THE EFFECTIVENESS OF PROBLEM BASED LEARNING (PBL) TO IMPROVE STUDENTS' SCIENCE LITERACY ON "ELECTROLYTE AND NON ELECTROLYTE" BASED ON SOCIO SCIENTIFIC ISSUES AT MA AMTSILATI BANGSRI JEPARA

Thesis

Submitted in Partial Fulfillment of the Requirements for
Obtaining a Bachelor Degree of Chemistry Education Program

Written By :
Melida Sholikhah Dwi Fametya
1808076057

CHEMISTRY EDUCATION PROGRAM
FACULTY OF SCIENCE AND TECHNOLOGY
UNIVERSITAS ISLAM NEGERI WALISONGO SEMARANG
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STATEMENT OF AUTHENTICITY

The Undersigned Below :

Name : Melida Sholikhah Dwi Fametya

NIM : 1808076057

Study Program : S1 Chemistry Education

Stated that the final examination with the title :

THE EFFFECTIVENESS OF PROBLEM BASED LEARNING (PBL) TO IMPROVE STUDENTS' SCIENCE LITERACY ON "ELECTROLYTE AND NON ELECTROLYTE" BASED ON SOCIO SCIENTIFIC ISSUES AT MA AMTSILATI BANGSRI JEPARA

As a whole is the result of my own research or work except for the certain parts that are referenced by the source.

Semarang, 27th of December 2021

Writer,

Melida Sholikhah Dwi Fametya

NIM.1808076057

KEMENTRIAN AGAMA REPUBLIK INDONESIA
UNIVERSITAS ISLAM NEGERI WALISONGO SEMARANG
FAKULTAS SAINS DAN TEKNOLOGI
Jl. Prof Dr. Hamka Ngaliyan Semarang
Telp.(024) 7601295 Fax. 7615387

PENGESAHAN

Naskah skripsi berikut ini :

Judul : **The Effectiveness of Problem Based Learning (PBL) To Improve Student's Science Literacy on Electrolyte and Non Electrolyte Based on Socio Scientific Issues At MA Amtsilati Bangsri Jepara**
Penulis : Melida Sholikhah Dwi Fametya
NIM : 1808076057
Prodi : Pendidikan Kimia

Telah diujikan dalam sidang *tugas akhir* oleh dewan penguji Fakultas Sains dan Teknologi UIN Walisongo dan dapat diterima sebagai salah satu syarat memperoleh gelar sarjana dalam ilmu pendidikan kimia.

Semarang, 30 Desember 2021

DEWAN PENGUJI

Penguji I,	Penguji II,
Achmad Hasmy Hashona, MA	**Ella Izzatin Nada, M.Pd**
NIP. 196403081993031002	NIP. 199210062019032023
Penguji III	Penguji IV
Anita Fibbonaci, M.Pd	**Fatmi'ah Setyowati, M.Pd**
NIDN. 2028113701	NIP. 199309292019032021
Pembimbing I,	Pembimbing II,
Ella Izzatin Nada, M.Pd	**Wiwik Kartika Sari, M.Pd**
NIP. 199210062019032023	NIP. 199302132019032020

ADVISOR APPROVAL

Semarang, 27th of December 2021

Excelency. The Head of Chemistry Program
Faculty of Science and Technology
UIN Walisongo Semarang

Assalamu'alaikum Wr. Wb
It is hereby notified that i have carried out guidance, direction and correction of the script with :

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Name	: Melida Sholikhah Dwi Fametya
NIM	: 1808076057
Study Program	: S1 Chemistry Education

I consider that the final examination script could be submitted to the Faculty of Science and Technology UIN Walisongo Semarang to be tested in the munaqosah examination.

Wassalamu'alaikum Wr.Wb

Adviser 1,

Ella Izzatin Nada, M.Pd
NIP. 199210062019032023

ADVISOR APPROVAL

Semarang, 29th of December 2021

Excelency. The Head of Chemistry Program
Faculty of Science and Technology
UIN Walisongo Semarang

Assalamu'alaikum Wr. Wb

It is hereby notified that i have carried out guidance, direction and correction of the script with :

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Name	: Melida Sholikhah Dwi Fametya
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I consider that the final examination script could be submitted to the Faculty of Science and Technology UIN Walisongo Semarang to be tested in the munaqosah examination.

Wassalamu'alaikum Wr.Wb

Adviser 2,

Wiwik Kartika Sari, M.Pd
NIP. 199302132019032020

ABSTRACT

Title : **The Effectiveness of Problem Based Learning (PBL) To Improve Students' Science Literacy on "Electrolyte and Non Electrolyte" Based on Socio Scientific Issues at MA Amtsilati Bangsri Jepara**

Writer : Melida Sholikhah Dwi Fametya

NIM : 1808076057

The research has been conducted to determine the effectiveness of Problem Based Learning (PBL) model on the science literacy skill of class X students of MA Amtsilati Bangsri Jepara. The population of this study were all students of class X MA Amtsilati Bangsri Jepara which consisted of 6 classes totaling 190 students, the research sample totaled 62 students consist of 32 students in class X-6 as the experimental class and 30 students in class X-4 as the control class. Sampling used cluster random sampling technique and data collection was done by interview method, observation method, questionnaire method, and test method. The data analysis technique was t-test with a significant level of 0.05. Based on the results of the study, the average science literacy skill of the experimental class was 79.32 and the control class was 70,34. The hypothesis test used is the t-test, the results are t_{obs} = 6,21 with t_{table} = 2,000 and the critical area is db = 60 {t/t -2,000 or t > 2,000}, which means, PBL (Problem Based Learning) model is effective on student's scientific literacy skills.

Keywords: Effectiveness, Science Literacy Skills, Problem Based Learning.

FOREWORD

Alhamdulillah, all praises and gratitude to Allah SWT who gives the grace of Taufik and his guidance to all of us so that the writer can complete this final examination. Sholawat and salam always be given to our prophet Muhammad SAW to his family, friends, and us as his ummat until the end.

The final examination title "The Effectiveness of Problem Based Learning (PBL) To Improve Students' Science Literacy Focus on 'Electrolyte and Non Electrolyte' Based on Socio Scientific Issues at MA Amtsilati Bangsri Jepara". It is compiled to fulfill the duties and requirements to obtain a bachelor's degree in the chemistry education program, faculty of science and technology UIN Walisongo Semarang.

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Jepara, 25th of December 2021

Writer,

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CHAPTER I
INTRODUCTION

A. Background

Education is an activities to educate, teach and train the students. Based on UU No. 20 of 2003 Chapter I, education is an intentional and planned enterprise to build an atmosphere of learning so students rigidly improve their skill to have religious noble attitude, self control, personality, intelligence, religious character, and abilities necessary for them selves, society, nation and State. The establishment of science education and technology (IPTEK) is the background for the advancement of science education. It means that every student must be able to act wisely and be able to adapt with science, the environment, society and technology (Situmorang, 2016). Science education will improve the potential students, one of them is to succeed in growing the potential for logical thinking and problem-solving abilities and also implementing the curriculum 2013 (Rahayu, 2014). So, by science education it will improve the education system in Indonesia especially the logical thinking and student's problem solving about the cases.

The data from Asia-Pacific Science Education 2019 stated that currently, the initiatives focused on developing national curriculum, improving teacher preparation, professional development initiatives, promoting educational research are driving change in the education system so, it is having an impact on science teaching and learning as well. In this case, it describes the present state of the Indonesian education system and by providing examples from science; it offers insights into particular challenges and growth in the field of science education in Indonesia today. Specifically, it describes the development of the national science curriculum and science textbook development and we provide context for understanding some of the challenges facing teachers when attempting to employ a standard curriculum in so many different kinds of schools, with diverse students, and in widely varying learning environments.

The curriculum 2013 is one of element which take a very significant endowment to developing potential quality of students especially in this era. Based on Aman (2016) stated that the curriculum 2013 emphasizes very much on the value, skills, and knowledge development in proper balance. For teaching program the curriculum 2013 implements scientific approach in teaching which strongly

provides students with activities. This approach correlates nicely with the character of Basic Competencies in a sense that the development all Basic Competencies can be facilitated by this approach. The scientific approach used by the curriculum 2013 has been modified from its original features so that all content from all courses can use this approach (Suhardi). As mentioned in curriculum document (The Minister of Education and Culture Regulation Number 81 A 2013) the scientific approach has the following steps: observing, questioning, exploring, analyzing, communicating as already elaborated in the previous section on the curriculum 2013 in this article. Competency Standards for the graduates of education contain 3 components, the ability to process, content, and the scope of application of the process and content components. Process and content abilities are components of scientific literacy. In addition, the 2013 curriculum also requires that science teachers integrate general and scientific process skills with content learning objectives as part of their general teaching and learning activities (Suhardi, 2013).

Science literacy is defined as a skill to participate with problems related to science, scientific ideas, and a pensive society (OECD, 2016). Chemistry is known as scientific literacy. Ogunkula (2013) adds that chemistry

literacy is an act of understanding science and applying it to the needs of society. Indicators of science literacy include (1) having knowledge of science, (2) using science concepts, science process skills, and science values, (3) understanding the connection among science, technology, and society, (4) being able to anticipate negative impact of science and technology. A science literate person is someone who wants to participate in talking based on science and technology, that needs competence to clarify scientific thing, evaluate and design scientific investigations, and interpret scientific data and proofs. One of the study field that studies the nature and behavior of all substances in the universe is the field of chemistry.

The chemistry field is close with human activities. Chemistry can be used to interact human needed and the environment (Nuray, 2010). One of chemical materials that close in human life, both of regarding the environment and daily life is electrolyte and non electrolyte solutions. Electrolyte and non electrolyte solutions are class X materials that are close to daily life and one of the appropriate materials to be taught with SSI (Socio Scientific Issues) context. The use of the SSI approach in learning in this case chemistry serves to overcome the implications society of science and technology, as well as

incorporating a philosophy student's personal and belief systems. This is in line with learning theory constructivism which states that student's knowledge is built as a result of the combination of all influence, both external and internally (Ogunkala, 2013). SSI also provokes involvement of student's minds in solve problems, so that students are motivated to can play an active role in learning and have good chemistry literacy (Toharudin, 2011). There is a big change in science and technology give some trouble in community life, one of is an environmental problem (Chairisa, 2016). Socioscientific issues (Social Scienctific Issues) have a high contextuality aspect. Socioscientific issues are presented in a dilemma or even problematic where scientific knowledge and social awareness arise in mental conflicts that require scientific literacy skills to make responsible decisions (Sadler, 2004). According to Sadler (2009) it is very interesting if material with Socioscientific context is presented in Problem Based learning (PBL) which directly provides contextual learning situations that can sharpen student's scientific literacy with argumentative scientific skills, intelligence in exploring moral issues, which they can use to solve problems. problems encountered in daily life.

Currently, one of the environmental problems around environmental damage due to waste battery. Environmental damage due to battery waste is an issue of socio scienctific, because it is related to science concepts, especially chemistry. This issue is related to the chemistry concept learned by class X. The students can solve the problem of electrolytes and nonelectrolytes. Students presented the problem of environmental damage due to battery waste, students will realize that this problem is a problem that can be solved scientifically. Then students will discuss and explore various information related to the problem. Then, students will do evaluate the information obtained to provide a solution of environmental damage problem due to battery waste. Through this learning, students will be more motivated to follow chemistry learning and training chemical literacy. (Rahayu, 2017). In addition, learning using SSI can improve student's critical thinking skills improve reasoning ability student's scientific knowledge (Rahayu, 2017), as well as ensure that students are actively involved in learning process so that help achieve scientific literacy students (Setiani, Ngazizah, N., & Setyadi Kurniawan,2016). It is the one of the efforts to improve scientific literacy skills can be. It is done by

implementing a chemistry learning context that relevant to the problems of daily life.

The essence of chemistry learning is in a line with the components contained in scientific literacy. Most of the research that identifies scientific literacy is based on research related to scientific literacy (Rahayu, 2017). One program that measures the level of scientific literacy of students in the world is PISA (Program for International Student Assessment). PISA is conditioned by Organization for Economic Cooperation and Development (OECD). Indonesia has been a PISA participant since 2000, from the PISA data in 2018, Indonesia is still in the top 10 of the lowest rank, namely 62 from 72 countries with an average score 395. From PISA data 2018, Indonesian student's awareness of scientific literacy is still poor than the average. Most of countries that are members of the Organization for Economic Cooperation and Development (OECD, 2016). World Education News and Reviews (WENR) in 2019 states that Indonesia struggles to provide inclusive, high quality education to its citizens. The country has much lower literacy levels than those of other Southeast Asian nations. An analysis by the World Bank showed that 55 percent of Indonesians who complete school are functionally illiterate compared with only 14

percent in Vietnam and 20 percent in member countries of the Organization for Economic Cooperation and Development.

The results of Indonesia scientific literacy assessment based on PISA shows that the development of scientific literacy in Indonesia is still poor. One of the causes of the low scientific literacy in Indonesian is the learning process at school. In addition students who lack awareness of science, this is evidenced by the lack of student's ability relate to student's scientific knowledge that learned in school. Students have not been able to identify, explain and apply scientific knowledge in various life situations and use their scientific understanding in supporting scientific phenomena.

Learning is an activity that cannot be separated from the various components that support each other. These components, among others, relate to the selection of learning models with the purpose of realizing effectiveness and meaningful learning for students. For learning, it is hoped that the teacher should use learning methods that can increase student activity, it relate with phenomena in daily life with learning materials and help students to solve the problems in teaching and learning program.

Problem Based Learning (PBL) is one of learning method that utilize a real world problems as a context for students to learn about certain learning materials by applying critical thinking processes and problem solving skills to obtain important knowledge and concepts from the course material or learning material. (Sudarman, 2007). Implementing the PBL model as a framework for the learning process should provide an advantage to the development of student competence. The data observation of Ariyani (2019) describes the advantages of implementing the PBL model, including: (a) students are encouraged to actively participate in following the learning process, (b) learning becomes meaningful because it presents authentic problems, (c) students are able to integrate the knowledge obtained multi dimensionally, (d) students have the ability to solve the problems, (e) students are trained to think critically and (f) students are encouraged to develop interpersonal skills in team work.

Problem Based Learning (PBL) model is designed by confronting students with contextual problems related to the learning material so that students know why they are learning then identify problems and collect information from learning sources, then student discuss with their friends to get problem solutions while achieving learning

objectives. Students will be able to compile knowledge by reasoning from all the knowledge they already have and from the results of interacting with fellow students (Wulandari, 2011).

According to Margetson in (Arends, 2012) suggested that PBL can enhance skill development lifelong learning in the mindset open, reflective, critical, and active learning. Toharudin (2017) suggested that one of the models or learning approaches that can building scientific literacy is PBL. Corresponding with Marpu'ah (2018) stated that scientific literacy increases with application of PBL. PBL (Problem Based Learning) is a learning that based on the problem. The problem comes from surrounding reality and challenge students so that students are able to identify. In PBL, problems given by the teacher then identify the problem. After the identification process continued with data collection then it will be processed and checked correctly whether or not the hypothesis that was set earlier with alternative findings and linked with the results of data processing. Based on the process, the PBL learning model carried out systematically with build student skills through problem solving, identification, and the solution given in problem solving.

Student's problem solving skills in chemistry need to be improved, with the purpose that students can solve the problems. Problem solving skills can be improved through learning where students are given problems in class and students are asked to complete with all the knowledge and abilities students have (Nurhadi, 2002). Problem solving can be done individually or in groups. Learning to solve the problems can train students to think actively and have broad insights. Problems that must be solved by students can be found from the phenomena that found in daily life. So that, students being able to practice solving the problems, students can also understand phenomena or events around them that have something to do with learning chemistry. In fact, student's scientific literacy skills in chemistry learning are still poor. The low scientific literacy skills of Indonesian are influenced by several factors, such as: gender, school location, socio economic skills of students, parental education level, teacher education level, and types school (Munger, 2009).

Based on the interview result with teachers and several students at MA Amtsilati Bangsri in 15th of September 2020 about learning process, it was concluded that students looked minus of enthusiastic, and felt bored to join learning process in class. Students appear passive,

and less trained in solving problems given by the teacher by themselves or problems that occur regarding phenomena in everyday life. According to Mrs. Sistyaningsih (one of the Chemistry Teacher), said that students understand better if the teacher provides an example or its application.

Another reason that indicates that student's scientific literacy skills at MA Amtsilati are still low can also be seen from the types and levels of questions used in the evaluation which were more related to the daily life. Student's awareness of science is also still low, this is evidenced by the deficiency of student's curiosity about the chemical material being taught. The lack of curiosity of these students can build scientific knowledge based on scientific evidence obtained. The lack of ability to relate student's scientific knowledge learned in school with phenomena in daily life.

Other facts also show that student's lack scientific literacy skills, students are less to explain further, understand and make decisions regarding nature and they made to change a nature through human activities. It is because chemistry lessons are considered difficult and boring, so they are lazy to find out a scientific problem that they have to solve. In the learning process not all are

brought in the discussion, student complicity depends on team members. Students only listen without asking or discuss with their friends who already understand. This is an indication that causes students to be less enthusiastic about learning (Sulistyani, 2017).

To overcome the problems, PBL method has been implemented as an effort to improve science which is strengthened by the research of Ardianto & Rubini (2016) which results in two out of three indicators of scientific literacy skills (identifying scientific problems, and using scientific witness). The percentage of student's scientific competence with the application of PBL method is superior to application of Guided Discovery model. According to Abanikanda (2016) by using PBL method will make students have experience in collecting, managing and preparing information from a problem that can be used for the future. In addition, it can be used to spell out with and solve complex problems in everyday life. Research conducted by Paramitha (2019) also proves that PBL method can improve student's scientific literacy skills. The research conducted by Setiani, Ngazizah, N., & Setyadi Kurniawan (2016) also proves that PBL (Problem Based Learning) improves student learning outcomes. By referring to the research results, it is hoped that the

application of PBL in this study can improve student's scientific literacy.

B. Identification of The Problem

Based the background of the problem it can be identified problems that are relevant to the research :

1. Students have difficulty with a scientific problem. To identify the scientific problems, formulate the hypotheses, it needs guidance from the teacher
2. Students scientific skill is still low
3. The learning model is still used teacher center learning
4. Less of curiousity and student's motivation in the learning

C. Limitation of The Problem

The limitation of this research is only leads to the two of scientific literacy competencies that consist of identify scientific questions and explain scientific phenomena. And using two of scientific indicators in every competencies that consist of identify problems that can be investigated scientifically, identify key words to obtain scientific information, describe phenomena scientifically, and apply scientific knowledge in given the condition.

D. Formulation of The Problem

Based on the descriptions above, the problem in this paper is how is the effectiveness of PBL (Problem Based

Learning) based on socio scientific issues to improve student's scientific literacy?

E. Purpose of The Study

The purpose of this observation is to analyzing the effectiveness of student's scientific literacy skills after applying PBL (Problem Based Learning) based on socio scientific issues.

F. Advantages of The Study

The advantages of this study are :

1. Students

   Increse student's scientific literacy skills and can solve the problems given by the teacher.

2. Teacher

   a. Provide useful input so the chemistry lessons can explore student's skills more

   b. Can be used in an effort to grow student's scientific literacy skills during the learning process

3. Colleger

   Add insight, knowledge, valuable experience, and student skills, especially related to the research using PBL (Problem Based Learning) model

4. School
    a. It is hoped that the results of this study can be used as one of the consideration in determining the learning model in the future
    b. Can be used as a reference in efforts to improve services and quality of education

CHAPTER II
STUDY OF LITERATURE

A. The Definition of "Effectiveness"

Effectiveness is an action or effort which means effective use. Effectiveness is the ability to choose the right goals or equipment to reach the purpose that have been set. The achievement of pre-determined goals or objectives (Sutomo & Prihatin, 2012). The effectiveness referred to this study is the achievement of the application of PBL model to improve scientific literacy skills.

The elements that can affect the effectiveness of learning are the teacher's ability to use learning methods. In this study, indicators of effectiveness can be seen if the learning objectives have been reached as evidenced by minimum student learning outcomes that reach the criteria for student's scientific literacy abilities. In addition, students are actively brought in learning.

Learning criteria using PBL method are effective if there is an improvement in science literacy of the sample class. It means that there is an increase if the price of t obtained is compared to the price of with dk, namely n - 2 if the price is greater or equal to the price *tabel* at the 5% significance level, then this variable has a significant effect. And learning means

to be effective based on the results of the questionnaire student responses by using PBL getting a positive response from students.

It deduced that the effectiveness of learning is a learning that deals with the problem of achieving learning objectives and the level of satisfaction of students who are brought in learning process to achieve predetermined goals.

B. Problem Based Learning (PBL)

B.1 Definition of PBL

Problem Based Learning (PBL) is a method that apply a real world problems as a context for students to learn about certain learning materials by applying critical thinking processes and problem solving to obtain the important knowledge and concepts from the course material or learning material. (Sudarman, 2007). Arends (2012) states that PBL is presenting authentic and meaningful problematic situations for students to carry out investigations. It means that PBL teaches students to begin learning activities with a problem that must be solved, producing in new knowledge.

In PBL model, students work together as a group to find out problem solving and most importantly they can improve their skills to decrease the problems and make decisions. PBL is what can encourage students to develop critical thinking through investigation or discussion (Zamzam, 2016). This

arguments is supported by Adiga & Sachidananda (2015) which argue that PBL is a method that really helps students to engage the world.

Based on the description above, it can be deduce that PBL is learning that focuses on students to be active in learning process. This learning will encourage students to be creative in solving the problems at a hand. Of course, the problems faced by students are related to the subject matter and can be related to problems in their life. In accordance with the theoretical study described by Shoimin (2014) which states that learning with a PBL model involves real problems, problems in daily life as the application of concepts. With PBL method students are more motivated and increased student interest in the material to be studied and individual student learning difficulties can be overcome by working in groups. Meanwhile, scientific literacy skills relate to real life so that students will be more easily to understand concept of the material.

The National Research Council (NRC) Robert and McCracken (2003) provides three principles related to assessment in PBL (Problem Based Learning) namely relating to content, the learning process, and similarity.

1. Content: the assessment must be reflected what is very important for students to learn and master

2. Learning process: assessment must be appropriated and directed at the learning process
3. Similarity: the assessment should describe student's equal opportunities to learn.

The PBL model can be distinguished from other learning models in terms of the characteristics of each learning model. The characteristics included in the PBL process according to Kek and Henk (2017) are as follows :

1. Student-centered learning process
2. The problems presented in the learning setting are organized in a particular focus and are a learning stimulus.
3. New information is obtained through self directed learning
4. The problem used is a problem that occurs in reality
5. Develop problem solving skills.

B.2 Syntax of PBL (Problem Based Learning)

Barret (2010) describes the steps for implementing PBL as follows :

1. Teacher give a problem to students (or problems are revealed from student experiences)
2. Students hold discussions in small groups and do the following:

a. Identify the cases
b. Specify the cases
c. Students improve their ideas with knowledge they have
d. Define to solving the cases
e. Define the action to solving the cases

3. Students are conducted to study independently regarding problems that must be resolved. They can do this by finding the sources in libraries, databases, internet, personal sources or making observations.
4. Students join PBL (Problem Based Learning) group to enlarge information, peer learning, and work together in solving the cases.
5. Students present their solutions.
6. Students are rescued by the teacher to estimate learning activities.

The syntax of PBL according to Arends (2012) consists of 5 phases as presented in Table 2.1.

Table 2. 1 Syntax Problem Based Learning (PBL)

No	Indicator Phase	Teacher's Attitude
1	Student Directive to Problems	Explain about learning objectives, and support students to engage in solving problem
2	Students Organizing	Help student to identify and organize the task
3	Guiding investigations Individual/group	Advise students to collect appropriate information, the teacher helps to obtain explanation, and problem solving.
4	Increase and present the work	The teacher helps and directs students to make reports from the information obtained and control them to present their presentation.
5	Analyze and evaluate the problem	Helping students to assess of their problems and their process that used

B.3 The Strength and Weakness of PBL (Problem Based Learning) Model

Learning activities using PBL (Problem Based Learning) have strengths and weaknesses (Hamdani, 2011). Here are the advantages of applying PBL (Problem Based Learning):

1. Students are involved in learning activities so that their knowledge is absorbed properly.
2. Students are trained to be able to cooperate with other students.
3. Students can obtain solutions from various sources.

Here are the weakness of PBL Model :

1. For students who are lazy, the objectives of the model cannot be achieved.
2. Requires a lot of time and money.
3. Not all subjects can be applied with this model.

C. Science Literacy

Science literacy is defined as the skill to engage with problems that connected to science, with natural science as an intellective society (OECD, 2016). PISA states science literacy as the way to utilize scientific knowledge and abilities, answer questions and conclude based on proof and data to understanding and assist researchers to make firmness about the reality and human interactions with nature. Tang (2015) explains that literacy is the skill of students to read, write, and communicate through activities that have dynamics and change quickly and then respond broadly in social and economic aspects.

PISA (2015) Draft Science Framework, developed scientific literacy into four dimensions, context, knowledge, competencies, and behaviour.

Table 2. 2 Aspects of science literacy estimate structure for the 2015 PISA

Aspects	Indicators
Context	Individual, local/global issues, nowdays and previous, that requires cognition of science and technology.
Knowledges	A cognition of the main element, concepts and theories that establish the basis of scientific knowledge, includes knowledge of the natural and technological artifacts (content of knowledge), knowledge of how these ideas are produced (procedural knowledge), and a cognition of principal reasons for these ways and the justification for their use (knowledge epistemic).
Competencies	Capability to present scientific things, evaluating and designing scientific investigations, and interpreting scientific evidence and data.
Behaviour	A manner toward science characterized by concern in science and technology, assessing scientific approaches to which questions are suitable, concept and conscious of problems environment.

The scientific competency aspect refers to the mental processes brought when finishing a question or solving a problem (Toharudin, 2011). The competency aspects in PISA 2009 are divided into three aspects which are presented in Table 2.3.

Table 2. 3 2009 PISA Scientific Competencies

1.	Identify scientific questions	a. Identify problems that can be investigated scientifically. b. Identify key words to obtain scientific information. c. Knowing the features of scientific inspection
2.	Explain phenomena scientifically	a. Apply scientific knowledge in a given condition. b. Describe or interpret phenomena scientifically and portend change. c. Recognize the right description, explanation and prediction.
3.	Using scientific evidence	a. Construe scientific proofs and express the conclusions. b. Recognize the supposition, proofs, and reasons behind the conclusions. c. Represent on the social involvement and developments of science and technology.

(OECD, 2009)

PISA assessment of scientific literacy requires students to identify scientifically, explain phenomena scientifically and use scientific evidence. These are three competencies were chosen because of the importance of these three aspects for scientific practice and key cognitive abilities (Thomson, 2013).

According to Putri dan Murni Ramli (2014) stated that students who have scientific literacy competencies are students who can: (1) know and understand scientific concepts and processes needed to participate in community activities; (2) asking questions, finding or determining the answer that

stem from their curiosity about their world; (3) describe, explain, and predict natural condition; (4) reading with understanding of popular published science articles and engaging in discussions about the validity of a conclusion; (5) identifies scientific issues related to national and local decisions; (6) states a scientifically and technologically justified position; (7) evaluating the quality of scientific information based on its source and the methods used to obtain that information; and (8) put forward and evaluate arguments based on evidence and apply the conclusions of such arguments adequately.

D. Electrolyte and Non Electrolyte

D.1 The Definition of Solution

A solution is a homogeneous mixture consisting of one or more solute and solvent. A solution is composed of a solvent and a solute. Solvents are generally substances that are in solution in large amounts, and solutes are in lesser amounts. The most abundant solvent in the universe is water. Water has excellent solvent properties, which causes water to be able to transport food substances in the organism's body, if a solution is formed from water solvent with solute ionic compounds, the solution will have the property of being able to conduct electric current. Solutes have two properties based on their behavior when an electric current is applied (Purba, 2012).

1. Electrolyte Solution

Electrolyte comes from the Greek word meaning carrier of electricity. Electrolyte solutions can conduct electricity because they contain ions that move freely. These ions play a role in conducting electric current through the solution. Examples of electrolyte solutions are NaCl, HCl, CH_3COOH, and H_2SO_4. In an electrolyte solution equipped with electrodes and an electrical circuit, the negative ions (anions) move towards the positively charged electrode (anode) and release electrons. While the positive ions (cations) move towards the negatively charged electrode (cathode) and take electrons (Purba, 2012).

2. Non Electrolyte Solution

Non-electrolyte solutions are the opposite of electrolyte solutions. This solution is not able to conduct electric current because when it is a solution, there are no ions that move freely in it. The type of bond that is owned by a non-electrolyte solution is a covalent bond. A covalent bond is formed due to the sharing of a pair of electrons. When in solution, covalent compounds do not undergo ionization, so there are no ions that can conduct electric current.

Examples of non-electrolyte solutions are sugar, urea and alcohol solutions (Purba, 2012).

All inorganic solutions, both acids, bases, and salts have the property of being able to conduct electric current. While all solutions derived from organic substances such as cane sugar, mannose, glucose, glycerin, ethanol, and urea, are not able to conduct electric current (Purba, 2012).

D.2 Electrical Conductivity

Based on their electrical conductivity, the type of solution can be divided into 2, those are electrolyte and nonelectrolyte solutions.

1. Electrolyte Solution

   An electrolyte solution is a solution that can conduct electric current. It is due to the ability of a compound to decompose into positive ions and negative ions. Positive ions, called cations, move towards the negative electrode (cathode) while the negative ions, called anions, move towards the positive electrode (anode). The ions move by conducting an electric current. There are two types of electrolytes are strong electrolytes and weak electrolytes. Strong electrolytes decompose completely into ions in aqueous solution or in a molten state, which includes

strong electrolytes are ionic compounds which in the solid state are ions such as NaCl and covalent compounds react with water to form ions, for example HCl. The characteristic of a strong electrolyte is when the solute is considered to have 100 percent dissociated into ions in solution. Dissociation is the breakdown of a compound into cations and anions. Thus we can state the process of dissolving sodium chloride in water as follows (Wulandari, 2016):

$$NaCl(l) \rightarrow Na^{+}(aq) + Cl^{-}(aq)$$

This equation states that all sodium chloride that enters the solution will become Na^{+} and Cl^{-} ions, not a single unit of NaCl is not dissociated in solution. The weak of electrolytes dissociate only a little bit into ions in aqueous solution. These electrolytes are mainly covalent compounds which react very little with water to form ions. Therefore a weak electrolyte is a poor conductor of electricity and has a small degree of ionization. Characteristics of a weak electrolyte solution are that it contains few ions and an incandescent light bulb glows dimly. The figure below shows the characteristics of a weak electrolyte

solution. Weak electrolytes usually come from two types of solutions, namely a weak acid and a weak base. One example of a weak acid which is also a weak electrolyte is acetic acid.

Acetic acid has a different character from strong acids, because when dissolved in water, acetic acid will not completely ionize, only about 1% of its molecules will dissociate into ions in aqueous solution. Example weak acid is acetic acid. The acetic acid found in vinegar is partially ionized. The reaction of acetic acid can be expressed as following:

$$CH_3COOH\ (aq) \rightleftharpoons CH_3COO^-\ (aq) + H^+\ (aq).$$

In the dissolution of acetic acid, the CH_3COOH molecules will constantly collide with water molecules and each collision there is a possibility that a proton from the CH_3COOH molecule will move to a water molecule and produce H_3O+ and CH_3COO^-. However, in the solution there is a pured between acetate ions and hydronium ions. If the two ions to be one, most likely the H_3O^+ ion will release its proton to the CH_3COO^- ion to re-form the CH_3COOH and H_2O molecules so that in the solution there are two reactions that run

simultaneously. So when dissolved in water, a weak acid will only produce a few ions and only conduct a small amount of electric current, so it is called a weak electrolyte. Similar to weak acids, weak bases which are weak electrolytes have the property of not being able to completely ionize in water. This causes weak bases only conduct a small amount of electric current. An example of a weak base is Ammonia (NH_3).

The ability of a solution to conduct electricity can be tested with an electrolyte test kit. The electrolyte test equipment consists of a vessel connected to two electrodes. The electrodes are connected to the switch and lamp. If the electrolyte solution is put into the vessel, the lamp will light up. Meanwhile, if a nonelectrolyte solution is entered, the lamp will not turn on. Electric current in an electrolyte solution is conducted by the migration of charged particles.

2. Non Electrolyte Solution

Nonelectrolyte solutions are solutions that do not conduct electricity. The properties of the nonelectrolyte solution are generally the solutes in the form of covalent compounds, the lamp does not light up when tested with an electrolyte test equipment. not

almost no ions are decomposed, have a degree of ionization (α = 0). For the examples are alcohols and sugars. When these compounds are dissolved in water, the molecules only mix with water molecules to form a homogeneous solution but the solution does not contain ions because the solute does not react with water. This kind of solute is called a nonelectrolyte.

Nonelectrolyte solutions will not ionize in solution and cannot conduct electricity. The ionization process is influenced by concentration. To distinguish electrolyte and nonelectrolyte solutions, the degree of dissociation (α) can be used. The degree of dissociation is the fraction of molecules that actually dissociate. Or it can also be the ratio of moles of the ionized substance to the moles of the original substance. The degree of dissociation can be expressed by the formula:

$$\alpha = \frac{\text{Ionized}}{\text{Initial}}$$

The value of α can vary, between 0 and 1, with the following conditions.

α = 1, the solution completely dissociates = strong electrolyte

$\alpha = 0 < < 1$, partially dissociated solution = weak electrolyte

$\alpha = 0$, undissociated solution = nonelectrolyte

Table 2. 4 Electrolyte Samples

Classification of Solute in Aqueous Solutions		
Strong Electrolyte	**Weak Electrolyte**	**Non Electrolyte**
HCl	CH_3COOH	$(NH_2)_2CO$ (urea)
HNO_3	HF	CH_3OH (methanol)
$HClO_4$	HNO_2	C_2H_5OH (ethanol)
H_2SO_4*	NH_3	$C_6H_{12}O_6$ (glucose)
$Ba(OH)_2$	H_2O	$C_{12}H_{22}O_{11}$ (sucrose)
Ionic Compounds : * H_2SO_4 has 2 ion H^+ which can be ionized pure water is the most of weak electrolyte		

Source : Raymond Chang (2004)

Based on the discussion the electrolyte and nonelectrolyte solutions, it can be concluded that the characteristics of Electrolyte Samples are as follows:

a. There are many classifications of matter, such as various electrolyte solutions and others.
b. There are chemical reactions that occur, for example ionization reactions in table salt and so on each solution has symptoms caused such as having the number of bubbles generated, the light from each solution, and so on.

c. The electrolyte and nonelectrolyte solutions are also related to chemical bonding materials and other chemical materials.
d. Electrolyte and nonelectrolyte solution material is one of the materials that can be deepened and clarified by experimentation, so that the material will be easy to understand and students' scientific skills can be improved.

In daily life, we often use electrolyte and non-electrolyte solutions. They are :

a. Batteries for calculators, cellphones, remote controls, toys, and so on. Batteries use a solution of ammonium chloride (NH_4Cl), KOH, or LiOH to conduct electricity.
b. The battery is used to start the vehicle, using a solution of sulfuric acid (H_2SO_4).
c. ORS is drunk with diarrhea so as not to become dehydrated or lack body fluids. Body fluids contain components of an electrolyte solution to allow the electrical current to be conducted which is required for nerve impulses to work.
d. River water and groundwater contain ions. This property is used to catch fish using electric shocks.

e. Distilled water used to make solutions in chemical experiments is non-electrolyte so it contains only a few ions.

The electrolyte and nonelectrolyte solutions are also related to chemical bonding materials and other chemical materials. Electrolyte and nonelectrolyte solution material is one of the materials that can be deepened and clarified by experimentation, so that the material will be easy to understand and student's scientific skills can be improved.

G. Socio Scientific Issues (SSI)

1. The Definition of Socio Scientific Issues

Socioscientific Issues (SSI) is the intentional use of science-related topics so that students can engage in dialogue, discussion, and debate. These topics are inherently controversial, dilemmatic and ill-structured, but have additional elements that require moral reasoning or evaluation of ethical issues in decision making framework to solve the problem. SSI is designed to be meaningful and interesting for students, requires reasoning that is based on scientific evidence, and provides context for understanding scientific information (Sadler, 2004). Due to its unstructured and controversial nature, SSI has long been used as a tool to

study several aspects related to functional scientific literacy, for example to study student's understanding of the nature of science, the quality of student's argumentation skills, student's scientific literacy, scientific knowledge, or moral reasoning (Lee et al, 2012).

But the real power of Socio Scientific Issues is if Socio Scientific Issues is used as a tool in science learning, because the recommendations of research results show that SSI (Socioscientific Issues) can improve several skills, for example, argumentation skills,critical thinking skills and problem solving and scientific literacy (Lee et al, 2012).

2. Socio Scientific Issues to Improve Scientific Literacy Skill

Scientific Literacy is related to the critical thinking and problem solving skills. Critical thinking is a complex process which requires high level thinking skills in processing a information (Choy and Cheah, 2009). Students who have the ability to think critically will be able to make wise decisions by giving various reasons that critical nature. And this is a part of scientific literacy (Brookhart, 2010). Therefore, someone who has the ability to think critically will

always analyze the SSI (Socioscientific Issues) problems encountered and then relate it to the knowledge they already have and then use it to find the best solution for the problem.

There are three basic aspects of scientific literacy based on socio scientific issues (1) the tendency to approach problems/issues with attitudes and ways of thinking based on foresight, (2) having the knowledge and skills needed for logical reasoning and fundamental questions, and (3) the ability to apply the knowledge and skills they have in everyday life (Samanci, 2015). Critical thinking demands a great effort to examine each belief or assumptive knowledge based on the supporting evidence and the further conclusions that result from it (Fisher, 2009).

H. The Relevant Research

The previous research that supports this observation are as follows:

1. Research from Wahyanti in (2012), the result of his research was that Contextual Teaching and Learning can improve student's scientific literacy skills, it can be seen from the increase in the average score of normalized gain values in the dimensions of science content, science context, and science processes by 0, 7.

2. Research from Heni Setiani in (2016), the result of her research is Problem Based Learning (PBL) improves student learning outcomes with tc_{ount} = 6.367 with t_{table} = 2,000, which means H_0 is rejected, it concluded that Problem Based Learning (PBL) was effective against science literacy.
3. Research from Izza Ratna (2016), the results of her research are applying Brain Based Learning (BBL) showing the increasing science literacy from four aspects of experimental class is higher than the control class.
4. Research from Abanikannda, MO (2016), the results of research stated that learning using Problem Based Learning (PBL) method can improve student academic achievement and can help students acquire skills that can be used in daily life, such as solving problem.
5. Research from Paramitha (2019) shows that Problem Based Learning (PBL) method can improve science literacy.
6. Research conducted by Putri, Tukiran, & Nasrudin (2018) entitled "The Effectiveness of Problem-Based Learning (PBL) Models Based on Socio-Scientific Issues (SSI) to Improve The Ability of Science Literacy on Climate Change Materials", states that learning with the

SSI context PBL model can increase the ability scientific literacy.

I. Framework of Thinking

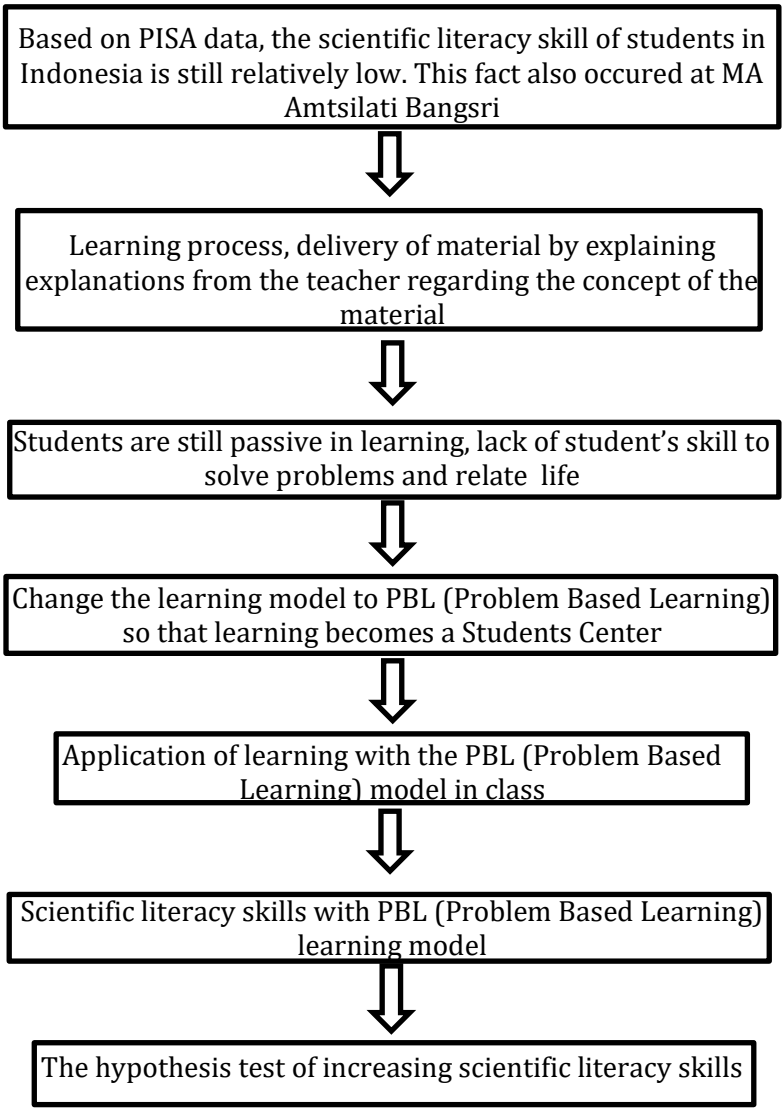
The learning process in the classroom can be effective if students are actively involved in learning. In the learning process students are required to understand the concepts, materials and their application in the questions given by the teacher. By understanding the concept and its application, students have other abilities such as problem solving skills and scientific literacy.

The reason that indicates that student's scientific literacy skills at MA Amtsilati are still low can also be seen from the types and levels of questions used in the evaluation which were more related to the daily life. Student's awareness of science is also still low, this is evidenced by the deficiency of student's curiosity about the chemical material being taught. The lack of curiosity of these students can build scientific knowledge based on scientific evidence obtained. The lack of ability to relate student's scientific knowledge learned in school with phenomena in daily life.

Electrolyte and non electrolyte materials are theoretical and rote learning materials that make students have difficulty understanding them. learning methods are needed that make students behave actively in the classroom. Helping students relate the material being taught to conditions that are appropriate to everyday life. In addition, students can also learn how to solve existing problems related to everyday life related to the material (Purba, 2012).

One of the learning methods that can make it easier for students to understand the material is the Problem Based Learning (PBL) method. This method can help teachers relate the content of learning materials to real-world situations; encourage students to solve problems in accordance with the learning material; motivate students to make connections between knowledge and its application to everyday life. This learning can also improve students' scientific literacy, where students are able to relate learning materials to everyday life (Arends, 2012)

In this study used Problem Based Learning (PBL) and practice questions. In summary, the description of the research to be carried out is presented on Picture 2.1 :



Picture 2. 1. Framework of Thinking

J. Hypothesis

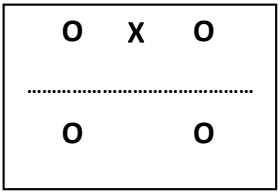
Based on theoretical studies, literature review, and framework of thinking in this research, the formulation of the hypothesis is proposed as follows :

1. H_0: PBL (Problem Based Learning) model is not effective to improve student's science literacy skill
2. H_1: PBL (Problem Based Learning) model is effective to improve student's scientific literacy skills.

CHAPTER III
RESEARCH METHOD

A. Research Design

Design of this experiment is Quasy Experiment with the Pre-test and Post-test Control Group Design. In this experiment, there were 2 groups, that consisted of experiment class and control class. In each group, a pre-test was given to determine the initial state of the class before being given treatment. Afterwards, the experimental class was given X handling, namely learning by Problem Based Learning. The control class was not given treatment or in this case the control class use one of teaching method, namely the conventional model with lectures and question exercises. After being given the treatment, one class was given a post test to determine the increase of science literacy in the experiment class carried out at the beginning of the meeting and control class at the end of meeting. Research design in the Picture 1.



Picture 3. 1 Design of The Research

Information :

O_1: pre test learning outcomes of the experiment group

O_2: post test of experiment group

O_3: output of the control class pre test

O_4: output of the control class post test

X: learning using Problem Based Learning (PBL)

B. Time And Place of The Research

This study was conducted at MA Amtsilati Bangsri, in class X semester 2. This research was conducted in odd semester of academic year of 2021.

C. Population And Sample

1. Population

The figures in this study were classes X of MA Amtsilati Bangsri Jepara.

2. Sample

The attempt used in this experiment were two classes, they are experiment class and control class. The sample was determined by Cluster Random Sampling, namely by lottery. First of all the researcher test to temp for normality, homogeneity, and balance. After two classes were drawn in normal, homogeneous, and balanced conditions, another draw was carried out to determine which was the experiment class and control class.

D. Research Variable

The independent variable was PBL (Problem Based Learning), while the depended variable in this study is the effectiveness of learning model by determining student's scientific literacy skills in electrolyte and non electrolyte solutions that obtained from the test results after being given treatment at the end of the meeting.

E. Collecting Data Technique

The researcher carried out severel technique to collect the data. Those are as follows :

1. Interview Method

   The interview method was carried out with teacher interview sheets to identify problems about "electrolyte and non electrolyte solutions" in the view of class X MA Amtsilati Bangsri Jepara.

2. Observation Method

   Observation was conducted twice, before and while the learning. Observations before the study were carried out by researchers using observation sheets in the classroom and students to describe the learning tools, learning process, student behavior, and student's scientific literacy abilities before the study.

3. Test Method

The tests given are pre test and post test. The pre test was an examination held before the treatment was applied. The objective of this exam is to analyse literacy skill. Meanwhile, the post test was carried out at the time of application of the handling by using Student Worksheets and aims to determine the achievement of student's scientific literacy abilities.

4. Questionnaire

Questionnaire is a data accumulation technique which done by applying some of questions or statements to students in order to fulfil them. In this study, the questionnaire used was a questionnaire for aspects of student's scientific literacy skill, namely motivation and curiosity.

F. Research Instrument

The device in this paper were in the below :

1. Observation Page of Learning Implementation

Observation sheet of learning implementation is used by observers to observe the implementation of the steps in learning electrolyte and non electrolyte solutions using Problem Based Learning (PBL). The education program implemented the ways in which

teacher and researcher must take a number based on the available estimated instruction.

2. Science Literacy Skill Check

This checking is to determine the science literacy skills shown during electrolyte and non electrolyte solutions learning process using Student Worksheets connected to the lesson. Test grid for the aspects of content, context, and competence of student's scientific literacy abilities would be seen in Table 3.1.

Table 3. 1 Science Literacy Aspects

Number	**Aspects**	**Dimention**	**Indicator**
1.	Context Aspect	Relevant to real situations and Involves science and Technology	Provide examples in daily life
2.	Science Aspect	In accordance with theories and concepts	Presenting facts, concepts, principles and law.
3.	Competence Aspect (Process)	Identify scientific questions	Students are looking for information so that the data is relevant.
		Explain phenomena scientifically	Students make and provide reasons for appropriate predictions
4.	Attitude	Using scientific evidence	Students are capable to draw obvious and rational relationships among proof and consequence Students are able to answer a question

			through the use of material.

3. Science Literacy Skill Questionnaire

The questionnaire was used to determine the student's motivation and curiosity which was shown during the learning process according to the grid. The questionnaire is composed of statements that match the indicators in the learning process. The researcher distributed a questionnaire on the aspects of the attitude of science literacy skills containing statements to respondents using Likert scale. The questionnaire grid for the aspects of student's scientific literacy abilities can be observed in Table 3.2.

Table 3. 2 Indicator of Science Literacy Skills

Number	Dimention	Indicator	Item Number
1.	Study Motivation	There is desire to succeed.	1, 5, 8, 12, 17
		There is an urge and need in study.	2, 6, 9, 13
		There are hopes and dreams future.	3, 10, 14, 18
		There is a deep appreciation learn.	7, 15, 19
		There are interesting activities in study.	4, 11, 16, 20

2.	Curiosity	Ask teachers and friends about the concept being studied	2, 6, 17
		Read and discuss concept or material with study groups	20, 21, 22, 23
		Looking for information outside the subject book to be studied	5, 10, 16, 20, 24
		Shows an interested or disinterested attitude towards material studied	4, 11, 16, 20
		TOTAL	24

The student attitude questionnaire instrument in this study used 4 alternative answers, including: Always (A), Often (O), Sometimes (R), and Never (N) with the provisions served in Table 3.3.

Table 3. 3 Guidelines for Assessing Science Literacy Ability Questionnaire

Answer Choices	**Score**
Always (A)	4
Often (O)	3
Rarely (R)	2
Never (N)	1

G. Data Analyze Technique

Data analysis was carried out in several steps as follows:

1. Item Analysis

   Before the test was tested on students, the researcher must try it out these questions to obtain good test questions as a tool data collectors in this study. The questions that were tested then analyzed to determine the validity, reliability, level of difficulty.

   a. Validity Test

      The validity of the test used in this study was the validity of content or content validity. The content validity of a learning outcome test was validity obtained after analysis, search or testing the content contained in the learning outcomes test to obtain a valid test, the researcher consult the test first with the chemistry field studies, Mrs. Sistyaningsih, S.Pd who teaches in class X IPA 2 and Mrs. Nur Alawiyah, M.Pd, the chemistry lecturer in UIN Walisongo Semarang. Researchers using the Pearson Equation to calculate the validity score :

$$t_{hit} = \frac{r_{xy}\sqrt{(n-2)}}{\sqrt{(1-r_{xy}{}^2)}}$$

$$r_{xy} = \frac{n\Sigma X_i Y_i - (\Sigma X_i)(\Sigma Y_i)}{\sqrt{\{n\Sigma X_i{}^2 - (\Sigma X_i)^2\}\{n\Sigma Y_i{}^2 - (\Sigma Y_i)^2\}}}$$

Description :

r_{xy} : correlation coefficient

n : number of trial respondents

X :score of each item

Y : score of all test respondents' items

The criteria for determining significance are by comparing the t-count and t-table values. If t-count > t-table, then we can conclude that the items are valid.

b. Reliability Test

Reliability comes from the word rely which means trust and reliable which means can be trusted. Reliability regarding the degree of consistency and stability of the data or findings. In the positivistic (quantitative) view, a data was stated reliable if two or more researchers on the same object produce the same data, or the same researcher at the same time different data produces the same data, or

a group of data when split into two shows data that are not different. Researchers using the Cronbach Alpha Equation to calculate the reliability value :

$$r_{11} = \frac{n}{n-1}\left(1 - \frac{\sum_{i=1}^{n} s_i^2}{s_t^2}\right)$$

Description :

r_{11} : reliability coefficient

n : number of questions

S_i^2 : question varians score i

S_t^2 : question varians score t

The criteria for determining significance are by the score of reliability. If realibility score ≥0,70 it can be reliable to be used.

c. Question Difficulty Level

A good question was a question that is not too difficult and not too easy. Problems that are too difficult will cause students to drop out hopeless and don't have the enthusiasm to try again because it is outside range. On the other hand, questions that are too easy are not stimulating students to enhance their problem solving skill. The researcher used the Excel

Program to determine the level of difficulty of the questions. Level criteria the difficulty of the questions used can be seen in the following table 3.4.

Table 3. 4 Question Difficulty Criteria

Difficulty Index	Intrepretation
0,71 – 1,00	Easy
0,31 – 0,70	Medium
0,00 – 0,30	Difficult

2. Similarity Test of Initial States

The data used to knowing the first state students in the control class and experimental class was a questionnaire sheet. Meanwhile, to knowing the first state of student, the explanation precondition exam was enforce that consisted of normality check and homogeneity check.

a. Normality Test

The normality test was doing of whether distribution of data to be explained is normal or not. The technique used to test the normality in this experimentis the Liliefors Test. The steps are as follows:

1. Hypothesis

   H_0: specimen is a population that is normally distributed

   H_1: specimen is not normally distributed

2. Significance Level

   In this study, $\alpha = 0.05$ was taken

3. Statistic Test

   $L = \max|F(z) - S(z)|$ where $z_i = (xi - \frac{\bar{x}}{s})$

   Information :

   $F(z_i) = P(Z \leq zi)$; $Z \sim N(0.1)$

   $S(z_i)$ = count pieces $Z \leq z_i$ for each Z_i

   Xi = respondent score

   $\bar{x}$ = mean of the respondent's score

   s = standard deviation of the respondent's score

4. Decision Test

   If H_0 is accepted (LϵDK), it means that it is normally distributed. If H_0 is rejected (L € DK) means that it is not normally distributed.

(Budiyono, 2009)

b. Homogenity Test

This test was purposing determine the study population has the same differences. To test this homogeneity, Bartlet test was used with the Chi

quadart test statistic with the procedure according to Budiyono (2009: 174).

1. Hypothesis

   H_0: σ12 = σ22 =… = σk2 (homogeneous populations)

   H_1: not all variances are equal (populations are not homogeneous) for i ≠ j; i: 1, 2 (k = 2 for row); h: 1, 2, 3 (k = 3 for columns)

2. Statistic Test

   $B = (\log s^2)\Sigma (ni-1)$

3. Significance Level

   In this study, it was taken (α) = 0.05

4. Decision Test

   If H_0 is answered (L ∈ DK) it proves that the resident variation is homogeneous. If H_0 is rejected (L ∉ DK) it means that the population variance is not homogeneous.

3. Analysis of Learning Inputs

Input from learning was obtained from data on student's initial scores. The data for the student's initial scores were obtained from the student's test scores and the questionnaire for the attitude aspects which the percentage was calculated using the following formula.

$$\text{Score Percentage} = \frac{\text{Score Accepted}}{\text{Score Maximal}} \text{ x } 100\%$$

Table 3. 5 Score Criteria

Number	Percentages	Criteria
1.	80% -100%	Very High
2.	66% - 79%	High
3.	56% -65%	Low
4.	40% - 55%	Very Low

4. Final Data Analysis

The final data were obtained from test results with Student Worksheets for context, content, and competence aspects as well as attitude aspect questionnaires students. Data on scientific literacy abilities were obtained from the average test results and attitude aspect questionnaires which were then analyzed for the percentage using the following formula:

$$\text{Scor Percentage} = \frac{\text{Score Accepted}}{\text{Score Maximal}} \text{ x } 100\%$$

Table 3. 6 Score Category

Number	Percentage	Criteria
1.	80% -100%	Very High
2.	66% - 79%	High
3.	56% - 65%	Low
4.	40% - 55%	Very Low

5. Analysis of Increasing Science Literacy Skills

Increasing of science literacy would be observed from the mean obtained from the student worksheet scores and student attitude questionnaires. Increasing student's scientific literacy skills would be searched by calculating the average score of each component aspect which is then used as a percentage using the formula:

$$\bar{x} = \frac{\sum x}{n} \text{ x } 100\ \%$$

Information :

$\bar{x}$ = average value

$\sum x$ = total value

n = amount of data

Increasing scientific literacy skills can be analyzed using normalized gain. Normalized gain can be found with the equation below:

$$g = \frac{Tf - Ti}{S1 - Ti}$$

Information :

g = normalized gain

T_f = post test score

T_i = pre test score

SI = Ideal Score

The results of normal gain calculations were afterwards converted into the normal classification of

Hake's gain, Ricard R (Meirita, 2013), with the criteria in Table 3.7, as follows :

Table 3. 7 Gain Normal Criteria

No	Criteria	Conclusion
1	g ≥ 0,7	High
2	0,3 ≥ g > 0,7	Rare
3	g < 0,3	Low

6. Hypothesis Test

Data analysis ways applied in this research is to test the hypothesis about the mean with the static test using the t-test which is a statistical test that would be applied to test the hypothesis about the differences between the experiment variables. In this study, the t-test was used to knowing whether the use of PBL (Problem Based Learning) was effective on the science literacy skills of class X MA Amtsilati Bangsri Jepara.

The data analysis procedure according to Budiyono (2009).

a. Formulate H_0 and H_1

1) H_0: PBL (Problem Based Learning) is not effective against student's scientific literacy skills.

2) H_1: PBL (Problem Based Learning) is effective on student's scientific literacy skills.

b. Determine significance level (α)

α = 0.05

c. Determine the Statistic Test

Because sample variance cannot represent population variance, using the t-test as the statistical test.

(Budiyono,2009).

$$t_{observasi} = \frac{\bar{x1} - \bar{x2} - d0}{sp\sqrt{1/n1 + 1/n2}} \sim t(n1 + n2 - 2)$$

$$sp^2 = \frac{(n1-1)+(n2-1)s2^2}{n1+n2-2}$$

Information :

$\bar{X}_1$ = mean experiments class

$\bar{X}_2$ = mean control class

S_1^2 = varians

S_2^2 = varians

n_1 = student experiment class total

n_2 = student control class total

d_0 = mean difference

S_p = combined standard deviation

d. Determine the Decision Test

If H_0 is accepted (observation ∈ DK) then the use of PBL (Problem Based Learning) was not effective for student's scientific literacy skills. However, if H_0 is rejected (observation ∉ DK) then the use of PBL

(Problem Based Learning) was effective for scientific literacy abbilities. If the researcher's hypothesis or H_1 is accepted, it means that the PBL could develop student's scientific literacy skills, it will be better to verify the effectiveness of PBL (Problem Based Learning) using descriptive testing with the following steps.

1. Formulating H_0 and H_1

a) H_0: $\mu_1 < 76$ (learning using PBL is not effective).

b) H_1: $\mu_1 \geq 76$ (learning using PBL is effective)

2. Determine The Significance Level (α)

$\alpha = 0.05$

3. Determine The Statistic Test

To examine the descriptive hypothesis, a one sample t exam was used. According to (Tomi, 2014) the equation is :

$$t = \frac{\bar{x} - \mu 0}{s/\sqrt{n}}$$

Where:

t = calculated t value, it is called t count

$\bar{X}$ = the mean of the experimental class

μ_0 = hypothesized value (KKM)

S = standard deviation

n = number of sample members

4. Determine the Decision Test

If H_0 is accepted (observation $\in$ DK) The criteria for determining decision test are by comparing the t-count and t-table values. If t-count < t-table, then we can conclude that the items of PBL is not effective. However, if H_0 is rejected (observation $\notin$ DK) If t-count > t-table then applying PBL (Problem Based Learning) is effective.

CHAPTER IV
RESULT OF THE RESEARCH AND DISCUSSION

A. Description Research

1. The Initial Data of Scientific Literacy Skill

The scientific literacy skill was obtained from the average of the attitude questionnaire results and the three aspects of the student's scientific literacy skill, there are consist the context aspect, the content aspect, and the competency aspect obtained from the student's test scores. The following is the initial data from the research results of student's scientific literacy skills which are presented in Table 4.1 below.

Table 4. 1 The Initial Data of Scientific Literacy Skill

No	Aspects	Experimental Class (%)	Control Class (%)
1.	Contextual Aspect	68,43	68,16
2.	Content Aspect	68,50	60,36
3.	Competence Aspect	46,75	46,26
4.	Attitude Aspect	62,77	63,33
Average		61,61	59,53

2. The Final Data of Scientific Literacy Skill

Based on the research that has been carried out on scientific literacy skills, the final score was obtained from the average attitude questionnaire results and the three aspects of student's scientific literacy skills which are context aspect, content aspect and competency aspect through Student Worksheets filled by the students. The illustrated data on Table 4.2 pictures out the reasearch on students' scientific literacy skills.

Table 4. 2 The Final Data of Scientific Literacy Skill

No	Aspects	Experimental Class (%)	Control Class (%)
1.	Context Aspect	80,00	72,43
2.	Content Aspect	79,50	67,50
3.	Competence Aspect	76,65	62,70
4.	Attitude Aspect	81,13	78,74
Average		79,32	70,34

B. Data Analysis

1. The Initial Data Analysis

Initial data analysis was used to determine the initial state of students in the control class and experimental class before treatment. The data used were test scores and attitude aspects of scientific literacy questionnaires. Before the t-test is carried

out, it had to checked the normality test and the homogeneity test of variance as described in Chapter III.

a. Normality Test

Normality test was carried out twice. First, normality test of scientific literacy skill of the experimental class. Second, normality test of the control class. In accordance with the steps described previously, the results of the normality test for initial scientific literacy skills were presented in the following Table 4.3.

Table 4. 3 Normality Test Results of Initial Science Literacy Skills

Sources	L_{max}	L_{tabel}	Result
Experimental Class	0.051	0.157	H_O accepted
Control Class	0.031	0.162	H_O accepted

Based on the results in Table 4.3, it obtained $L_{max} < L_{table}$ so that it can be interpreted that H_o is accepted, which means the sample from the population was normally distributed in the experimental class and control class.

b. Homogeneity Test

The homogeneity of variance test was carried out once based on the results of the student's scientific literacy skills before the treatment was carried out using the Problem Based Learning model. The results of the homogeneity of variance test can be seen in Table 4.4.

Table 4. 4 Result of Homogeneity Test of Initial Variance of Student's Science Literacy Ability

Sources	X^2_{count}	X^2_{table}	Result
Experimental and Control Class	0,924403403	3,841	Ho accepted

Based on the results in the table above, it was obtained X^2 count < X^2 $table$ so it can be interpreted that H_0 is accepted, which means that the samples come from a homogeneous population.

c. Validity Test

Validity test was carried out once, which is validity test of scientific literacy question by Excel Computer Program. In accordance with the steps described previously, the results of the validity test for scientific literacy skills questions were presented in the following Table 4.5.

Table 4. 5. Validity Result

Matter	Valid
Valid Score	15
Invalid Score	5

Based on the result of the validity test, from 20 questions there were 15 questions are valid that consist of questions number (1,3,4,6,8,9,10,11,13,14,16,17.18,19,20) and 5 more are invalid which consist of questions number (2,5,7,12,15). So it means there were just 15 questions which properly use in observing the scientific literacy skill.

d. Reliability Test

Reliability test was carried out once, which is reliability test of scientific literacy

question by Excel Computer Program. In accordance with the steps described previously, the results of the reliability test for scientific literacy skills questions are presented in the following Table 4.6.

Table 4. 6. Reliability Result

Varians Item	0,65
Varian Item Score	12,20
Varian Total	36,18
Reliability	0,697

Based on the result of reliability test, it was 0,69 (0,70). So it can be interpreted that the scientific literacy questions were reliable to used.

e. Question Difficulty Level

Question difficulty level test was carried out once by Excel Computer Program. In accordance with the steps described previously, the results of the validity test for scientific literacy skills questions were presented in the following Table 4.7

Table 4. 7. Question Difficult Level Result

Average Score	3,36	3,53	2,4
Scor Maks	5	5	5
QD	0,673	0,70	0,48
Criteria	MEDIUM	MEDIUM	MEDIUM

Based on the result of question difficulty level test, from 20 questions there were 2 questions in the number (2 and 12) are relatively easy, 15 questions in the number (1,3,4,5,6,8,9,10,11,13,14,15,17,19, and 20) are relatively medium, and 3 questions in the number (7,16 and 18) were relatively difficult.

2. Learning Input Analysis
   a. The Initial Data
      1. Experimental Class

         The student's initial data before treatment was obtained from students' test scores for aspecs of context, content aspect and aspect of competence as well as attitude questionnaires for aspect of scientific literacy skills. Based on Table 4.1, the scientific literacy skill of students analyzed as shown in Table 3.6 in the form of a diagram obtained 61.61% results

consisting of four aspects, namely context aspects 68.43%, content aspects 68.50%, competence aspects 46.75%, and attitude aspect 62.77%.

2. Control Class

Initial data obtained from student's test scores for the context aspect, content aspect and competence aspect and attitude questionnaire for the attitude aspect of scientific literacy skills. Based on Table 4.1 the scientific literacy skill of students who were analyzed as in Table 3.6 in the form of a diagram obtained the results of 59.53% consisting of four aspects, namely the context aspect 68.16%, the content aspect 60.36%, the competence aspect 46.26% and the attitude 63.33%.

3. Analysis of Increasing Scientific Literacy Skills

a. Experimental Class

The analysis of increasing student's scientific literacy skills with Problem Based Learning model can be identified through the student's answers on the Student Worksheets for context aspect, content aspect, and

competence aspect as well as the results of the attitude aspect questionnaire that has been filled out by students in the experimental class which was analyzed using the equation :

$$\bar{x} = \frac{\sum x}{n} \text{ x } 100 \text{ \% and g } = \frac{Tf - Ti}{S1 - Ti}$$

Based on the calculations and criteria referred to Table 4.2 for the context aspect of 80.00%, the gain criteria is 0.37 in the medium category, the content aspect is 79.50%, the gain criteria is 0.34 in the medium category, and the competence aspect is 76.65. % obtained the gain criteria of 0.56 in the medium category and 81.13% in the attitude aspect obtained the gain criteria of 0.49 with the medium category. The average increase in all aspects, namely 79.32%, obtained the gain criteria of 0.46 in the medium category. The details of the data analysis of scientific literacy abilities obtained in the experimental class can be seen in Appendix.

b. Control Class

The analysis of increasing student's scientific literacy skills in the control class with the Cooperative Learning model can be identified through the written test results of multiple choice questions for context aspect, content aspect, competency aspect and attitude aspect questionnaires which were analyzed using equations :

$$\bar{x} = \frac{\sum x}{n} \text{ x } 100 \text{ \% and g} = \frac{Tf - Ti}{S1 - Ti}$$

Based on the calculations and criteria referred to Table 4.2 for the context aspect, 72.43% obtained the gain criteria of 0.13 in the low category, the content aspect of 67.50% obtained the 0.18 gain criteria in the low category, the competence aspect of 62.70 % obtained a gain criteria of 0.64 in the medium category and 78.74% in the attitude aspect obtained a gain criterion of 0.42 in the medium category. The average increase in all aspects is 70.34% obtaining a gain criterion of 0.27 with a low category. Details of the analysis of

scientific literacy skills can be seen in Appendix.

4. Final Data Analysis

The final data analysis was done after the two classes carried out learning for the experimental class using Problem Based Learning model and the control class using the existing learning model in the school, namely Cooperative Learning. Data on scientific literacy ability was obtained from the average results of the three aspects (context aspect, content aspect, and competency aspect) using LKPD and attitude aspect using a questionnaire. Hypothesis testing is done by using t-test after the t-test prerequisites fulfilled.

a. Normality Test

The normality test after the treatment procedure is the same as the normality test before the treatment. The normality test was carried out twice. First, normality test of scientific literacy ability in the experimental class. Second, normality test of scientific literacy ability in the control class. Based on the steps described

previously, the results of the normality test can be seen in Table 4.8 below.

Table 4. 8 The Normality Test Results After Treatment of Student's Science Literacy Skills

Sources	L_{max}	L_{table}	Result
Experimental Class	0.026	0.157	H_0 accepted
Control Class	0.029	0.162	H_0 accepted

Based on the results in Table above, it is obtained that $L_{max} < L_{table}$ so that it can be interpreted that H_0 is accepted, which means that the sample from the population is normally distributed in both the experimental class and the control class.

b. Homogeneity Test

The homogeneity of variance test was carried out once based on scientific literacy skill. The results of homogeneity of variance test are presented in Table 4.9 below.

Table 4. 9 The Result of Homogeneity of Variance After Treatment of Student's Science Literacy Skills

Sources	X^2_{count}	X^2_{table}	Result
Experimental and Control Class	1,715	3.841	Ho accepted

Based on the results in Table 4.9, it is obtained X^2 count < X^2 *table* so it can be interpreted that H_0 is accepted, which means that the samples come from a homogeneous population.

5. Hypothesis Test

Hypothesis test was used to determine the effectiveness of Problem Based Learning model on student's scientific literacy skills. Hypothesis testing in this study used the t-test. T-test was carried out with the help of Microsoft Office Excel, the results are presented in Appendix.

a. The steps in testing the hypothesis to determine the effectiveness of Problem Based Learning model on student's scientific literacy abilities are as follows :

1. Hypothesis

H_0: Problem Based Learning model is not effective on student's scientific literacy skills.

H_1: Problem Based Learning model is effective on student's scientific literacy skills.

2. Significant Level (α) = 0.05
3. Statistic Test

   The t_{table} for this study is 2,000 and the t_{count} in this study is 6,21
4. Critical Area with db= 60 {t/t -2,000 or t > 2,000}
5. Decision Test : H_0 rejected (6,21 DK)
6. Conclusion: Problem Based Learning model is effective on student's scientific literacy skills.

Descriptive tests were also used to determine the effectiveness of Problem Based Learning model on scientific literacy skills, descriptive tests of student's scientific literacy skills are as follows:

a. Hypothesis

   H_0: Problem Based Learning model is not effective on student's scientific literacy skills.

   H_1: Problem Based Learning model is effective on student's scientific literacy skills.

b. Significance Level

   Significant level (α) = 0.05

c. Statistic Test

The t_{table} for this study is 1.6939 and the t_{count} in this study is 5.95.

d. Critical Area

The critical area is db= 32 {t/t -1.6939 or t > 1.6939}

e. Decision Test

H_0 is rejected (5,95 DK)

f. Conclusion

Problem Based Learning model is effective on student's scientific literacy skills.

C. Discussion

From the results of the study, it will be discussed about the effectiveness of PBL model to improve science literacy. It will also discuss the differences between initial and final aspects of student competence before and after the experiment.

1. The Initial Learning Process Treatment with PBL (Problem Based Learning)

   During the learning process with PBL model, each meeting begins with praying, greeting, checking student attendance, and motivating students to be interested in the material to be studied. But before teacher do some of learning processes, to use the

scientific literacy question in pre test and post test, it had to be tested first.

One of the tools used as a means for assessing learning outcomes is a test. According to Sudijono (2012) the test is a way of measuring and assessing in the field of education in the form of giving assignments or a series of tasks that must be done by students, so we know the value of student achievement. That value is then compared with the values achieved by other testees, or compared with certain standard values. Therefore, to determine the quality of the items used for the test, it is necessary to analyze the items.

Item analysis is an activity that the teacher must do to improve the quality of the questions that have been arranged. According to the Ministry of National Education (2008), the purpose of item analysis is to improve the quality of test items and find out student diagnostic information. Quality questions are questions that can provide accurate information, so that we could identified students who have mastered the material and those who have not. A good evaluation test has characteristics and the requirements that must be met, namely the test must be valid or have a good level of validity. An evaluation test is valid if the test can

accurately and correctly measure what is intended to be measured. Validity can be predictive validity or construction validity, then the test must be reliable, objective, practical and economical. In educational evaluation, both test and non test are instruments or tools for collecting and processing data about the variables studied (Magdalena, 2021).

The characteristics of a good instrument as an evaluation tool is to meet the requirements of validity and reliability. This is the reason why a good evaluation tool can be seen from several aspects (Ina Magdalena, 2021), including: (1) validity, (2) reliability, (3) objectivity, (4) practicability, (5) distinguishing power, (6) level or degree difficulty, (7) option effectiveness, (8) efficiency

Based on the description above, it was necessary to analyze the items quantitatively to determine the quality of the questions. The quality of the questions can be seen from the results of the validity, reliability, level of difficulty and discriminating power. Researchers are interested to test the scientific literacy questions for electrolyte and non electrolyte solutions in this research which consist

of validity test, reliability test, and question difficulty level.

For the validity test, the aim is to know wheter the scientific literacy question is valid (can be used) or not. The validity test was validated by the chemistry teacher (Mrs. Sistyaningsih, S.Pd) and the chemistry lecturer of UIN Walisongo (Mrs. Nur Alawiyah, M.Pd). The result of validity test from Excel Computer Program is 15 questions which are valid and the other 5 are invalid. Next, the reliability test with Excel Computer Program. The aim of reliability test is to know the accuracy and consistency. Learning outcome tests are believed if it provides relatively consistent measurement result.T he result of reliability test is 0,69750 (0,70). Based on BINUS University Quality Management Center, questions are reliable if ≥ 0,70. So it means that the questions are reliable. Next, the question difficulty level test. The aims of question difficulty level test is to find out whether the question is classified as easy or difficult. The result of question difficulty test showed that there were 2 questions which are relatively easy, 15 questions are relatively medium, and 3 questions are relatively difficult.

2. The Learning Process with PBL Model to Improve Student's Scientific Literacy Skills in MA Amtsilati Bangsri Jepara

In this study used two variables which become the object of research, they are the independent variable (PBL) and the dependent variable (Scientific Literacy Skill and Electrolyte and Non Electrolyte). In this study, the researcher acted as a teacher, using two classes as samples, namely class X-6 (experimental class) which amounted to 32 students and class X-4 (control class) amounted 30 students.

The treatment in class X-6 (experimental class) applied learning with PBL model that was integrated with problem solving activities, while in class X-4 (control class) learning was applied using discussion and question and answer methods.

Stages of chemistry learning in "Electrolyte and Non Electrolyte" material using PBL models in control and experimental classes, starting from 18th-21th of December 2021. The learning process was carried out in four meetings. First meeting was allocated for material explanations and the next three meetings carried out project work that was integrated with the PBL model. Accompanied by the work of LKPD.

Learning with PBL model is one of the suitable learning model because it can bring students closer to their surroundings, so that they can meet direct objects and see the facts on the ground and hope to be sensitive and able to overcome problems that occur from year to year, through predictive activities ask and guess the consequences of a cause.

Learning with PBL model was integrated with problem solving activities in class X-6 (experiment) was carried out on 18th of December 2021, where the activity began by distributing pretest questions on the ability to think creatively and initial scientific literacy to students which are intended as initial data, after that the teacher organizes students into six groups for each group of five students, at this stage the teacher motivates students and explains the model used in this study and the objectives in learning. In addition, the teacher also explains the points on the material of electrolyte and non electrolyte which includes the definition of solution, solution based on electrical conductivity, classification of solute, and the relation of electrolyte and non electrolyte with daily life. Then after the group was formed, each group was given different material to discuss and present, and another

group respond to group questions presenting. The teacher as a facilitator straightens out answers that are less precise than the questions asked. And the teacher told the activities for the next meeting by giving group assignments to prepare an experiment of electrolyte and non electrolyte.

The 2nd meeting was held on 19th of December 2021, at this meeting students began to design and make experiment that were carried out in class which were intended to make it easier to observe the level of student scientific literacy skills at the same time. First, the teacher re-explained the steps of PBL model as it was the standard of problem solving work so that it was more structured in the process. The teacher exemplified the experiment to know the step that have to be finished. Each student was divided into groups that has been determined by the teacher. The teacher then distributed Student Worksheet according to the material that have been shared. Next, each group members began to design and start step by step in making the experiment, at the same time students also work on the group worksheets that have been distributed. At this stage, the teacher became a facilitator and monitor to see the level of critical

thinking skills and identified the scientific literacy action of each student, so that students did not rely on each other in the learning process. The second meeting ended with semi-finished results so that students only showed the results obtained and presented the results of Student Worksheet related to electrolyte and non electrolyte material.

The 3rd meeting was held on 20th of December 2021, at this meeting the students continued yesterday's experiment which was 75% finished and the presentation of the results of the experiment that had been completed by each group, starting from the definition about solution. The experiments were examined with question and answer sessions between groups regarding its current and long term benefits and the positive side for ourselves. The next learning stage was correcting and concluding about the learning activities. The teacher asked each group to conclude the material about electrolyte and non electrolyte that has been studied at the previous meetings. It can be concluded based on Purba (2012) that electrolyte solutions could conduct electricity because they contained ions that move freely. These ions played a role in conducting electric current through the

solution. And non electrolyte solutions were not able to conduct electric current because there were no ions that move freely within it. The type of bond that was owned by a non-electrolyte solution was a covalent bond. Then students were asked to did the post test questions on the fourth meeting on 21th of December 2021. Based on the results of observations, step by step contained in the learning process was a process of developing student scientific literacy skill of students for better learning.

The implementation of PBL model certainly required appropriate media, so that the implementation of learning model could be better. One of the media used was Student Worksheet (LKPD) which was distributed to each group which contained problems that must be solved with their critical thinking skills, as well as limit the material to be worked on by each group, by seeking information from relevant sources. The purpose of using Student Worksheet was to provide media for each group to practice their critical thinking and cooperation skills between members to combine various ideas into a brand-new idea. The teacher did not only transfer knowledge to students but also encouraged students to

explore more about the material, so that there was reciprocity from two directions.

The use of PBL model provided opportunities for students to learn autonomously, construct their own learning to create works or real products in the form of waste recycled products. Thereby, it indirectly and directly pushed the student's critical thinking and scientific literacy skill (Jauhariyyah, 2017).

The PBL model supported the realization of the science component which includes processes, products, and self regulation as in the learning process the teacher gave projects and provided opportunities for students to plan, carry out and present their work starting from the tools and materials used, how to make them, their uses and improvements as well as self-assessing the results. It has been made, thus it formed a setting in students. This was in line with the theory explained by Santiyasa that Problem Based Learning increased student scientific literacy skill, motivation to learn, self confidence, creative abilities and self admiration (Jauhariyyah, 2017).

The PBL model has steps in the learning process. The steps in the PBL model according to Arends (2012) were as follows: 1) Student Directive to

Problems. The teacher explained about learning objectives, and supported students to engage in solving the problem. 2) Students Organizing. The teacher helped student to identify and organize the task. 3) Guiding investigations Individual or group. The teacher advised students to collect appropriate information. The teacher helped to obtain explanation, and problem-solving. 4) Increase and Present the Work. The teacher helped and directed students to make reports from the information obtained and controlled them to present their presentation. 5) Analyze and Evaluate the Problem. The teacher helped students to assess their problems and their process that used.

The use PBL model in learning process was led to create fun and humane learning. This model was considered capable of stimulating students to improve the quality of their learning outcomes in all aspects (affective, cognitive and psychomotor) by involving more senses of sight, hearing, touch, smell and providing more memorable experience (because of direct-experience together with other people) (Wulandari, 2016). It made easier for students to understand the learning material they learn while seeing and acting the objects directly, so that they

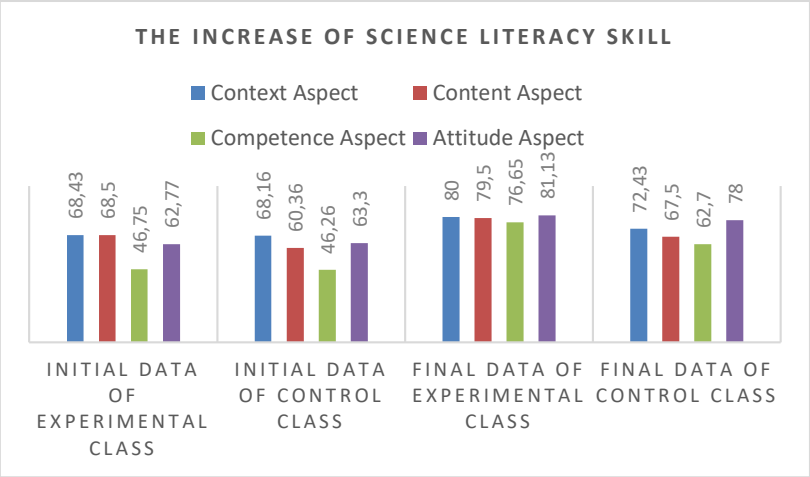
understand the concept of material. The teacher used this problem solving activity to help students in understanding, so that they did not learn only by listening and writing but also seeing and practicing their scientific literacy and critical thinking skills through experiment and problem solving. Therefore, students understood better electrolyte and non electrolyte material during the learning process.

3. The Effectiveness of PBL (Problem Based Learning) Model in Increasing Student's Scientific Literacy Skill

   According to Mulyasa (2014) learning were considered successful if 75% of students have completed KKM. The results of the study showed that the experimental class learning completeness was 79.32% which means that the PBL model was effective in increasing student's scientific literacy skill. The increase in student's scientific literacy skill was influenced by several things, one of which learning by using PBL model.

   PBL model has a role to develop ideas by making guided discoveries that encourage students to discover the concepts that they learned on their own so that they did not only get material from educators but also from other sources such as books. Toharudin

(2011) stated that the existing phenomena of learning material on electrolyte and non electrolyte were to push students into a lot of readings, especially science reading students can be trained. Another influential factor was that students were enthusiastic in participating the learning process by filling out questions, LKPD towards learning, namely enthusiasm that is more prominent in the experimental class. There were 4 aspects of scientific literacy skills, those are knowledge aspect, competence aspect, context aspect, and attitude aspect. The average value of the pre-test and post-test results on every aspect of the scientific literacy skill of the experimental class and control class students can be seen in following Picture 4.1 :



Picture 4. 1. Science Literacy Improvement Diagram

Based on Picture 4.1, the value of context aspect of experimental class science increased from 68,43 to 80, the knowledge aspect also increased from 68,5 to 79,5, as well as competence aspect increased from 46,75 to 76,65 and for the last is attitude aspect also increased from 62,77 to 81,13. This was because students were able to understood scientific phenomena, using scientific evidence and identify scientific questions in accordance with the Problem Based Learning model. Nurfaidah (2017) stated that explaining natural phenomena and drawing conclusion based on scientific evidence will make students have the ability to recognize, remember, explain, describe

and apply the knowledge they have acquired in everyday life. Ekohariad (2009) suggested that there were various factors that affect the scientific literacy ability of students in Indonesia, such as the scientific attitude possessed by the students, the curriculum that were used, and the socio-cultural environment or the background of the students. Research conducted by Ainina (2016) suggested that scientific attitudes, school curriculum, and student backgrounds may affect student's scientific literacy skills. This was in line with other research by Khoiruddin (2017) that the factors which influence the literacy abilities of students include the classroom environment, family support and the ability or readiness of students to accept learning.

The average value on context aspect of control class increased from 68,16 to 72,43, the knowledge aspect also increased from 60,36 to 67,5, as well as in the competence aspect increased from 46,26 to 62,7. The last aspect is attitude aspect which also increased from 63,3 to 78. Based on Picture 4.1, it could be concluded that the average indicator per class aspect from the experimental class is higher than the control class. This was because the experimental class students

were more enthusiastic during learning process and in terms of facilities for online media were also better.

The advantage of PBL (Problem Based Learning) was to develop the motivation for learning, encouraging students to be creative in thinking, active in learning and optimize their abilities meta-cognition, learn to analyze a problem, and encourage students to have high self-confidence to learn independently so as to make meaningful learning (Rusmono, 2012).

The results showed that the experiments in science learning, especially chemistry, became more active. Students actively participated in groups to completed tasks and made observations. PBL (Problem Based Learning) was able to increased student's ability to found and solved a given problem, so that students discovered new knowledge. This was in accordance with Piaget's theory of constructivism which quoted by Danoerbroto who stated that students constructed knowledge and discovered by themselves, then transformed complex information and checked new information with old rules, as well as revising if the rules no longer applied. Problem-solving, expressing ideas and looking for truth is the central point of the learning model (Danoerbroto, 2015).

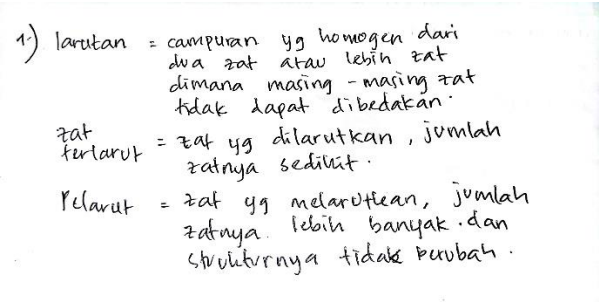
PBL as a centered learning model help students to practice skills and abilities to solve the problem. According to Hafiza, PBL was a model for small group teaching which helped students became problem-solvers. In addition, the PBL model was able in generating student's motivation to learn (Hafiza, 2013).

4. The Analysis of Science Literacy Achievement in Learning Process (Student's Responses)

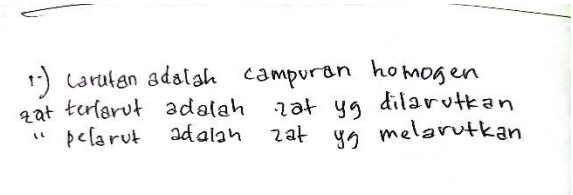
The measured aspect of knowledge was about the concept of science of electrolyte and non-electrolyte solutions. The scientific literacy skills test on the aspects of student's knowledge, context, competence and attitude aimed to describe the extent to which student's ability to apply their knowledge in the contexts that are relevant to life. Based on the data post-test obtained, scientific literacy skills of chemistry in the overall knowledge aspect was 67,50% which categorized "High". Some students were able to master basic concepts and theories about electrolytes and non- electrolytes. In this case, discuss about the student's answer based on the balancing of experimental class and control class. Researcher chose

3 questions from 15 scientific literacy questions which related to the 4 scientific literacy aspects.

The 1st question was the concept of electrolyte and non-electrolyte according to daily life problems. The first question is one of the content aspect of scientific literacy. And based on student's responses most of 27 students answered correctly, suitable with indicators of science literacy and explained the exact reasons for the questions given. For the control class, almost answer the question briefly. Only 3-4 students who answered with a good explanation.



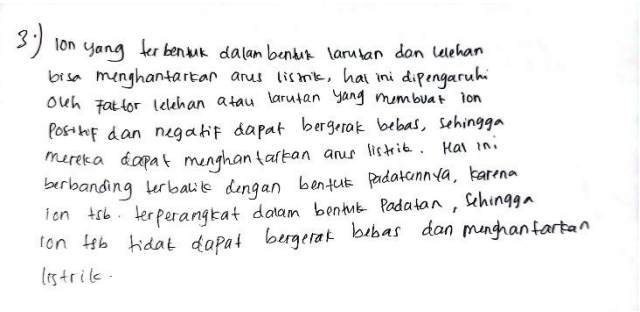
Picture 4. 2. Experimental Class Student's Answer



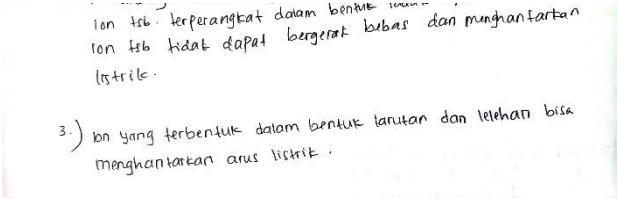
Picture 4. 3. Control Class Student's Answer

Based on the student's responses that has been carried out, it can be seen that the students with has the higher and good scientific literacy skill of the experimental class can answer the question very well but the control class it can be seen that it has a lower of scientific literacy skill. It means that PBL (Problem Based Learning) model applied in the experimental class has increased scientific literacy skills compared to the Cooperative Learning model applied in the control class. The results of this study are in accordance with the theoretical study described by Shoimin in Chapter II which states that PBL model is trained to solve problems with scientific literacy and in accordance with real situations. PBL model involves students in scientific literacy. The teacher only acts as a guide and monitors learning activities (Ferdi, 2019).

The 2nd question was about the correct statement about the concept of electrolyte and non-electrolyte according to solution and solute. The second question is one of the competence aspect of scientific literacy. Almost 25 students from 32 can answered correctly as it was relatively easy. They answered correctly with solution and solid solution.


3.) Ion yang terbentuk dalam bentuk larutan dan lelehan bisa menghantarkan arus listrik, hal ini dipengaruhi oleh faktor lelehan atau larutan yang membuat ion positif dan negatif dapat bergerak bebas, sehingga mereka dapat menghantarkan arus listrik. Hal ini berbanding terbalik dengan bentuk padatannya, karena ion tsb. terperangkat dalam bentuk Padatan, sehingga ion tsb tidak dapat bergerak bebas dan menghantarkan listrik.

Picture 4. 4. Experiment Class Student's Answer


ion tsb. terperangkat dalam bentuk
ion tsb tidak dapat bergerak bebas dan menghantarkan
listrik.

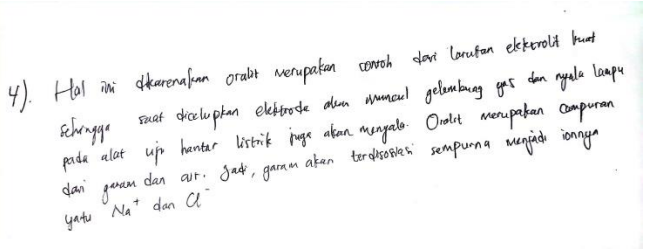
3.) Ion yang terbentuk dalam bentuk larutan dan lelehan bisa menghantarkan arus listrik.

Picture 4. 5. Control Class Student's Answer

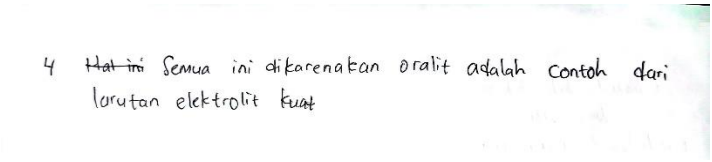
Based on the student's responses, it can be seen that the students with has the higher and good scientific literacy skill of the experimental class can answer the question very well. Student can explained the case clearly. But the control class it can be seen that it has a lower of scientific literacy skill. Regarding to the student's answered it still need to has critical thinking by the case more. PBL models helped students develop thinking skill and problem solving skill (Aman, 2016). In addition, according to Wulandari, the PBL model especially the competence aspect in scientific literacy skill made students more creative in thinking, active in

processing experiments and discussing. The interaction within group friends was also very good. The students were very active and creative in processing problems (Wulandari, 2016).

The 4th question was about the characteristic of electrolyte and non-electrolyte in oralit. Most of students had not difficulty to answered this question. The fourth question is one of the attitude aspect related to scientific literacy skill aspect. 22 students of experimental class can aswered the question with good explaination but students of control class answered the question in general only. This was caused by a problem that required analysis. Learning difficulties experienced by students must be addressed immediately so that it does not affect student's learning outcomes.


4). Hal ini dikarenakan oralit merupakan contoh dari larutan elektrolit kuat sehingga saat dicelupkan elektroda akan muncul gelembung gas dan nyala lampu pada alat uji hantar listrik juga akan menyala. Oralit merupakan campuran dari garam dan air. Jadi, garam akan terdisosiasi sempurna menjadi ionnya yaitu Na^+ dan Cl^-

Picture 4. 6. Experimental Class Student's Answer

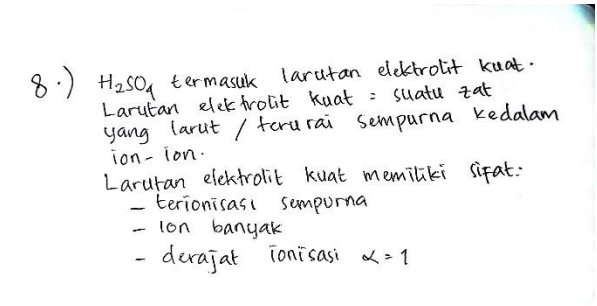


Picture 4. 7. Control Class Student's Answer

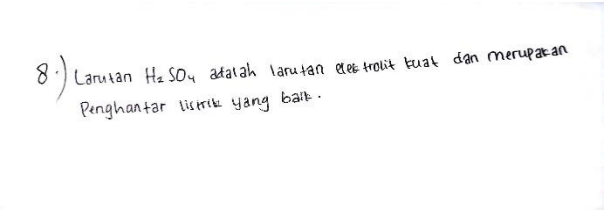
Based on the student's responses that has been carried out in number 4, it can be seen that the students with has good explanation and critical thinking showed has scientific literacy skill but the control class it can be seen that it has a simple answered. It showed a lower of scientific literacy skill. Learning with PBL model involves real problems. Problems in daily life as the application of concepts. With PBL, students were more motivated and increase student interest in the material to be studied and individual student learning difficulties can be overcome through group work. Meanwhile, scientific literacy skills are related to real life so that students will more easily understand a concept (Novita, 2013).

The 8th question was about the probability if we test the sulfuric acid solution for electrical conductivity of sugar solution. In this question was used context aspect related to the scientific literacy aspect. There were some students who answered clearly in experimental class. Almost 17 students answered with

very good explanation. But there were also others who just wrote the simple answer comes from control class.


8.) H_2SO_4 termasuk larutan elektrolit kuat.
Larutan elektrolit kuat = suatu zat yang larut / terurai sempurna kedalam ion-ion.
Larutan elektrolit kuat memiliki sifat:
- terionisasi sempurna
- ion banyak
- derajat ionisasi $\alpha = 1$

Picture 4. 8. Experimental Class Student's Answer


8.) Larutan H_2SO_4 adalah larutan elektrolit kuat dan merupakan Penghantar listrik yang baik.

Picture 4. 9. Control Class Student's Answer

Based on the student's answered, it is one of an attitude aspect from scientific literacy. Based on the student's responses, it can be seen that the students of experimental class with has good explanation about H_2SO_4 solution clearly showed the scientific literacy skill. But the control class it can be seen that student answered the definition of H_2SO_4 solution only. It

showed that it is one of example of a lower of scientific literacy skill. According to research conducted by Hernandes Ramosand Pas, explained that students who learn through PBL (Problem Based Learning) models do not only have the ability to collect facts but also interpret information, have a higher collaborative work spirit and develop positive attitudes within students (Erniza, 2017).

National Science Education Standart (1996) stated scientific literacy is knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity. Based on this statement, the emphasis of scientific literacy is not on mastering knowledge and understanding of scientific concepts and processes, but rather than directing how to enable someone to be able to make a decision and be involved in social life based on their knowledge and understanding of science. Scientific literacy is important for everyone as a society. Everyone must have a certain level of scientific literacy in order to survive in nature and in the workplace. Scientific literacy is related to knowledge, understanding, skills and values contained in science.

The reasons scientific literacy is important for students are : (1) understanding science offers personal fulfillment and joy, can be shared with anyone and (2) countries in the world are faced with questions in their lives that require scientific information and scientific ways of thinking to make decisions and the interests of many people need to be informed, such as air, water and forests (Zuriani, 2013).

Based on the results of student's answered, the factors that influence the achievement of student's scientific literacy by NSES National Science Education Standart (1996) are as follows: 1) Students had never worked on scientific literacy questions before, so that students feel awkward with questions that are different from those usually obtained at school. 2) Student's habits prefer memorizing learning material rather than understanding it, so that students do not understand and apply the material in daily life. 3) The questions that were usually given by the teacher for evaluation were not yet a matter of analysis, so they do not require students to use their reasoning. This results in students not being accustomed to reasoning and critical thinking. 4) Student's lack of interest in reading and student's unfamiliarity with answering questions

in the form of discourse, graphs, and pictures. 5) Students prefer to answer multiple choice questions compared to descriptions. On choice questions, students only need to choose without having to think about the answer.

Based on the results of the achievement of student answers, it can be concluded that there were an improvement in student's scientific literacy skill by applying the scientific literacy question after using PBL (Problem Based Learning) model.

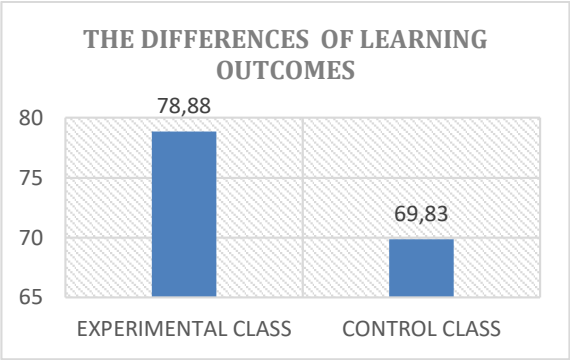
5. The Difference of Student's Scientific Literacy Skills Between Experimental Class and Control Class

Independent test sample t-test was used to determined the difference in average learning outcomes between the experimental class and the control class.

Table 4. 10 The Result of T-test

n1	32
n2	30
Sp	5,73
atas	1971,98
bawah	60
T	6,21
derajat bebas	60
tingkat sig 5%	2,0003

Table 4. 11. The Differences of Learning Outcomes



Based on the data that has been generated, it was possible to test the hypothesis with the statistical test using the t-test. The author used the t-test because the sample variance could not represent the population variance. The calculation of the hypothesis test used data from the results of scientific literacy skills in the experimental class and the control class. In the hypothesis test of student's scientific literacy skills, it was obtained t_{obs} = 6,21 with t_{table} 2,000 and critical area (DK) ={t/t -2,000 or t > 2,000}, t_{obs} DK. This showed that H_0 is rejected, which means that Problem-Based Learning model is effective on scientific literacy skills.

Based on the hypothesis test which shows that H_0 is rejected and H_1 is accepted, it was necessary to do

an analysis using descriptive t-test in order to found out whether PBL model is effective or not on scientific literacy skills in chemistry learning in class X MA Amtsilati Bangsri Jepara. In the calculation of the hypothesis of scientific literacy ability, it was obtained that t_{count} = 5.95 with t_{table} 1.6939 which fell in the rejection area of H_0 with the results of the analysis showing that PBL model is effective on student's scientific literacy skills.

Review from the input in the form of daily test scores or pre-test for the context, content and competence aspect of the control class and experimental class as well as the results of the attitude aspect questionnaire to determine the initial state of scientific literacy ability before treatment. RPP for the experimental class is in the form of PBL and RPP for the control class is a Cooperative Learning model with practice questions.

Based on Table 4.1, the average percentage of scientific literacy ability is 79.32% in which categorized in high category. The highest increase was in the aspect of competence, which was 0.56 in the medium category. It was because in the aspect of competence there were three indicators, identifying

scientific questions, explaining phenomena scientifically, and using scientific evidence. So, in this aspect, students were easier to answer questions because scientific investigations were carried out, students could found answers directly to questions through direct experiments, so that the material obtained were easier to understood. While the lowest aspect is the content aspect of 79.50% and the gain is 0.34. It was because, students were required to be able to present facts, principles, and concepts.

Most of the students found it difficult to discovered the principles of the material being studied. While in the control class using the Cooperative Learning model where students did not find their own concepts but from the teacher's explanation. Students conducted discussions to solve the questions given by the teacher.

The difference of the average results of students between the experimental class and the control class in science learning was due to the fact that the experimental class which was used the PBL (Problem Based Learning) model has a fairly good enthusiasm for learning, and the absorption capacity in mastering the material was quite good. The results of

this study are in accordance with research conducted by (Hartanto, 2014) suggesting that using the media can improve student learning outcomes which are seen from the mastery of the material and the absorption of students increases in absorbing lessons. The results of (Fauziah, Hakim, and Handayani, 2019) show that the Problem Based Learning model provides significant effect on increasing student's scientific literacy skills and student attitudes.

The material such as electrolyte and non-electrolyte was material that has very close characteristics to daily life, presenting problems on environmental change material through PBL (Problem Based Learning) was able to developed student's analytical and problem-solving skills which were included in scientific literacy skills. The purpose of PBL (Problem Based Learning) is to provide opportunities for students to be able to develop thinking skills, problem-solving, learn independently and develop social skills (Arends, 2008).

This deep difference was also influenced by online learning in the experimental class. Many previous research results showed the advantages of online learning compared to conventional learning.

This is balance with the results of Kek and Henk (2017) which stated that online learning has a higher impact than learning using Student Worksheet on chemistry learning achievement.

Based on the results of the research that has been done, it can be concluded that PBL model on electrolyte and non-electrolyte materials that was integrated with experiment and problem-solving activities improved the student's scientific literacy skills as it made students to be able to treated waste directly become a product that has a selling value during learning process, also making students to be able to find their own real learning concepts and how to organized and planned the learning process, so that students are interested and active to follow the lesson. Students learn independently, look for information and materials by themselves through problem-solving activities and group discussions. Student activities in PBL model increased curiosity and provided opportunities for students to cooperated with each other which means providing opportunities for students to think independently and collaboratively so that the knowledge gained can last a long time. The student were able to remember easily which then

affected the student's mastery of concepts about the material presented. This is supported by Bruner's statement which explains that the learning process will be active, creative, effective and fun if the teacher provides opportunities for students to find a rule including concepts, theories and definitions through examples which describes or represents the source (Yuli, 2018).

Based on a review of the results or data analysis and discussion, it can be concluded that research with PBL model on electrolyte and non-electrolyte was the result of innovation from previous researches. From the results of calculations, analyzing and discussions that have been carried out, the research hypothesis is accepted, meaning that there is a significant effect between PBL on student scientific literacy skills. And there is an effect of PBL to improve student's scientific literacy skill in 10th Grade at MA Amtsilati Bangsri Jepara.

6. Analysis of Scientific Literacy Results with Socio Scientific Issues

The implementation of PBL (Problem Based Learning) based on the learning model with PBL has been proven significantly in improving scientific

literacy skills in aspects of knowledge, competence, context, and student attitudes. The content of science in this study refers to scientific concepts that are connected with a socio scientific context to be able to understand natural phenomena and changes that may occur to nature through human activities. As 1st example in a flood situation, PLN must turn off the electric current to prevent the flow of electric current to the water. This is illustrated by the activities during the learning process, in accordance with the implementation of the activities in the introduction when motivating students by thinking Electrolyte and Non electrolyte content with socio scientific issues which were further sharpened in LKPD, problem orientation. For example, in learning activities at the 2nd meeting which was held on 19th of December 2021, the PBL syntax in the teacher phase presented problems that raised problems in daily life through LKPD. This issue was chosen because according to the researcher this is a very local contextual because it is related to daily life.

Student's knowledge abilities will increase if in the learning process students are presented with a real learning experience where students know and

experience for themselves what happens from the scientific phenomena discussed during learning (Sadler, 2004). In this condition students will be able to answer questions on scientific knowledge because students know how to solve problems if there is a flood and there are some electricity or cables around them, so in making attitudes students become more precise because the decision making process has been based on knowledge.

2nd example is the energy crisis, in this case students are directed to be able to develop alternative energy in overcoming the energy crisis in Indonesia. In this problem students be able to answer the question scientifically. Seawater can be used as a generator of electricity because seawater contains NaCl (salt) compounds which break down into Na+ and Cl- in the water. Seawater is also an electrolyte solution with the largest solute. To get a large electric current, it needs an electrode plate that has a large area and a lot of seawater. Students will be able to solve the problem clearly.

The 3rd examples is student had the barium hydroxide spilled into the table and then hit the wires connected to the electricity. A few minutes later the

same thing happened to another solution, alcohol. The incident made Aira very panicked and accidentally again Aira's hand touched the spill, but this time Aira did not feel an electric shock in her hand. So by this condition, it made easy for students to relate the knowledge he knows with theoretical scientific knowledge. In accordance with the principle of constructivism which is the basis of PBL that the knowledge that is constructed within students about its relationship with the real world is basically a process of meaning from what is learned in students (Sadler, 2009). In this case, students are the center of learning activities and the teacher is the facilitator so that students learn more meaningfully and ultimately affect the achievement of student's scientific literacy (Musfiqon, 2015).

Based on the results of research and statistical data analysis and the discussion described in the previous chapter, it can be concluded that the implementation of PBL in the context of socio scientific issues on the concept of Electrolyte and Non-Electrolyte has been carried out properly according to the implementation of teaching learning. While the characteristics of PBL (Problem Based learning) with

the Socio Scientific Issues context are: 1) assisting in developing student's knowledge and scientific literacy skills, 2) student centered learning, 3) the context of socio scientific issues presented sharpens scientific literacy and problem solving skills (Sadler, 2009).

CHAPTER V
CLOSING

A. Conclusion

Based on the research result and data analysis that has been carried out on the effectiveness of PBL model on student's science literacy skills, PBL (Problem Based Learning) model is effective on scientific literacy skills with the results of t_{obs} = 6,21 with t_{table} = 2,000 and critical area db = 60 {t/n-2,000 or t > 2,000.

B. Suggestion

1. Students
    a. Each student has different scientific literacy skills so that students should understand their obligations as students, namely having high enthusiasm and curiosity in participating in learning activities.
    b. Students should be more active in learning activities and dare to express opinions and have a high curiosity in solving a problem.
2. Teachers
    a. Teachers have an obligation to develop student's scientific literacy skills through the selection of appropriate and effective learning

models. One alternative learning model that can be applied in Electrolyte and Non Electrolyte learning process is PBL (Problem Based Learning) model.

b. PBL (Problem Based Learning) model should be applied in the learning process to train students in solving problems and can grow scientific literacy skills in learning Chemistry.

3. Observers
   a. In this study, the aspect that you want to know by using PBL (Problem Based Learning) model is in terms of student's scientific literacy abilities. For other prospective observers, they can conduct reviews from other sides, such as critical thinking skills, process skills, and so on.
   b. Similar research is needed to compare the most effective learning models on student's scientific literacy skills.
   c. It is necessary to conduct a similar research, namely to determine the effectiveness of PBL (Problem Based Learning) model on the scientific literacy ability of students in several schools.

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