Thabiea : Journal of Natural Science Teaching
Vol. 5(1), pp. 1-16, 2022
Available online at
http://journal.iainkudus.ac.id/index.php/Thabiea
p-issn: 2580-8474, e-issn: 2655-898X

# Development of Three-Tier Test Instrument Based on Scientific Literacy in Electrolyte and Non-Electrolyte Solution Topics

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**Keywords:**
Scientific literacy
Three Tier Test
Instrument
Electrolyte and Non-Electrolyte Solution

**Abstract**

Scientific literacy is very important for students as a provision to face the challenges of the 21st century. The scientific literacy of students in Indonesia ranked 70 of 78 countries in PISA in the last period in 2018. One of the factors which cause students' scientific literacy to tend to below is that students have not been trained in answering questions with typical as on PISA. Efforts to train students to be familiar with scientific literacy include developing test instruments based on scientific literacy. This study aims to examine the feasibility and characteristics of the scientific literacy test instrument for electrolyte and non-electrolyte solutions; besides, examine the profile of students' scientific literacy abilities. The type of this study was Research & Development with a 4D model which includes the stages: define, design, develop, and disseminate. The research subjects were students of class X Science from one of the Senior High Schools in Sragen regency. The results of the study show that (1) the scientific literacy test instrument which is developed is feasible and valid to be used with a validity of 34 of 35 questions which is declared valid and reliability of 0.86; (2) the characteristics of the test instrument is that using three aspects of scientific literacy in one question at once and can be used to determine the student's scientific literacy profile well; (3) the profile of students' scientific literacy skills is in a fairly good criterion with a percentage of 59%. The profile of students' scientific literacy abilities from the aspect of scientific competence is obtained as much as 57.21%; 59.72%; and 60.46%.

To cite this article:
Dewi, A. M., Haryani, S. (2022). Development of Three-Tier Test Instruments Based on Scientific Literacy in Electrolyte and Non-Electrolyte Solution Topics. *Thabiea : Journal of Natural Science Teaching*, Vol. 5(1), 1-16.

## Introduction

The rapid expansion of science and technology is a sign of the challenges of the 21st century. It affects various fields of life, including the field of education (Fatmawati & Setiawati, 2018). Scientific literacy is very important for students as a provision to face the challenges of the 21st century. Scientific literacy is used to understand the environment, health, economy, and other problems which are faced by modern society that rely on technology and the advances and development of science (Sanjaya *et al.*, 2017; Thummathong & Thathong, 2016; Cigdemoglu, 2015). The latest development of PISA results in 2018; especially, in scientific literacy, Indonesia ranks 70 out of 78 countries (OECD, 2019). It shows that students have difficulty in getting significance and using science to solve various problems which occur in daily life which actually require a good understanding of science (Salamah *et al.,* 2017).

One of the factors which cause students' scientific literacy to tend to below is that students have not been trained in answering questions with typical as on PISA (Fraenkel & Wallen, 2012). To date, the test instruments which are used in schools only emphasize content, not scientific literacy; such as applying science in everyday or contextual life, thinking of solving problems, and some scientific process skills. Therefore, efforts are needed to train students to be accustomed to scientific literacy, including by developing test instruments based on scientific literacy. Rusilowati *et al.,* (2018) stated that the measurement of scientific literacy ability is important to determine the extent of students' literacy of the science concepts which have been studied. The development of test instruments in order to measure scientific literacy skills continues. Setiyoningtyas & Kasmui (2020) developed a scientific literacy-based test instrument by using one aspect of scientific literacy on one question not combining all three aspects of scientific literacy at once in one question so that it is necessary to develop a scientific literacy-based test instrument that includes all three aspects of scientific literacy, which are context, content, and competence in each question.

The results of interviews with teachers of chemistry subjects at one of the Senior High Schools in Sragen regency show that the application of scientific literacy in making test instruments has never been conducted. The learning evaluation test which is used in schools has not yet been based on scientific literacy. In addition, the teacher has never tried to give questions in the three-tier test model to students in order to find out students' understanding of concepts. The test instrument which is used in one of the Senior High schools in Sragen regency usually uses an ordinary multiple-choice model. Thus, it has not been able to know the understanding of students' concepts.

One of the materials taught to class X students is an electrolyte and non-electrolyte solutions. The material for electrolyte and non-electrolyte solutions contain factual, conceptual, and procedural knowledge (Sari *et al.,* 2019). In addition, this material is full of theoretical concepts which are closely related to daily life so that it can be linked to scientific literacy (Habibati *et al.*, 2019).

Based on these problems, research on the development of a three-tier test instrument based on scientific literacy was conducted on electrolyte and non-electrolyte solutions. The test instrument developed was in the form of three-tier test questions since the questions were not used to being developed by teachers to evaluate learning outcomes in schools (Wahidah *et al.,* 2019). The three-tier test was an instrument with three parts. The first part contained multiple-choice questions. The second part was the reasons which refer to the multiple-choice answers. The third part was the question of students' trust in answering the questions of the previous two parts (Monita & Suharto, 2016). This study aims to examine the feasibility of the test instrument, examine the characteristics of the test instrument, and examine the profile of students' scientific literacy skills on electrolyte and non-electrolyte solutions.

## Method

Research and Development Research is designed to produce a three-tier test instrument based on scientific literacy for students on electrolyte and non-electrolyte solutions which adapts the Four D model from Thiagarajan (1974). The four D research model has four stages including the define, design, develop, and disseminate stage. The research subjects were students of class X SMA majoring in science for the academic year 2020/2021. Meanwhile, the data were collected by initial interviews, three-tier test instruments based on scientific literacy to determine the profile of students' scientific literacy, the scale of student and teacher responses to determine the feasibility of the test instrument.

The define stage consists of two main activities, which are field studies and literature studies. In the field study phase, interviews were conducted in order to obtain information regards to the learning process, the application of scientific literacy in schools, and the assessment instruments used in schools. The results of the literature review phase are that students need to have scientific literacy skills (Pertiwi *et al.*, 2018); besides, measurement of scientific literacy skills is needed to determine the extent of students' literacy of the science concepts which have been studied (Rusilowati *et al.*, 2018).

The design stage is needed to design the test instrument and its supporting instruments. The design stage starts from determining scientific literacy indicators and concept understanding indicators, making test instruments, making rubrics and discussions, compiling student and teacher response scales, compiling interview sheets and validation instruments. The test instrument developed in this study was in the form of 35 questions that already included aspects of scientific literacy.

The developed stage consists of three phases, which are expert validation, small-scale test, and large-scale test. The expert validation process was conducted by three validators and the results of the expert validation were used as a reference for revision of the test instrument before the test was conducted. Furthermore, this study consisted of two tests, which were a small-scale test and a large-scale test. The small-scale test was only used to determine the readability of the test instrument and the time needed to work on the test instrument with 32 students as respondents. The results of the small-scale test were improved for use in the large-scale test. Meanwhile, a large-scale test was used to determine the scientific literacy profile with 64 students as respondents. The research data were analyzed qualitatively and quantitatively. Moreover, the validation of the questions was calculated by calculating the point-biserial coefficient while the reliability of the questions was determined by using KR 21. The test instrument was declared reliable if the r11 was more than 0.7 (Arikunto, 2013). The dissemination stage obtained the final product of the test instrument and the output of the article which was disseminated through journal publications.

## Result and Discussion

### Test Instrument Feasibility

The test instrument can be said to be suitable for use if it meets certain requirements both in terms of language, validity, reliability, difficulty level, and item power (Wijayanto *et al.,* 2016). The feasibility of the developed test instrument refers to the results of expert validation, validity, reliability, level of difficulty, and discriminating power of items as well as supporting data in the form of teacher and student responses. Moreover, the results of the validation from the validator show that the test instrument is in the category suitable for use with a percentage of 91.42%.

The validity of the test instrument on the small-scale test is obtained 32 valid questions from a total of 35 questions. Meanwhile, the validity of the test instrument on the large-scale test is stated to be 34 valid questions from a total of 35 questions. Several factors which can affect the validity of the test instrument are following research conducted by Rusilowati *et al.,* (2016), which are (1) sufficient ability of student; (2) teacher objectivity in assessment; and (3) the condition of the students. These factors are in line with the factors which affect the validity stated by Yusup *et al.,* (2018) which is the condition of the students themselves. Items that are invalid in the small-scale test are corrected before being used in the large-scale test.

The reliability of the test instrument on the small-scale test is obtained 0.78 while on the large-scale test the result is obtained 0.86. The test instrument is feasible to use since it has a reliability of more than 0.7 (Arikunto, 2013). Reliable test instruments are needed in learning in order to correctly measure the skills and abilities of students (Putri *et al.*, 2020). Furthermore, the results of the reliability on the small-scale and large-scale tests have differences, it is caused by several factors which affect the reliability of the instrument stated by BSNP (2010) including a large number of questions, the condition of students, the distance from the first test to the second test, the presence of interference or the obstacles experienced in the process of conducting the test, as well as the readiness of each student.

The level of difficulty of the questions is divided into three categories, which are easy, medium, and difficult. The data on the difficulty level of the items on the small and large scale trials respectively can be seen in Figure 1. The overall results, it can be said that the test instrument which is developed as a "medium" difficulty level questions with a "medium" difficulty level are good questions. It is in line with Arikunto's (2013) statement which states that a good question has a proportional level of difficulty, which is that the question is not too easy and not too difficult.

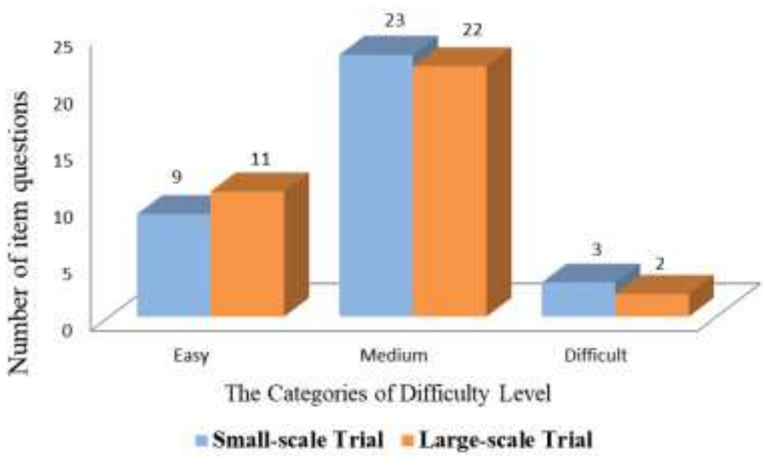


**Figure 1.** The Difficulty Level of The Items on The Small and Large Scale

The discriminating power of the questions on the small-scale test is divided into categories of very good, good, quite good, and not good. The results of the discriminating power on the small test in a row are 0, 5, 14, and 16. Meanwhile, the discriminating power of the questions on the large-scale test is 0, 11, 16, and 8. The questions with discriminating power criteria are "good" and "quite good" suitable to be used as a test instrument since it can distinguish high-ability students from low-ability students (Sudiyono, 2012).

Based on the teacher's response scale, the test instrument is declared suitable for use with a score of 51 out of a total score of 60. The student response scale is estimated by using the Cronbach Alpha formula and it is obtained a reliability of 0.72 on the small-scale test and 0.85 on the large-scale test. From the results of the reliability coefficients on the small-scale and large-scale tests, the developed student response scale is declared reliable, in accordance with Sudaryono (2013) which states that an instrument is reliable if it is worth $r_{11}$ 0.7.

**Characteristics of Test Instruments**

The characteristics of the test instrument are generally seen from the results of the validity, reliability, discriminating power, and level of difficulty which have been tested. The validity of the test instrument on the small-scale test is obtained 32 valid questions from a total of 35 questions. Meanwhile, the validity of the test instrument on the large-scale test was stated to be 34 valid questions from a total of 35 questions. The reliability of the test instrument on the small-scale test is obtained 0.78 while on the large-scale test the result is obtained 0.86. The test instrument is reliable since it has a reliability of more than 0.7 (Arikunto, 2013).

The characteristics of the test instrument are then seen from the purpose of the study, which is to determine the profile of students' scientific literacy on electrolyte and non-electrolyte solutions. The previous study and development of scientific literacy-based test instruments only measured one or two aspects of scientific literacy, or measured all three aspects of scientific literacy but only used one aspect in each question. Scientific literacy according to PISA 2015 has three aspects, which are content, competence, and context (OECD, 2017). The previous study only included one aspect of the problem, while this study used all three aspects of scientific literacy in one question at once. The results of the developed test instruments can measure students' scientific literacy profiles well and can measure students' conceptual understanding of electrolyte and non-electrolyte solution materials.

The reference used in the preparation of this test instrument is the syllabus for chemistry class X science. Based on the syllabus, it is obtained Basic Competencies for electrolyte and non-electrolyte solution materials, which are (3.10) analyzing the characteristics of electrolyte and non-electrolyte solutions based on their electrical conductivity and (4.10) Designing, conducting, concluding, and presenting experimental results to determine the characteristic of electrolyte solutions and non-electrolyte solutions. The two basic competencies are further described in Competency Achievement Indicators (GPA).

Each item is associated with aspects of scientific literacy and indicators of conceptual understanding. The scientific literacy aspect which is used refers to the results of PISA 2015 (OECD, 2017), which are content (knowledge), competence (process), and context (application of science). Furthermore, the indicators for understanding the concept used to refer to the Ministry of National Education (2007), which are: (1) Restating a concept; (2) Classifying objects according to certain characteristics; (3) Giving examples and not examples of a concept; (4) Presenting concepts in various representations; (5) Developing the necessary and sufficient conditions for a concept; (6) Using, utilizing, and selecting certain procedures or operations; and (7) Applying concepts or algorithms to solving problems which are presented. The indicators measurements and the number of items can be seen in Table 1 and the example of the question (have been translated into English) can be seen in Figure 2.

**Table 1.** The indicators measurements

| **The aspect of Scientific Literacy based on PISA** | | | **Competency Achievement Indicators** | **The indicators for understanding the concept** | **No. Items** |
|---|---|---|---|---|---|
| Content | Competence | Context | | | |
| Concept of electrolyte and non-electrolyte solutions | Explaining issues or phenomena scientifically | Environments | Explaining the concept of electrolyte and non-electrolyte solutions | Restating a concept | 1 |
| Concept of electrolyte and non-electrolyte solutions | Explaining issues or phenomena scientifically | Threat and danger | Explaining the concept of electrolyte and non-electrolyte solutions | Restating a concept | 2 and 3 |
| Characteristics of electrolyte and non-electrolyte solutions | Identifying and designing scientific investigations, | Natural resources | Analyzing the characteristics of electrolyte and non-electrolyte solutions based on their electrical conductivity | Presenting concepts in various representations | 4 |
| Characteristics of electrolyte and non-electrolyte solutions | Identifying and designing scientific investigations | Environments | Analyzing the characteristics of electrolyte and non-electrolyte solutions based on their electrical conductivity | Presenting concepts in various representations | 5 |
| Characteristics of electrolyte and non-electrolyte solutions | Interpreting data and evidence scientifically | Natural resources | Analyzing the characteristics of electrolyte and non-electrolyte solutions based on their electrical conductivity | Classifying objects according to certain characteristics | 6 and 8 |
| Characteristics of electrolyte and non-electrolyte solutions | Interpreting data and evidence scientifically | Natural resources | Analyzing the characteristics of electrolyte and non-electrolyte solutions based on their electrical conductivity | Giving examples and not examples of a concept | 7 |
| Types of electrolyte and non-electrolyte solutions | Identifying and designing scientific investigations, | Environment | Analyzing the characteristics of electrolyte and non-electrolyte solutions based on their electrical conductivity | Classifying objects according to certain characteristics | 9 |
| Types of electrolyte and non-electrolyte | Identifying and designing the scientific | Natural resources | Analyzing the characteristics of electrolyte and non- | Giving examples and not examples | 10 |

| **The aspect of Scientific Literacy based on PISA** | | | **Competency Achievement Indicators** | **The indicators for understanding the concept** | **No. Items** |
|---|---|---|---|---|---|
| Content | Competence | Context | | | |
| solutions | investigation | | electrolyte solutions based on their electrical conductivity | of a concept | |
| Types of electrolyte and non-electrolyte solutions | Interpreting data and evidence scientifically | Natural resources | Classifying of strong electrolyte, weak electrolyte and non-electrolyte solutions | Giving examples and not examples of a concept | 11 dan 12 |
| Types of electrolyte and non-electrolyte solutions | Interpreting data and evidence scientifically | Scientific and Technology Development | Analyzing the characteristics of electrolyte and non-electrolyte solutions based on their electrical conductivity | Classifying objects according to certain characteristics | 13 |
| Characteristics of electrolyte and non-electrolyte solutions | Interpreting data and evidence scientifically | Natural resources | Analyzing the characteristics of electrolyte and non-electrolyte solutions | Classifying objects according to certain characteristics | 14 |
| Electrical Conductivity | Explaining issues or phenomena scientifically | Scientific and Technology Development | Analyzing the advantage of electrolytes in daily life | Presenting concepts in various representations | 15 |
| Electrical Conductivity | Explaining issues or phenomena scientifically | Threat and danger | Explaining the concept of electrolyte and non-electrolyte solutions | Presenting concepts in various representations | 16 |
| Electrical Conductivity | Interpreting data and evidence scientifically | Natural resources | Analyzing the characteristics of electrolyte and non-electrolyte solutions based on their electrical conductivity | Classifying objects according to certain characteristics | 17 |
| Electrical Conductivity | Interpreting data and evidence scientifically | Scientific and Technology Development | Analyzing the factors that can affect the electrical conductivity of electrolyte solutions | Applying concepts or algorithms to solving problems that are presented | 18 |
| Electrical Conductivity | Identifying and designing the scientific investigation | Scientific and Technology Development | Analyzing the factors that can affect the electrical conductivity of electrolyte solutions | Applying concepts or algorithms to solving problems that are presented | 19 |
| Electrical Conductivity | Identifying and designing the scientific investigation | Natural resources | Explaining the concept of electrolyte and non-electrolyte solutions | Developing the necessary and sufficient conditions for a concept | 20 |
| Electrical Conductivity | Identifying and designing the scientific investigation | Natural resources | Analyzing the factors that can affect the electrical conductivity of electrolyte solutions | Using, utilizing, and selecting certain procedures or | 21 |

| **The aspect of Scientific Literacy based on PISA** | | | **Competency Achievement Indicators** | **The indicators for understanding the concept** | **No. Items** |
|---|---|---|---|---|---|
| Content | Competence | Context | | | |
| | | | | operations | |
| Electrical Conductivity | Identifying and designing the scientific investigation | Natural resources | Analyzing the factors that can affect the electrical conductivity of electrolyte solutions | Classifying objects according to certain characteristics | 22 |
| Electrical Conductivity | Identifying and designing the scientific investigation | Natural resources | Analyzing the factors that can affect the electrical conductivity of electrolyte solutions | Developing the necessary and sufficient conditions for a concept | 23 |
| Electrical Conductivity | Explaining issues or phenomena scientifically | Natural resources | Analyzing the advantage of electrolyte solutions in daily life | Presenting concepts in various representations | 24 |
| Chemical Bond | Identifying and designing the scientific investigation | Natural resources | Analyzing the types of chemical bond of electrolyte solutions | Developing the necessary and sufficient conditions for a concept | 25 |
| Chemical Bond | Identifying and designing the scientific investigation | Natural resources | Analyzing the types of chemical bond of electrolyte solutions | Giving examples and not examples of a concept | 26 |
| Chemical Bond | Interpreting data and evidence scientifically | Environments | Analyzing the types of chemical bond of electrolyte solutions | Classifying objects according to certain characteristics | 27 |
| Ionization Reaction | Explaining issues or phenomena scientifically | Environments | Analyzing the ionization reaction of electrolyte solutions | Developing the necessary and sufficient conditions for a concept | 28 |
| Characteristics of electrolyte and non-electrolyte solutions | Interpreting data and evidence scientifically | Environments | Analyzing the advantage of electrolyte solutions in daily life | Presenting concepts in various representations | 29 |
| Ionization Reaction | Interpreting data and evidence scientifically | Natural resources | Analyzing the ionization reaction of electrolyte solutions | Developing the necessary and sufficient conditions for a concept | 30 |
| Ionization Reaction | Identifying and designing the scientific investigation | Environments | Analyzing the ionization reaction of electrolyte solutions | Developing the necessary and sufficient conditions for a concept | 31 |
| Ionization Reaction | Explaining issues or phenomena scientifically | Health | Analyzing the advantage of electrolyte solutions in | Presenting concepts in various | 32 |

| **The aspect of Scientific Literacy based on PISA** | | | **Competency Achievement Indicators** | **The indicators for understanding the concept** | **No. Items** |
|---|---|---|---|---|---|
| Content | Competence | Context | | | |
| | | | daily life | representations | |
| Ionization Degree | Identifying and designing the scientific investigation | Scientific Development | Concluding ionization degree (α) of electrolyte solutions based on observation data of electrical conductivity experiment of electrolyte solutions | Using, utilizing, and selecting certain procedures or operations | 33 |
| Ionization Degree | Interpreting data and evidence scientifically | Natural resources | Concluding ionization degree (α) of electrolyte solutions based on observation data of electrical conductivity experiment of electrolyte solutions | Using, utilizing, and selecting certain procedures or operations | 34 |
| Characteristics of electrolyte and non-electrolyte solutions | Explaining issues or phenomena scientifically | Health | Analyzing the advantage of electrolyte solutions in daily life | Presenting concepts in various representations | 35 |

| **NO.** | **The aspect of Scientific Literacy based on PISA** | | | **Competency Achievement Indicators** | **The indicators for understanding the concept** |
|---|---|---|---|---|---|
| | Content | Competence | Context | | |
| 1. | Concept of electrolyte and non-electrolyte solutions | Explaining issues or phenomena scientifically | Environment | Explaining the concept of electrolyte and non-electrolyte solutions | Restating a concept |

The fisher is looking for fish in the river in an environmentally unfriendly way. The fisher used electric shocks that were inserted into the river water. The electric current used is not too large, just enough to kill fish. However, after trying it, it turned out that not only the fish died, but other river biota also died. Based on this phenomenon, what are the reasons that cause fish and other biota to die?

A. River water contains pollutants that intoxicate fish and other river biota
B. The stun tool hits the river biota so that the river biota gets electrocuted and causes death
C. River water contains ions that can kill river biota if an electric current is inserted
D. Pollution in river water becomes more concentrated when it is electrified by electric shocks.

Reason :

A. River water contains ions that can conduct electricity because it contains electrolyte substances.
B. Pollutants are very dangerous for the survival of river biota because they contain deadly substances.
C. Electric stun that has a high conductivity power easily kills river biota.
D. Electric shocks that are inserted into the river can intoxicate the river biota so that it can cause death.

Confidence level :

1. Sure
2. Not sure

**Figure 2.** Example of Question

This scientific literacy-based three-tier test instrument can make it easier for teachers to find out the weaknesses of concepts that are experienced by students so that remediation or enrichment process can be conducted as a further step. Teachers can evaluate the learning which is taught by strengthening concepts that have not been mastered by students. Thus, students' learning difficulties can be overcome.

**Science Literacy Profile**

The profile of students' scientific literacy abilities is based on the mastery of scientific literacy aspects. The percentage of students' scientific literacy skills is adapted from Arikunto (2015) which is stated that students' scientific literacy abilities are categorized into four, which are very good, good, enough, less, and failed. The categories of students' scientific literacy abilities can be seen in Table 2. The percentage of students' scientific literacy skills can be calculated by the following equations :

$$P = \frac{R}{SM} x100\% \qquad (1.1)$$

Explanation:

P = The percentage of students' scientific literacy skills (%)

R = Sum of students score were correct

SM = Maximum score

**Table 2.** The Categories Of Students' Scientific Literacy Abilities

| Sum of Poin | Categories |
|---|---|
| 79% < P ≤ 100% | Very Good |
| 65% < P ≤ 79% | Good |
| **55% < P ≤ 65%** | **Enough** |
| 39% < P ≤ 55% | Less |
| 30% < P ≤ 39% | Failed |

Analysis of the test results of the test instrument on a large-scale test is obtained a scientific literacy ability profile of 59%. At the percentage of 55% <P≤65%, students' scientific literacy skills are in enough criteria. The profile of students' scientific literacy can be seen in Figure 3.

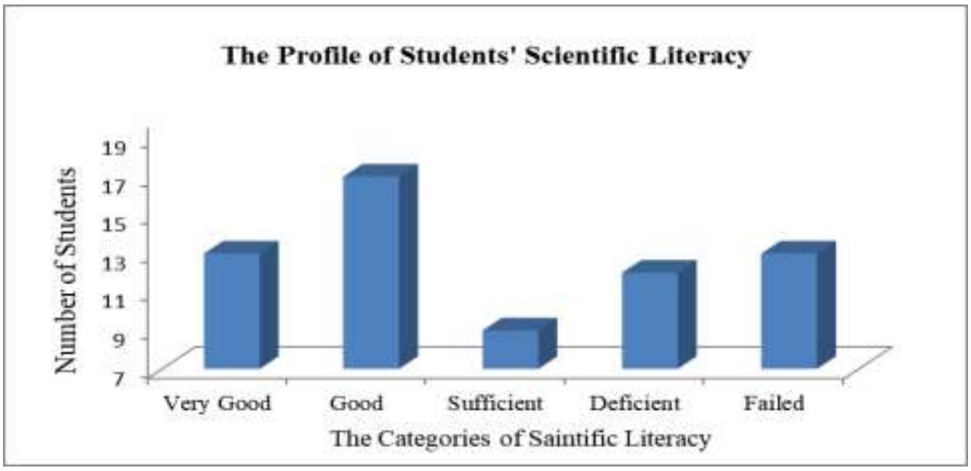


**Figure 3.** The Profile of Students' Scientific Literacy

Figure 3 shows that most students are in the "good" and "very good" categories. Students are considered to have a good scientific literacy profile since they have been able to relate the scientific literacy contained in the test instrument with their material knowledge. The category which has the least number is in the sufficient criteria. Based on this category, students are considered to be good enough in understanding and linking scientific literacy contained in the test instrument with their material knowledge.

Students with failed categories mean that they have not been able to relate learning to scientific phenomena or issues in daily life, and are not accustomed to working on test instruments based on scientific literacy. According to the OECD (2017), factors that can affect students' scientific literacy skills include environmental, gender, social, and economic factors. Environmental factors include the process of learning activities in schools. Moreover, teachers tend to only provide material to students without being concerned with real life. The learning process causes students to be unable to solve the problems encountered in scientific literacy problems since students have difficulty applying the concepts of the material obtained with scientific issues (Fuadi *et al.*, 2020). Permanasari *et al.* (2021) support this statement, in Indonesia many students have difficulty relating the scientific knowledge they have learned to phenomena that occur in nature since students do not gain experience and learn to relate it.

The profile of students' scientific literacy abilities based on aspects of scientific literacy competence is divided into three indicators which have been determined by PISA including explaining issues or phenomena scientifically, identifying and designing scientific investigations, and interpreting data and evidence scientifically OECD (2017). Moreover, the ability of scientific literacy in the aspect of competence possessed by students describes students' initial abilities which can later be used to draw interpretations of a scientific phenomenon related to the material which has been obtained (Laksono, 2018). The percentage of students' scientific literacy skills based on competency aspects can be seen in Figure 4.

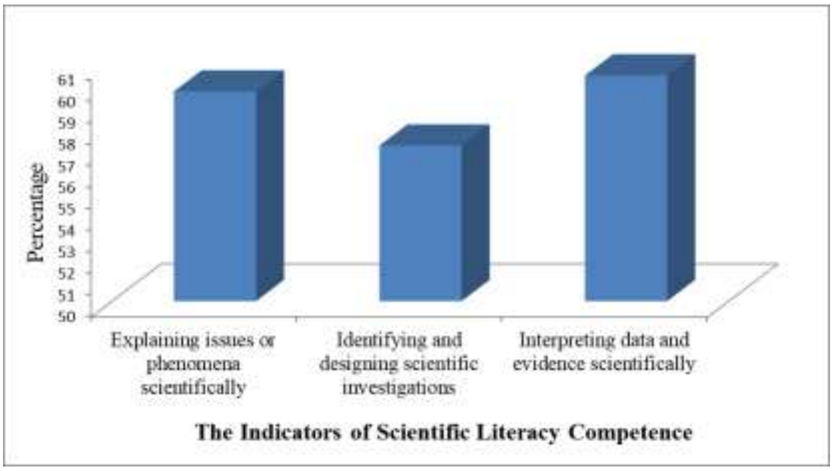


**Figure 4.** The Percentage of Students' Scientific Literacy Based on Competency Aspects

Based on these data, it can be seen that each indicator of scientific literacy competence with a percentage of 55% < P ≤ 65%, on enough criteria. The largest percentage results are obtained on the competence to interpret data and evidence scientifically. It shows that students are able to interpret data and evidence scientifically, it is in line with research from Safitri & Mayasari (2018) the results of the percentage of competence in interpreting data and evidence scientifically are high since students find it easy to represent, analyze, interpret, and draw appropriate conclusions according to the test instrument which is given.

The scientific literacy competency indicator in the section explaining scientific issues or phenomena is included in enough categories, which means that students are quite capable of understanding scientific issues or phenomena given on the test instrument. It can be proven by the ability of students to use their scientific knowledge in solving scientific literacy problems based on the concept of electrolyte and non-electrolyte solutions. Furthermore, the higher the student's ability to use scientific knowledge in solving scientific literacy problems cause the higher the percentage of scientific literacy competence in explaining scientific issues or phenomena. Wulandari & Sholihin (2016) stated that the ability of students to complete the test instrument in the indicator section to explain scientific issues or phenomena is influenced by the concept of knowledge possessed by the students themselves. Sinaga (2015) also supports the statement that every student has a fairly good ability to identify problems, but students have difficulty connecting them with appropriate knowledge concepts.

The lowest percentage in the aspect of students' scientific literacy competence is the competence to identify and design scientific investigations. One of the factors which influence the low percentage of competency indicators in identifying and designing scientific investigations is that the learning conducted by schools generally does not emphasize the process. Syaputra (2016) supports the statement that chemistry learning in schools only comes from the teacher as a result, students find it difficult to apply the material in daily life. Haryani *et al.* (2017) stated that students need to get used to applying skills in dealing with problems related to daily life.

The "enough" and "good" categories in the scientific literacy profile indicate that the students' scientific literacy skills are good. Students' scientific literacy skills based on test results are strengthened by student interviews. The results of the analysis of student answers are in line with the results of student interviews related to scientific literacy skills. Moreover, student interviews were conducted through the Google Meet platform with 9 students as respondents consisting of high, medium, and low categories. Students were given several questions related to responses to the test instruments conducted and other questions regarding the three aspects of scientific literacy (content, competence, and context).

The examples of interview questions on aspects of competence to explain scientific phenomena, which students are asked to explain one of the scientific phenomena related to electrolyte and non-electrolyte solutions in daily life contained in the questions. Students in the high and medium categories can explain scientific phenomena and their reasons well. Meanwhile, students in the low category are only able to explain scientific phenomena in outline. The following is a snippet of student answers during the interview session (have been translated into English):

> "*Natural phenomena such as wet hands should not touch electricity because water can conduct electricity so it can be electrocuted*."
> "*I just mentioned one example, fishing in rivers with electric shocks is prohibited because the river water is an electrolyte solution so that electricity flows throughout the river*."
> "*When there is a flood, all the electricity is turned off because the electricity that is still on can cause electrocution, flood water can conduct electricity*."
> "*For example, the small child in the swimming pool, because there is a cable in the pool that breaks, the cable will shock the child because the water in the pool is an electrolyte solution*."

## Conclusion

The feasibility of the test instrument refers to the results of expert validation on the test instrument, the scale of teacher and student responses to the test instrument, the validity and reliability of the items, as well as the level of difficulty and discriminating power of the items. The result of the validity is stated that 34 valid questions out of a total of 35 questions with item reliability of 0.86. The characteristics of the test instrument are that it uses three aspects of scientific literacy in one question at once and can be used to determine the student's scientific literacy profile well. Furthermore, the profile of students' scientific literacy ability is 59% and it is considered in enough criteria. The profile of students' scientific literacy abilities from the aspect of scientific competence is obtained results for the competence to explain scientific issues/phenomena of 59.72%; identify and design scientific investigations by 57.21%, and competence to interpret data and evidence scientifically by 60.46%. Thus, this instrument is declared feasible to determine the profile of students' scientific literacy.

Suggestions which can be given are as follows;

1) The scientific literacy test instrument which is applied in chemistry learning should also be followed by scientific literacy-based teaching materials and it is better for learning in schools to apply scientific literacy to be able to improve students' scientific literacy skills even better.
2) The results of the study show that students' scientific literacy skills are in enough category. Thus, it needs to be improved again with other scientific literacy instruments.
3) To develop the test instrument further, it is recommended to link the items to the level of scientific literacy.

## Acknowledgment

I would like to thank all those who have helped and contributed so that this study can be conducted.

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