OPEN ACCESS
Journal of Advances in Education and Philosophy
Abbreviated Key Title: J Adv Educ Philos
ISSN 2523-2665 (Print) |ISSN 2523-2223 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: https://scholarsmepub.com/jaep/

Original Research Article

The Scientific Literacy Strategy in Efforts to Eliminate Student Misconceptions

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DOI: 10.36348/JAEP.2019.v03i10.001 | **Received:** 26.09.2019 | **Accepted:** 03.10.2019 | **Published:** 14.10.2019

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Abstract

Preliminary research shows the difficulties of students in understanding the concepts of photosynthesis and cellular respiration which is characterized by the low achievement of student learning outcomes in the academic field. This research is based on the desire of researchers to find out the factors that influence student's learning difficulties, namely factors of misconception or low mastery of concepts by students. This study used a pre-experiment with a one group pre-test post-test design approach. The research instruments consisted of subtopic biology Photosynthesis and Cellular Respiration modules, RPP, instruments for identifying student misconceptions, concept mastery test instruments, and science process skills test instruments (KPS). The study population was students of class XII of the SMA Negeri 2 Palangkaraya Science Department with the research sample being Class 12 IPA-8 which amounted to 41 students. The procedure of data collection is taken using 2 types of data, namely using multiple-choice questions (three-tier multiple tests) to identify misconceptions and questions in the form of descriptions for mastery of concepts and KPS. Analysis of pre-test and post-test data using the Certainty of Response Index (CRI) method. The results showed the level of student misconception before being given scientific literacy-based learning was quite high with a percentage of 68.29%. Another impact of the application of scientific literacy-based learning strategies to the achievement of student learning outcomes is increasing the ability to master student concepts and science process skills (KPS) in the subtopics of photosynthesis and cellular respiration.

Keywords: Scientific literacy, misconception, concepts mastery, science process skills.

INTRODUCTION

Photosynthesis and cellular respiration are important sub-topics in biology because scientific studies of these two concepts have a very important role in the field of biology. However, these two concepts are difficult for students to understand because the study of the concepts in them is complex and characterized by a combination of several different disciplines, such as: ecology, physiology, biochemistry, and energetic [1, 2]. Svandova [3] in her research shows that many students do not even understand the basic concept that photosynthesis and cellular respiration are interrelated, and both have interconnected physiological functions.

Students' difficulties in understanding the concepts of photosynthesis and cellular respiration have an impact on the low achievement of student learning outcomes in academics, especially biology, especially on both topics. The low achievement of student learning outcomes on the topic of photosynthesis and respiration was also experienced by 12th grade students of SMA Negeri 2 Palangkaraya, which was reflected in the low achievement scores of student daily tests. This preliminary information was obtained based on the narrative from fellow biology teachers stating that the majority of students had low test scores on this topic.

Preliminary research is conducted in advance to find out what exactly causes low achievement of student learning outcomes on the topic. The aim is to find out the factors that cause students difficulties in learning. The initial guess about the causative factor is students do not know/understand the concept or students experience misconceptions. The preliminary study was conducted with a written pre-test with multilevel multiple choice questions (three-tier multiple choice), which were given to as many as 41 students of 12th grade students of SMA Negeri 2 Palangkaraya as samples. The results of the preliminary study showed that about 62% of students experienced misconception, as many as 22% of students did not know the concept

and the rest understood the concept as well as not misconception.

These results indicate that the low achievement of student learning outcomes in daily test results on the topic of photosynthesis and cellular respiration is caused by misconceptions. Misconception is a form of wrong and deviant understanding related to a matter of a scientific nature that is contrary to the actual scientific concept. Misconceptions are conclusions and understandings of concepts that are unacceptable or scientifically contradictory but are formed in such a way in the minds of students and as if in accordance with the correct scientific concept, even though in reality it is wrong. Misconceptions can take the form of differences in one's scientific beliefs with scientist opinions and consensus, mistakes mention examples of concepts, errors in combining interconceptions, or understanding immature concepts.

Misconception in the world of education is a big obstacle. Misconception is an obstacle to understanding scientific phenomena in the field of science lessons as a whole. Misconceptions in the field of biology have been recognized as the main factors influencing student's understanding of science at the high school level, with many misconceptions being brought up to the level of education at the college level [4]. Student misconceptions can be eliminated through increased mastery of concepts and improvement of students' science process skills. Mastery of concepts can be interpreted as the level of understanding of students related to the topic of learning that has been learned. Mastery of concepts is the basis for thinking. Whereas science process skills (KPS) is the ability of students to apply scientific methods in understanding, developing and discovering science. KPS is all the skills needed to acquire, develop, and apply concepts, laws, and scientific theories, both in the form of mental skills, physical skills (manual) and social skills [5].

One method of learning science that is good according to researchers is the scientific literacy approach. Scientific literacy-based learning is learning that is based specifically on the development of natural knowledge (science), especially biology. Scientific literacy methods are sought to realize science learning in schools, especially biology. Biology as one of the branches of Natural Sciences (science), it is appropriate to be taught with scientific literacy learning methods, because biology as an applied science is directly in contact with people's lives, it is necessary to have scientific knowledge skills from various aspects of life. The hope, through scientific literacy methods can eliminate misconceptions in students and also can improve mastery of concepts, science process skills, and achievement of student learning outcomes.

METHODS

This study included pre-experimental research with a one group pre-test post-test design approach. The group of subjects was observed before the intervention, then observed again after intervention [6]. The research instruments consisted of subtopic biology Photosynthesis and Cellular Respiration modules, RPP, instruments for identifying student misconceptions, concept mastery test instruments, and science process skills test instruments (KPS). The research variables consisted of independent variables namely scientific literacy learning strategy and the dependent variable were three namely student misconception (Y1), mastery of concepts (Y2), and science process skills (Y3). The study population was students of 12th grade students of the SMA Negeri 2 Palangkaraya Science Department with the research sample being IPA-8 which amounted to 41 students. The selection of samples in this study used purposive sampling with certain reasons and considerations. The procedure of data collection is taken using 2 types of data, namely using multiple-choice questions (three-tier multiple tests) to identify misconceptions and questions in the form of descriptions for mastery of concepts and KPS. Analysis of pre-test and post-test data using the Certainty of Response Index (CRI) method.

RESULTS

Identification of Student Misconceptions

Before an analysis of student answers in a pre-test, the interpretation of misconceptions is based on the results of the student's answers to the identification test instrument, a misconception in the form of a three-tier multiple choice. The value of Miminum Mastery Criteria (KKM) biology for 12th grade students based on Curriculum-2013 (K-13) is 78. Based on the analysis of student's answers in the pre-test the percentage of students understood the concept of 14.63% or as many as six students. While the percentage of students with misconceptions was 68.29% or as many as 28 students, and the percentage of students who did not understand the concept was 17.07% or as many as seven students. From these results it can be concluded that the category of students' misconception level in the sub-topic of photosynthesis and cellular respiration before the implementation of scientific literacy learning strategies was high with a percentage value of 68.29%.

Based on the results of the analysis of the pre-test data which shows the high percentage of students who experience misconception, learning sub-topics of photosynthesis and cellular respiration are based on scientific literacy. This application is carried out through stages and learning steps contained in the lesson plan (RPP) and equipped with learning tools in the form of learning modules. Scientific literacy-based learning is carried out in an integrated manner with technological literacy, by utilizing progress and developments in the field of information and technology (IT). This learning uses animated videos that are relevant and closely related to the process of photosynthesis and cellular respiration presented at the

beginning of the learning process as one form of scientific literacy learning.

Post-tests were carried out at the end of the learning activities using test instruments for identification of misconceptions as in the previous pre-test. Based on the results of the analysis of the students' answers to the post-test, it was found that the percentage of students who understood the concept was 82.93% or as many as 34 students. Percentage of student categories with misconceptions of 9.76% or as many as four people. While the percentage of students who do not know the concept is only 7.32% or as many as three people. The percentage value of students who misconception in the post-test, after the application of scientific literacy-based learning, falls into the low category.

In conclusion, the application of scientific literacy methods to the learning sub-topics of photosynthesis and cellular respiration can significantly eliminate student misconceptions. This is based on a decrease in the number of students who experience significant misconceptions, in the pre-test the percentage of students whose misconceptions amounted to 68.29%, while in the post-test, the percentage of students who misconceptions was only 9.76%. So that it can be said that scientific literacy-based learning strategies can significantly eliminate student's misconceptions in the sub-topic of photosynthesis and cellular respiration.

Table-1: Comparison of the value of the percentage of pre-test and post-test identification of student misconceptions

Category	Pre-Test	Post-Test
Understand the concept	14.63%	82.93%
Misconception	68.29%	9.76%
Not understand the concept	17.07%	7.32%

The results of the identification of student misconceptions are in line with the results of research conducted by Setiawati *et al*., [7], which states that the profile of students' misconceptions in the topic of photosynthesis and cellular respiration in 9th grade junior high school students in Denpasar varies considerably and students have diverse misconceptions about the concepts of phosphorus and cellular respiration they learn, and in general, types of student misconceptions related to concepts of photosynthesis, respiration in plants, and the relationship of these two concepts. This is also in line with the results of Svandova [8] study, which shows that many students do not even understand the basic concept that photosynthesis and respiration are interrelated, and both have interconnected physiological functions.

Students Concept Mastery

Based on the results of the analysis of the student's answers in the pre-test, before the implementation of scientific literacy strategies in the learning sub-topics of photosynthesis and cellular respiration, it was found that the percentage of achievement of the average mastery of student concepts was 57.72%. From the percentage value, it can be concluded that the level of student concepts mastery before the implementation of scientific literacy-based learning falls into the sufficient category. Subsequently the learning sub-topics of photosynthesis and cellular respiration based on scientific literacy were carried out through stages and learning steps as contained in the lesson plan (RPP) which was also supplemented by the use of biology modules on the topic of metabolism, sub-topics of photosynthesis and cellular respiration. Scientific literacy-based learning is carried out in an integrated manner with technological literacy, by utilizing progress and developments in the field of information and technology (IT), through the use of animated videos that are relevant and closely related to photosynthesis and cellular respiration which are presented as early as the learning process one form of scientific literacy learning.

Post-tests were conducted at the end of the learning activities using the concept mastery test instrument in the pre-test that had been carried out previously. Based on the results of the analysis of the students pre-test answers, it was found that the percentage of achievement of the average level of mastery of students' concepts was 81.10%. The level of mastery of student concepts in the post-test, after the implementation of scientific literacy-based learning, is in a very good category. Then an analysis was carried out to determine the increase in mastery of student concepts after the implementation of scientific literacy strategies in learning the sub-topics of photosynthesis and cellular respiration by calculating the normalization value of gain (N-gain). Based on the results of calculations and analysis of the scores and grades of student achievement in the pre-test and post-test, it was found that the average value of normalization gain (N-gain) mastery of student's concepts was 0.57 with criteria for increasing mastery of concepts in categories is being Thus it can be concluded that the application of scientific literacy strategies in the learning sub-topics of photosynthesis and cellular respiration can improve student process skills (KPS) which were originally only in enough categories with student's average KPS of 57.72 %, increased to 81.10% with a very good category.

Table-2: Comparison of the percentage value of students concept mastery in pre-test, post-test, N-gain, and the assessment of improved mastery of concepts

Description	Pre-Test (%)	Post-Test (%)	*N-gain*	Assessment of Student Mastery Concept Improvement
Mastery of the Concept	57.72	81.50	0.57	Sufficient
Concept Assessment Category	The level of mastery of the concept in sufficient level	The level of mastery of the concept at a very good level	Increased mastery of concepts at a moderate level	There is a significant increase in mastery of concepts significantly

Student Science Process Skills (KPS)

Based on the results of the analysis of student's answers in the pre-test, before the implementation of scientific literacy strategies in learning the sub-topics of photosynthesis and cellular respiration, it was found that the percentage of achievement of the average KPS score was 46.83%. Based on these achievements, it can be concluded that the level of KPS students before the implementation of scientific literacy-based learning is in the sufficient category. Subsequently the learning sub-topics of photosynthesis and cellular respiration based on scientific literacy were carried out through stages and learning steps as contained in the lesson plan (RPP) which are also equipped with the use of maternal metabolic biology modules, sub-topics of photosynthesis and cellular respiration. Scientific literacy-based learning is carried out in an integrated manner with technological literacy, by utilizing progress and developments in the field of information and technology (IT), through the use of animated videos that are relevant and closely related to photosynthesis and cellular respiration which are presented as early as the learning process one form of scientific literacy learning.

Post-tests were carried out at the end of the learning activities using the KPS test instrument in the pre-test that had been carried out previously. Based on the results of the analysis of the students' pre-test answers, it was found that the percentage of achievement of the mean score of the student's KPS level was 81.07%. The KPS level of students in the post-test after the implementation of scientific literacy-based learning is in a very good category. Then an analysis was conducted to determine the increase in KPS of students who had applied scientific literacy-based methods in learning the sub-topics of photosynthesis and cellular respiration by calculating the normalization value of gain (N-gain). Based on the results of the calculation and analysis of the scores or achievement scores of each student in the pre-test and post-test, the average KPS gain (N-gain) normalization value of the students was 0.64 with the criteria for increasing KPS students in the medium category.

Thus it can be concluded that the application of scientific literacy in the learning sub-topic of photosynthesis and cellular respiration can increase the student's KPS which was originally only in the sufficient category with the student's average KPS score of 46.83%, increasing to 81.07% with the very category well. Comparison of the percentage of student's KPS in the pre-test and post-test after the application of scientific literacy strategies in the learning sub-topics of photosynthesis and cellular respiration, as well as the value of increasing KPS after application in the N-gain and assessment of student KPS improvement are presented in Table-3.

Table-3: Comparison of the percentage value of students KPS in the pre-test, post-test, N-gain, and assessment of students KPS improvement

Description	Pre-Test (%)	Post-Test (%)	*N-gain*	Student KPS Improvement
KPS	46.83	81.07	0.64	-
KPS Category	Sufficient	Very Good	KPS increase is in the medium category	Significantly there has been a significant increase in KPS

DISCUSSION

Identification of Student Misconceptions

Based on the analysis of the identification of student misconceptions based on the interpretation of the results of the students answers in the pre-test by using the multi-level multiple choice student's misconception test instrument instruments, it was found that 28 students experienced misconceptions or 68.29%. Whereas after the implementation of scientific literacy strategy in learning the sub-topics of photosynthesis and cellular respiration and post-test was carried out using the same instrument with the pre-test, the number of students who experienced misconception was only four people or 9.76%. This shows that there is a significant reduction in the number of students experiencing misconceptions after the method of scientific literacy strategy in learning the sub-topics of photosynthesis and cellular respiration. The number of students who

experienced misconceptions after learning the sub-topic of photosynthesis and cellular respiration through the application of scientific literacy drastically reduced to only four people or 9.76% of the original as many as 28 people or 68.29% when students had not followed learning with scientific literacy.

These differences arise as a positive impact of the application of scientific literacy methods in the learning sub-topics of photosynthesis and cellular respiration. Previously the sub-topic of photosynthesis and cellular respiration had been studied at the elementary and junior high school levels, because in Indonesia both of these sub-topics were taught at all levels of education, from elementary school to university [9]. The concept and initial knowledge formed in the minds of students while studying the sub-topic of photosynthesis and cellular respiration while in elementary and junior high school played a major role in influencing student misconceptions while in high school.

While the scientific literacy learning model is a learning model that is able to explain the meaning of fundamental scientific concepts and fundamentals contained in the sub-topics of photosynthesis and respiration with clear language combined with technological literacy in the form of animated videos and images and internet learning media simultaneously. The scientific literacy learning model can explain to students the meaning of actual scientific concepts intended in the sub-topic of photosynthesis and cellular respiration. This is the main characteristic that is characteristic of the scientific literacy learning model.

The results showed that the number of students who experienced misconceptions was related to the sub-topic of photosynthesis and cellular respiration after being taught with a scientific literacy model drastically reduced and there were only four people left or 9.76% of the original 28 people or 68.29%. This indicates that the application of scientific literacy can change students' misconceptions about a subject topic, becoming an understanding of good and right concepts. This is in line with the results of Glynn [10] who concluded that through scientific literacy can be explained the meaning of fundamental and fundamental scientific concepts contained in a lesson with clear language so that it can be understood.

The scientific concepts contained in the sub-topic of photosynthesis and cellular respiration are difficult to understand because they contain abstract and complex (complex) concepts and are interconnected with other branches of biology such as biochemistry, making it difficult for students to understand and master both sub-topics [1, 2]. This is in line with the results of previous studies which state that the sub-topic of photosynthesis and respiration is part of a biological topic that is difficult for students to understand and not a few students who experience misconceptions in understanding and mastering the scientific concepts in it [11-14]. In addition, the results of the Tundugi [15] study are also in line with this and state that the level of misconception of high school students in Palu City, Central Sulawesi, in biology subjects tends to be high, especially on the topic of metabolism and genetic substance.

The application and use of scientific literacy strategies in the learning sub-topics of photosynthesis and cellular respiration will help students to understand scientific concepts that are considered abstract and complex that exist in both sub-topics, because through this learning model, the subject matter regarding photosynthesis and cellular respiration processes are presented visually through animated videos with the help of electronic equipment and supporting technology, and are also supported by the existence of biological modules on the topic of metabolism, sub-topics of photosynthesis and cellular respiration, making it easier for students to understand and master scientific concepts is in the sub-topic of photosynthesis and cellular respiration.

Student misconceptions occur because student's understanding of a concept is incomplete, thus giving birth to their own understanding which is contrary to the actual situation scientifically. Students who have been able to understand and master the concepts contained in a topic well and intact in full, will certainly not experience misconceptions. Likewise in the sub-topic of photosynthesis and cellular respiration, with student's understanding of scientific concepts in photosynthesis and cellular respiration in their entirety and in full, the student's misconceptions will disappear and turn into a form of good, intact and correct understanding of the concept concepts of photosynthesis and cellular respiration.

Students Concept Mastery

Based on the results of the analysis of the achievement of the pre-test mastery concept of students before the implementation of scientific literacy strategies in the learning sub-topic of photosynthesis and cellular respiration, it was found that the percentage of student's average score was 57.72% with sufficient concept mastery criteria. Meanwhile, based on the results of student post-test value analysis after the application of scientific literacy learning was obtained, the percentage of student's average achievement scores was 81.50% with the concept of mastery criteria very good. This shows that there is a difference in mastery of student concepts between before and after learning the topics of photosynthesis and cellular respiration with the application of scientific literacy models, in other words there is an increase in students' mastery of conceptual skills after the implementation of scientific literacy-based learning on photosynthesis and respiration sub-topics cellular.

This difference occurs because the post-test was carried out after the implementation of scientific literacy in the study of photosynthesis and cellular respiration, while the pre-test was carried out before the application of scientific literacy in learning. Learning carried out with the scientific literation model produces mastery of student's concepts that are significantly better than before the application of scientific literacy. In other words, the difference in mastery of the concept between the pre-test and post-test is the application of scientific literacy in the study of photosynthesis and cellular respiration. This is in line with the results of Restianingsih [16] research in his thesis which concluded that scientific literacy had more dominant influence on concept mastery.

Many experts and research point out that the scientific concepts contained in the sub-topic of photosynthesis and cellular respiration are concepts that are difficult for students to understand and master, because they are abstract and complex and involve several other branches of biology, such as biochemistry. The sub-topic of photosynthesis and cellular respiration taught using conventional learning models will result in the mastery of student concepts being low, because students find it difficult to understand the concepts that exist in the two sub-topics of photosynthesis and respiration.

The scientific literacy learning model in the subject of the topic of cellular photosynthesis and repiration is able to explain the meaning of fundamental and fundamental scientific concepts contained in the sub-topic of photosynthesis and cellular respiration with clear language because it is combined with technological literacy in the form of animated videos and images and media learning the internet simultaneously and assisted with biology modules on topics of metabolism, sub-topics of photosynthesis and cellular respiration, so that scientific literacy methods can explain the meaning of scientific concepts regarding photosynthesis and cellular respiration properly and correctly to students. In addition, the availability of various learning tools in the form of modules, lesson plans, and other learning media, will greatly help and facilitate students in finding and obtaining knowledge information about the sub-topics of photosynthesis and cellular respiration needed by the teacher's guidance.

Students can see these scientific concepts visually through animated videos that are supported by images and learning resources in the form of modules whose contents have been arranged in such a way specifically from various trusted sources. Students through scientific literacy learning is possible to learn by seeing and reading, so that almost all information needed by students is available in the learning tools. Memory memories of students will be faster and easier to remember the topic of lessons that are seen visually added by reading the information needed through the learning tools that have been provided.

The scientific literacy learning model can help and facilitate students to be able to understand while mastering the scientific concepts contained in the sub-topics of photosynthesis and cellular respiration. This is evident from the results of the post-test achievement values which showed an average value of 81.50% with the concept of mastery of the concept very well. Thus it can be said that scientific literacy can improve mastery of student's concepts. The scientific literacy learning model makes students learn more independently independently. The role of the teacher in the scientific literacy learning model is only as a mediator, the facilitator as well as giving information to students who need and experience difficulties in learning, so that the learning process can run well because all students actively participate in learning and are not entirely dependent on the teacher. Learning tools in scientific literacy models such as Modules and RPP are designed and prepared in such a way that students will be able to build their own knowledge through their own learning experiences. The scientific literacy learning model will create a conducive and student-centered learning climate, so that students will always try to answer the problems faced in each lesson because students are able to understand and master the concepts well.

Student Science Process Skills (KPS)

Based on the results of the analysis of the achievement of students pre-test scores on KPS before the implementation of scientific literacy strategies in the learning sub-topics of photosynthesis and cellular respiration, it was found that the percentage of student's average score was 46.83% with the criteria of KPS in sufficient levels. Meanwhile, based on the results of the post-test value analysis of students after the implementation of scientific literacy learning was obtained, the percentage of achievement of the average value of students was 81.07% with the concept of mastery criteria very good. This shows that there are differences in student KPS between before and after learning on the topics of photosynthesis and cellular respiration with the application of the scientific literacy model.

This difference occurs because the post-test was carried out after the implementation of scientific literacy in the study of photosynthesis and cellular respiration, while the pre-test was carried out before the application of scientific literacy in learning. Learning carried out with the scientific litearation model produces student KPSs that are significantly better than before the application of scientific literacy. In other words, the difference in student KPS between the results of the pre-test and the post-test was the application of scientific literacy in the study of photosynthesis and cellular respiration.

Some of the results of research that support this research include the results of Rachmawaty [17] research in his journal which concluded that the scientific approach (scientific literacy) had more influence on student science process skills compared to learning using conventional learning. Hanifah [18] research also states that the use of the scientific approach (scientific literacy) significantly influences the improvement of student science process skills. Students through scientific literacy learning is possible to learn by seeing and reading, so that almost all information needed by students is available. Memory memories of students will be faster and easier to remember the subject topics that are seen visually added by reading the required information through the modules provided.

The scientific literacy learning model can help and make it easier for students to be able to apply the KPS they obtained during the learning process to solve and solve problems found and faced such as the subject matter questions and the daily life problems of students. This is evident from the results of the post-test achievement values which show the average student's KPS score of 81.07% with very good criteria. Meanwhile, the pre-test achievement score showed that the average student KPS was only 46.83% with sufficient criteria. Thus it can be said that scientific literacy can increase student's KPS. This condition is in line with the opinion of Aktamis & Ergin that the results of learning science process skills are principled on solving problems found [19]. More clearly, Hazir explained that science process skills are lifelong learning processes that are used to build knowledge and solve problems [19].

The scientific literacy learning model makes students learn more independently independently. The role of the teacher in the scientific literacy learning model is only as a mediator, the facilitator as well as giving information to students who need and experience difficulties in learning, so that the learning process can run well because all students actively participate in learning and are not entirely dependent on the teacher. Learning tools in scientific literacy models such as Modules and RPPs are designed and prepared in such a way that students will be able to build their own knowledge through their own learning experiences. The scientific literacy learning model will create a conducive and student-centered learning climate, so that students will always try to answer the problems faced in each learning because students are able to have a very good KPS.

CONCLUSION

Based on the analysis of the data from the results of the research and discussion that have been put forward, conclusions can be drawn as follows.

- The category of student misconception level on the sub-topic of photosynthesis and cellular respiration before being given scientific literacy-based learning was high, which was 68.29%.
- The application of scientific literacy-based learning strategies can eliminate student's misconceptions on the sub-topics of photosynthesis and cellular respiration and at the same time be able to form a good and correct understanding and mastery of students concepts. Student's misconceptions in the pre-test results were 68.29% and the post-test results after scientific literacy-based learning were 9.76%.
- The application of scientific literacy-based learning strategies can improve the mastery of students' concepts in photosynthesis and cellular respiration, with an increase in normalized gain (N-gain) value of 0.57% with a medium criterion. It means that there is an increase in the mastery of students concept which initially only reaches the average percentage value of 57.72% with sufficient concept mastery criteria, increasing to 81.50% with very good concept mastery criteria.
- The application of scientific literacy-based learning strategies can improve student's science process skills in photosynthesis and cellular respiration, with an increase in normalized gain (N-gain) value of 0.64%, with moderate criteria. It means that there is an increase in KPS of students who initially only achieved a percentage of average score of 46.83% with a sufficient level of KPS criteria, increasing to 81.07% with a very good KPS criteria level.
- The impact of the application of scientific literacy-based learning strategies to the achievement of student learning outcomes in the photosynthesis and cellular respiration sub-material is the increase in student's ability to master the concepts contained in photosynthesis and cellular respiration as well as the increase in student's science process skills.

RECOMMENDATIONS

Based on the results of research on scientific literacy-based learning strategies, to improve the quality and effectiveness of biology learning the authors suggest the following:

- To achieve the objectives and optimal learning outcomes, biology teachers should be able to choose the right learning model to be used in learning a biology subject matter, so that learning takes place well and effectively so that the learning goals and objectives can be achieved optimally.
- Biology teachers are expected to be able to be literate in the field of science and in the field of technology, because the demands of 21st century education and learning require teachers to be able to innovate to create learning models that attract students' attention in order to create a pleasant learning climate.

- Scientific literacy-based learning strategies can be used and applied as a new alternative learning model in the study of biological material, especially materials that are considered difficult by students because they contain abstract and complex scientific concepts such as photosynthesis and cellular respiration.

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