

# Profile of Learning Process Based on Students' Scientific Literacy in Senior High School in Surakarta

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**Abstract**— This study aimed to assess students' participation qualitatively during the process of physics learning based on students' scientific literacy. Lack of students' participation leads to students only know and memorize physics as learning objectives without being able to apply physics in a contextual way. Students' participation should be needed in cognitive construction, as stated in the curriculum 2013. The qualitative and quantitative research method was used in this study. The study was conducted in senior high school in Surakarta during the first semester of the 2018/2019 academic year. Samples were students from XI MIPA 4 and XI MIPA 3 in SMAN X Surakarta. Observation, interviews, and questionnaires were used to perform data collecting. Data were analyzed using descriptive quantitative, supported by the qualitative method. Results from observation showed that 49% of students were agreed, and 12% of students have disagreed with the statement said that they often used a laboratory to learning physics. Besides, results from interviews and questionnaires showed that 56% of students were agreed, and 12% of students were disagreed to do experiment methods to learning physics. It was concluded that students' participation during the process of physics learning based on students' scientific literacy was low on quantitative and qualitative context.

**Keywords:** *students' scientific literacy, students' participation, experiment, laboratory*

## I. INTRODUCTION

Learning in schools has the goal of achieving the expected competence. Each school has its own competency criteria that are tailored to the conditions and needs of the school. Some people consider Physics to be the most fundamental science or science because it is the basis of all other fields of science. In essence, Physics is one branch of Natural Sciences that studies the fundamental relationship between matter and energy. Therefore, the characteristics of natural science are also possessed by Physics, such as scientific attitude, scientific methods, and scientific products. Theories and laws of Physics

as a scientific product is a knowledge that is found through observation of the natural surroundings, data collection, experimentation, inference, and the formation of theories that are part of the scientific method. In the process of finding the physical laws, it requires determination, curiosity, perseverance, and honesty, which are scientific attitudes, to uncover the natural phenomena. Physics is part of science that deals with matter and energy, with laws that govern the movement of particles and waves, with interactions between particles, with the properties of molecules, atoms, and nuclei, and with larger-scale systems such as gas, liquid, and solid[1]

The development of science and technology is a challenge for young people who are required to use technology in various fields, including education. Effectiveness of the Utilization of Interactive Multimedia Learning of Natural Sciences Biology in Improving Learning Motivation of Male and Female Students of SMP 19 Jambi City where the facilities that enable e-learning are computers that can be developed into learning media that can be used by teachers as facilitators and can be used by students during the learning process [2].

Multimedia can be used in the learning process to bring students closer to the phenomenon that leads students to concepts based on learning objectives. Applying the Science of Learning: Evidence-Based Principles for the Design of Multimedia Instruction, which reveals that multimedia can create meaning through the learning process[3]. Meaningful learning can further instill concepts to students so that students are able to apply learning outcomes to real conditions in society. Development of Multimedia Literacy-Based Learning for Junior High School Students on the Technology Theme said that multimedia learning based on scientific literacy that has been developed has deficiencies in the design content of epistemic knowledge[4]. This shows that the development of learning media based on scientific literacy needs to be explored to foster scientific attitudes and add to the concepts of physics learning

The identity of the Indonesian people is dominated by diverse cultural cultures. Local Cultural Wisdom Adhesives Nation's Identity says that proper learning is needed to strengthen national identity through local wisdom[5]. Use local cultural values as glue and strengthen the nation's identity because the Indonesian nation is a multicultural passion so that all components of the nation are obliged to maintain and educate people based on diversity without losing their identity.

The physics learning process can not be separated from the scientific methods used in shaping the concept of knowledge. Student's Literacy Ability in Ecosystem Learning finds that students tend to be more able to process quantitative data compared to understanding scientific methods[6]. The reason for this is that in schools, the skills to process, analyze, and interpret quantitative data are more often used because they are integrated with Mathematics. But the understanding of scientific steps is less mastered because it is rarely practiced in schools. This encourages researchers to be able to create e-modules that are able to drive the learning process scientifically through virtual practicum and real practicum that is packaged practically in e-modules.

The use of e-modules in learning is able to cover the shortcomings of learning using textbooks. Development of Science Literacy-Based E-modules on Electromagnetic Radiation Materials the development of science-based e-module literacy was successful with a valid and appropriate expression as a learning medium[7]. E-modules are more interesting for students to learn independently and follow the learning process in class. Nana and colleagues add that it is recommended that e-modules be added with science literacy based animation to illustrate abstract concepts so that they are easy for students to understand.

It has created a Physics mobile application that was categorized as good. The m-learning learning media developed has the following specifications: (1) created using Adobe Flash CS 5.5 software; (2) run on an Android smartphone; (3) has a capacity of 2.71 Mb. In this study, Rifa'atul Maulidah tested one instructional media expert, one material expert, one linguist, three high school physics teachers, five peer reviewers, and responses to the media from 38 high school students. Based on the results of the study, it was concluded that learning media in the form of mobile learning could be used as supporting learning media in high school physics lessons [8].

Implementation of mobile learning in J2ME-based mathematics, the results of product evaluations by mathematics teachers, and students on them-learning applications have obtained a good response to aspects of visual communication, aspects of the software, and aspects of learning design[9]. The weakness of the J2ME-based mobile learning, are namely the type of platform from J2ME, which only supports the type of Java mobile devices so that this technology cannot support other mobile devices that are currently developing, such as devices with Android Operating System (OS) and iPhone.

Developed the Physics pocket learning media on smartphones using Adobe Flash Professional CS 5.5. This study uses the Borg and Gall R&D (research and development) approach[10]. The assessment results obtained from the

validator, and students show that this media has very good criteria and is suitable for use in learning activities. The difficulty at this stage of making media is the limited reference of books about Adobe Flash CS 5.5.

Science is a systematic effort to create, build, and organize knowledge to understand the universe. This effort starts with human nature, which is full of curiosity. This curiosity is then followed up with an investigation in order to find the simplest, but an accurate and consistent explanation to explain and predict humans and the universe. This investigation is carried out by integrating scientific work and work safety, which includes observing activities, formulating problems, formulating hypotheses, designing experiments, collecting data, analyzing, finally concluding and giving recommendations, and reporting experimental results verbally and in writing. In other words, science exists to shape thought patterns, behavior, and build human character to care and be responsible for himself, society, and the universe. The presence of science that shapes human behavior and character to care and be responsible for himself, society, and the universe is what is defined as scientific literacy.

The fact of the 2015 PISA results shows the average science value of OECD countries is 493, while Indonesia has only reached a score of 403. This shows that there are gaps in treating science education. In the national education system, the concepts and mindset of science education are explicit and use a scientific and inquiry approach[11]. However, the fact that this has not been applied in learning classes.

Science literacy in learning in Indonesia is perceived only in learning science. Science learning is also mostly limited to textbooks/texts. This is due to the narrow interpretation related to PP No. 13 of 2015 Article I paragraph 23, which explains that "textbooks are the main source of learning to achieve basic and core competencies." Most understand that textbooks are the only teaching material, so that science learning has not adopted a scientific and inquiry approach. If, in the context of science lessons alone, scientific literacy has not been applied precisely and comprehensively, its application in other learning needs to be questioned. This fact makes many Indonesians not accustomed to finding various sources. The low scientific literacy ability of Indonesian students is influenced by many things, including the curriculum and education system, the selection of methods and models of teaching by teachers, learning facilities and facilities, learning resources, teaching materials, and so forth. One of the factors that is directly related to student learning activities and affects the low ability of Indonesian students' scientific literacy is the existence of student learning resources, in this case, teaching materials in the form of books, which so far are still the main sources of student learning in school[12]. According to Stake and Easley in a research journal written by Adisendjaja[13], 90% of science teachers still use books in the learning and teaching process. Given the important role of books in learning, it is necessary to develop research on teaching materials in the form of books, which are currently still very limited. [14] explained that science education is responsible for achieving the scientific literacy of the nation's children because it needs to be improved in quality. Improving the quality of science education can be done through scientific thinking where science thinking can be

developed through the ability to think higher level (expert thinking). This high-level thinking ability can be used as a foundation to shape the nation's character, where the character of a child of a nation who is able to think at a high level will not be easily fooled by issues that provoke conflict in the community. For example, someone who thinks high-level will understand the characteristics of foods containing hazardous substances, understand how to spread an epidemic, and understand how to cause disasters and how to overcome them.

**II. EASE OF USE**

*A. The Present Study Entities*

The profile of learning process based on Students' Scientific Literacy

*B. The population of the study*

The population of the study consist of all Sain's class student of SMAN X Surakarta.

*C. Sample and Procedure of the Study*

Two classes in SMAN X Surakarta are selected. Random sampling technique was used to select groups by the researches in this study

*D. Tools for Data Collection*

*1) Documentation*

Documentation is a way of taking data through analysis and collecting documents. Documents in this study can be in the form of written documents, drawings, or electronic documents. Written document data are the 2013 curriculum for the high school physics syllabus, books used by students, and evaluation sheets used by students (about PTS or PAS).

*2) Interview*

Interviews are a way of taking data with questions and answers between researchers and research subjects as a basis for the development of interactive modules.

*3) Questionnaire*

The questionnaire consisted of an open questionnaire and a closed questionnaire. An open questionnaire is used to get comments and suggestions used in revising interactive modules that are developed, and closed questionnaires are used to determine the quality of interactive modules that are developed based on the choice of answers that are tailored to the needs of research.

The reliability test was conducted on the questionnaire, and the following results were obtained:

TABLE I. RELIABILITY STATISTIC QUESTIONNAIRE

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
i1	27,67	18,644	,326	,796
i2	27,77	16,461	,507	,777
i3	27,77	15,909	,563	,770
i4	28,60	17,214	,452	,784
i5	27,97	17,482	,344	,796
i6	28,30	15,941	,656	,761
i7	27,37	16,447	,403	,792
i8	27,33	17,954	,405	,789
i9	28,53	16,120	,481	,781
i10	27,40	14,869	,614	,762

TABLE II. RELIABILITY STATISTICS

Cronbach's Alpha	N of Items
,799	10

From the above data, the alpha value is 0.799, which is included in the acceptable category. So the questionnaire can be used as a research instrument

**III. DATA ANALYSIS AND INTERPRETATION**

The teacher, as a facilitator and students, can use the learning media based on the Surakarta local wisdom, the gamelan gong, which is integrated with the material of equilibrium of rigid objects. The summary of the results of the needs analysis can be seen in the following table:

*A. Aspect 1*

TABLE III. STUDENT OPINIONS ON ASPECT 1

Aspect 1	Opinion				
	SA	A	S	D	SD
Learning physics in class is fun	5%	31%	58%	7%	0%

In table 3 it is found that 5% of students strongly agree, 30% of students choose to agree, 58% of students choose sometimes, 7% choose to disagree, and 0% of students choose strongly to disagree on aspect two that learning physics in class is fun. From these data, it was found that the majority of students felt that learning physics in class was fun. These data indicate that students have the motivation to study Physics. Linear with the results of the teacher's interview, which says that students are interested in Physics lessons during the learning process that is marked by student attention during the learning process.

**B. Aspect 2**

TABLE IV. STUDENT OPINIONS ON ASPECT 2

Aspect 2	Opinion				
	SA	A	S	D	SD
I love physics	3%	37%	49%	10%	0%

In table 4 it was found that 3% of students strongly agreed, 37% of students chose to agree, 49% of students chose sometimes, 10% chose to disagree and 0% of students chose strongly disagree on aspect 2. From the data, it was found that the majority of students liked physics. The data is linear with the results of indicator 1 where students have an interest in Physics lessons taught at school.

**C. Aspect 3**

TABLE V. STUDENT OPINIONS ON ASPECT 3

Aspect 3	Opinion				
	SA	A	S	D	SD
Physics lessons related to daily life	3%	27%	49%	20%	0%

In table 5 it was found that 4% of students strongly agreed, 27% of students chose to agree, 49% of students chose sometimes, 20% chose to disagree, and 0% of students chose strongly disagree with aspect 3. From the data, it was found that the tendency of students to like Physics lessons related to daily life. This shows that students are interested in contextual learning contained in the indicators of scientific literacy

**D. Aspect 4**

TABLE VI. STUDENT OPINIONS ON ASPECT 4

Aspect 4	Opinion				
	SA	A	S	D	SD
I often use laboratory equipment	0%	2%	37%	49%	12%

In table 6 it is found that 0% of students strongly agree, 2% of students choose to agree, 37% of students choose sometimes, 49% choose to disagree, and 12% of students choose strongly disagree on aspect 4. From the data, it is found that the tendency of students to state that students rarely use practical tools at school. This shows that Physics learning in the school has not maximized the psychomotor aspects that affect the students' kinesthetic creativity.

**E. Aspect 5**

TABLE VII. STUDENT OPINIONS ON ASPECT 5

Aspect 5	Opinion				
	SA	A	S	D	SD
I do not know the function component of the Physics experiment tool	2%	32%	46%	20%	0%

In table 7 it is found that 2% of students strongly agree, 32% of students choose to agree, 46% of students choose sometimes, 20% choose to disagree, and 0% of students choose strongly disagree with aspect 5. From the data, it is found that the tendency of students to state that students do not know the function components of practical tools in school. This is linear with the results from aspect four that practicum in the physics learning process at the school is not maximized as it should be stated in the revised syllabus of the 2013 Curriculum. The 2013 curriculum states that in the learning process, there are stages of experimentation or exploration.

**F. Aspect 6**

TABLE VIII. STUDENT OPINIONS ON ASPECT 6

Aspect 6	Opinion				
	SA	A	S	D	SD
I am skilled at using laboratory equipment	2%	7%	42%	47%	2%

In table 8 it was found that 2% of students strongly agreed, 7% of students chose to agree, 42% of students chose sometimes, 47% chose to disagree, and 2% of students chose strongly disagree on aspect 6. From the data, it was found that the tendency of students stated that students are not skilled in using laboratory equipment. The emergence of psychomotor skills through physics experimentation tools is caused because learning in schools does not provide an opportunity for students to discover Physics concepts through exploratory learning processes in the laboratory. This is linear with teacher interviews stating that teachers rarely conduct experiments in the physics learning process in the classroom due to the limited teaching time with a load of Physics material which is considered to be many and the lack of laboratory assistants because at that school there is only one laboratory assistant for three laboratories namely the Chemistry, Biology laboratory, and physics. A solution is needed for this problem because to realize the achievement of learning objectives in the 2013 revision curriculum requires an exploration or experimental stage for students to emerge psychomotor skills and student skills in seeing the contextual phenomena that exist in the exploration process. The limited-time and laboratory staff can be overcome by the existence of virtual experiments that can speed up the exploration process of students. The advantages of virtual experiments can provide a solution to the loss of the stages of the exploration process in learning Physics. Virtual Physics experiments can be done in the classroom or outside the classroom according to the circumstances and needs of students.

Virtual Experiments not only make it easier for students to do the exploration process, but students can also get to know the experiment tools and their functions during the learning process. The appearance of virtual experiments that are colorful and have variables that can be changed (2-way learning) makes it possible for students to look for physics concepts through virtual experiments independently or classically.

*G. Aspect 7*

TABLE IX. STUDENT OPINIONS ON ASPECT 9

Aspect 7	Opinion				
	SA	A	S	D	SD
I like to do experiments while studying Physics	12%	56%	29%	0%	3%

In table 9 it was found that 12% of students strongly agreed, 56% of students chose to agree, 29% of students chose sometimes, 0% chose to disagree, and 3% of students chose strongly disagree on aspect 7. From the data, it was found that the tendency of students to state that students like to do experiments in the process of discovering physics concepts. These results support aspect six so that the exploration process is expected to be able to increase student participation and understanding with the concepts of physics obtained during the exploration process. The exploration process becomes one of the indicators in students' scientific literacy where students can form new concepts from existing concepts that will be constructed or built through existing stages

*H. Aspect 8*

TABLE X. STUDENT OPINIONS ON ASPECT 10

Aspect 8	Opinion				
	SA	A	S	D	SD
I know the local culture of Surakarta	14%	51%	34%	2%	0%

In table10, it was found that 14% of students strongly agreed, 51% of students chose to agree, 34% of students chose sometimes, 2% chose to disagree, and 0% of students chose strongly disagree on aspect 8. From the data, it was found that the tendency of students to state that students know the local culture of Surakarta. These results indicate that students know the culture of the city of Surakarta obtained through formal and informal learning. The city of Surakarta, which is a city of culture and a point of life for Javanese culture, strives to preserve Javanese culture in various ways. One of the strong Javanese culture in the city of Surakarta is Gamelan. In the junior high school curriculum, gamelan becomes one of the lessons students must learn. This indicates that students are no strangers to Surakarta Gamelan.

*I. Aspect 9*

TABLE XI. STUDENT OPINIONS ON ASPECT 11

Aspect 9	Opinion				
	SA	A	S	D	SD
I did not know that the concept of Physics existed in Gamelan devices	7%	49%	17%	27%	0%

In table 11 it is found that 7% of students strongly agree, 49% of students choose to agree, 17% of students choose sometimes, 27% choose to disagree, and 0% of students choose strongly to disagree on aspect 9. From the data, it is found that student tendency states that students do not know that there is a concept of Physics in Gamelan. Gamelan, which is already familiar to students, is only regarded as local culture and has no meaning in the context of science. Physics is a science that is tight in everyday life can be explored and become a source of learning to find concepts. The concept can be raised through exploration and literacy activities that build new concepts from existing concepts. In aspect eight, students know the culture but have not interpreted that science also exists in the culture. Science inspired our predecessors through experiences or habits that were inherited from generation to generation and were regarded as a standard by Javanese people. The standard is inherited as a benchmark acting as in the standard arrangement of the gong.

In the preparation of gongs on Gayor has a standard that a large gong is placed near the supporting pole. The standard can be brought in the Physics concept in the equilibrium class of class XI Odd Semester. The concept of science that has existed for hundreds of years, known as the standard, can be explored and interpreted as a source of contextual physics learning. Students can build concepts of physics through close experience and culture of students so that the concepts obtained have meaning.

*J. Aspect 10*

TABLE XII. STUDENT OPINIONS ON ASPECTS 12

Aspect 10	Opinion				
	SA	A	S	D	SD
I would be interested in learning if there is a Physics module that illustrates Physics phenomena using Surakarta cultural wisdom	17%	51%	24%	8%	0%

In table 12 it is found that 17% of students strongly agree, 51% of students choose to agree, 24% of students choose sometimes, 8% choose to disagree, and 0% of students choose strongly to disagree on aspect 10. From the data, it is found that the tendency of students to be interested in the Physics module that describes Physics phenomena through Surakarta cultural wisdom. Contextual learning provides motivation for students in finding new concepts obtained through phenomena that are close to students. That way, students are able to solve science concepts that exist in students' daily lives so that. The concept of science obtained through the learning process based on local cultural wisdom has two double meanings. Students understand the concepts of science and understand the culture where both can run in harmony without a collision between logic and the existing cultural standard.

#### IV. CONCLUSION

From the research found in the learning process at school, students still lack in the context of science literacy. Science literacy should emerge in classroom learning as the basis of science learning itself. It was concluded that students' participation during the process of physics learning based on students' scientific literacy was low on quantitative and qualitative context. This happens because the learning process in schools is only focused on the delivery of material, not on the development of competencies based on affective and psychomotor as delivered in the 2013 curriculum.

The author's suggestion to the reader that the learning process in class must be in accordance with the objectives and references of the 2013 curriculum. In the 2013 curriculum, it is stated that the learning process fosters the scientific literacy of students so that scientific attitudes emerge for students.

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