the subject of Physics is one of them through effective and efficient laboratory management is one of the ways that can be taken, namely by equipping students with science process skills in achieving a complete and perfect understanding of Physics so that it can be applied in solving problems in everyday life and producing quality, competitive and independent graduates. The laboratory management system using the concept of quality management is carried out by schools by conducting stages of supervision planning, implementation and follow-up as an effort to improve the quality of Physics learning.

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