

Development of Concept Mastery Instruments Based on Scientific Literacy in Chemistry Subjects

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ABSTRACT

The research "Development of Science Literacy-Based Concept Mastery Instruments in Chemistry Subjects in Class XI Even Semester" was conducted to: (1) develop scientific literacy-based concept mastery instruments, (2) find out student learning outcomes, and (3) find out teacher responses to mastery instruments developed scientific literacy-based concepts. The research method used is Research and Development (R&D) with a 4D development design consisting of Define, Design, Develop and Disseminate. The research subjects consisted of four chemistry teachers consisting of one MAN Model Banda Aceh teacher, one MAN 2 Banda Aceh teacher, one Inshafuddin High School teacher, and one SMAN 5 Banda Aceh teacher. The trials were limited to the cognitive instruments developed and applied to one class XI from each school. The instruments used were interview guide sheets, teacher needs analysis questionnaires, and multiple choice test questions based on scientific literacy. The results showed that scientific literacy-based concept mastery instruments were declared valid and suitable for use in limited trials with an average validator result of 98.70%. The achievement of the trial results was limited to students from four SMA/MAN in Banda Aceh City amounting to 84.25%, so that the developed scientific literacy-based concept mastery instrument was able to improve student learning outcomes. The teacher gave a positive response to the scientific literacy-based concept mastery instrument which was developed in the very good category.

Keywords: *Assessment Instruments, Scientific Literacy, Chemistry*

INTRODUCTION

Chemistry is a part of Natural Sciences (IPA) and is included in the basic sciences which play a big role both in everyday life and in the fields of science and technology. Chemistry is one of the subjects taught to high school students because it is part of science. The main goal in science learning in the 21st century is currently the application of scientific literacy. Therefore, chemistry learning makes scientific literacy the main goal in improving students' mastery of concepts (Yuliana et al., 2021). Scientific literacy refers to students' ability to understand and apply the chemical knowledge they learn in everyday life. There are 3 (three) main aspects of chemistry in scientific literacy, namely; understand aspects of knowledge, high-level learning skills, awareness and application of chemical attitudes in life (Wahyuni & Yusmaita, 2020).

Literasi sains dapat diukur dengan menggunakan *Program for International Student Assessment* (PISA). PISA adalah program penilaian literasi yang diadakan oleh *Organization for Economic Cooperation and Development* (OECD) sejak tahun 2000-an. Literasi sains Indonesia dari tahun 2012, 2015 dan 2018 berturut-turut berada pada urutan 64 dengan skor 382 dari 65 negara, urutan 62 dengan skor 403 dari 70 negara, dan urutan 70 dengan skor 396 dari 78 negara. Berdasarkan hasil pengukuran tersebut, posisi Indonesia selalu berada pada 10 peringkat terbawah dari keseluruhan negara yang diukur. Data tersebut memberikan fakta bahwa kemampuan literasi sains siswa di Indonesia masih sangat rendah (Musayaroh et al., 2021).

In general, students' concept mastery is measured through a concept mastery test, so that it can be stated whether the student's learning outcomes have improved or not. In chemistry learning, concept mastery tests are not only about solving problems consisting of various numbers, but also questions about various facts that occur in life. The 2013 curriculum currently requires students to be able to identify problems, draw conclusions based on observations and analyze based on the knowledge they have. In accordance with the objectives of scientific literacy, students are directed to be able to improve their mastery of concepts, identify questions, summarize data, and be creative in applications related to their environment (Hanum et al., 2017).

Current scientific literacy is still not optimal in supporting students' mastery of concepts. This is because teachers have not optimally used concepts mastery instruments related to literacy aspects. Data on National Examination results for the 2016/2017 school year at Banda Aceh City SMA/MAN is still not optimal, especially in class XI chemistry learning in the even semester. This situation requires efforts from the teacher to develop students' mastery of concepts so that their learning outcomes can be better.

Students' mastery of concepts can be supported through scientific literacy-based learning. This is because scientific literacy abilities are assumed to be through abstract and logical reasoning and application. As students' understanding develops, their intellectual level can become better. In general, a person's intelligence can be measured through a concept mastery test, where students who have good scientific literacy skills are able to understand a material concept as a whole (Yuriza & Sigit, 2018).

Determining how good students' literacy is in learning, especially in chemistry material, can be done through efforts to use scientific literacy-based assessment instruments. The scientific literacy-based concept mastery assessment instrument is an instrument that is carried out at every stage of learning so that it is able to help students to better understand the nature of science comprehensively (Astuti, 2012). Through this application, students are expected to be able to get used to learning to face problems in different forms so that they can experience increased scientific literacy. Scientific literacy-based assessment instruments can provide opportunities for students to gain meaningful experiences by demonstrating thinking abilities that contain dimensions of scientific literacy. This makes the material in chemistry learning easy to understand and easy to apply so that it is more meaningful for the needs of students in the surrounding environment (Haristy, 2013).

The development of scientific literacy-based concept mastery instruments is very necessary to find out how much knowledge students have in understanding what they have learned. The aim is to produce an assessment instrument that is valid and able to measure how well students' scientific literacy is, so that later mastery of concepts can be more varied and stored for a long time in students' minds (Pertiwi et al., 2018). Research on the development of instruments for mastering concepts based on scientific literacy in chemistry subjects for class XI, even semester, is expected to be able to support the increase in students' scientific literacy.

Papers should be written in English, clearly describe the background of the subject, the author(s)' work, including the methods used, and concluding discussion on the importance of the work.

METHODS

This type of research is (R&D), namely research used to obtain certain products and test the product's effectiveness. The development model that researchers use is a 4-D model which consists of four stages, Define, Design, Develop and Disseminate. This research was carried out at MAN Model Banda Aceh, MAN 2 Banda Aceh, SMAN 5 Banda Aceh and SMA Inshafuddin. The selection of research locations was based on the results of interviews with chemistry subject teachers at MAN Model Banda Aceh, MAN

2 Banda Aceh, SMAN 5 Banda Aceh and SMA Inshafuddin who showed that they only used questions in textbooks to carry out assessments without developing literacy-based concept mastery instruments. science.

From a total of 37 (thirty seven) schools in Banda Aceh City, researchers chose 4 (four) schools to conduct research, namely MAN Model Banda Aceh, MAN 2 Banda Aceh, SMA Inshafuddin, and SMAN 5 Banda Aceh. The four schools were selected based on the results of initial observations in March 2018, where the learning outcomes were different from the four schools, there were several problems in chemistry learning, especially in the assessment process. The four schools selected are a combination of favorite, middle and lower schools.

Research data was collected using interviews, needs analysis questionnaires, and scientific literacy-based learning outcomes test questions. Data processing was carried out descriptively qualitatively with the aim of obtaining the validity of the assessment instruments that have been developed. The validation criteria for scientific literacy-based concept mastery instruments are carried out using the following formula.

$$\text{Percentage of total score} = \frac{\text{score obtained}}{\text{maximum score}} \times 100\%$$

Analyze individual students' completeness scores using the following formula.

$$\text{Individual completeness} = \frac{\text{number of correct answers}}{\text{total number of questions}} \times 100\%$$

Classical analysis of student completeness scores uses the following formula.

$$\text{Classical completeness} = \frac{\text{total number of students}}{\text{the total number of students}} \times 100\%$$

The percentage results of scientific literacy indicators for each scientific literacy category in the concept mastery instrument can be calculated using the following equation (Kurnia, et al. 2014).

$$\text{Percentage of scientific literacy} = \frac{\text{number of indicators per category}}{\text{total number of indicator categories}} \times 100\%$$

RESULTS AND DISCUSSION

Defining

The definition is carried out by collecting information regarding the questions used by teachers to support the teaching and learning process. Information collection was carried out by interviews and needs analysis

questionnaires. From the results of researchers' interviews with chemistry subject teachers from MAN Model Banda Aceh, MAN 2 Banda Aceh, SMA Inshafuddin, and SMAN 5 Banda Aceh, it is known that teachers are interested in using scientific literacy-based assessment instruments in the assessment process, but teachers have difficulty in designing or develop questions in the form of scientific literacy. Scientific literacy-based concept mastery instruments are still not used in learning. The assessment process applied by teachers in chemistry subjects still consists of giving questions accompanied by the numbers needed to solve them without any understanding of science that can be linked to everyday life.

The results of the teacher needs analysis questionnaire show that during the assessment process teachers are still unfamiliar with the use of questions based on scientific literacy. Teachers still use questions found in textbooks and LKPD, this causes students to only understand chemistry learning from a calculation perspective. mathematics rather than from the application of concepts in everyday life. Assessment should help make students motivated in learning and more active, thereby making chemistry easier to understand.

Design

The next stage is initial design to determine the product according to the design prepared to produce an instrument for mastering concepts based on scientific literacy in chemistry subjects. The design was carried out based on multiple choice questions that had been used by teachers previously, so that the resulting instrument product was in accordance with the needs of the school. The source of questions for the scientific literacy-based concept mastery instrument that was developed came from questions at MAN Model Banda Aceh, SMA Inshafuddin, and SMAN 5 Banda Aceh. So the researchers developed a concept mastery instrument based on scientific literacy based on multiple choice questions that had been used previously at MAN Model Banda Aceh, SMA Inshafuddin, and SMAN 5 Banda Aceh.

Pada reaksi $\text{H}_3\text{O}^+ + \text{NH}_2^- \rightleftharpoons \text{NH}_3 + \text{H}_2\text{O}$
Pasangan asam basa konjugasinya sesuai dengan teori dari Bronsted-Lowry adalah

a. H_2O dan NH_2^-	d. H_3O^+ dan NH_3
b. NH_3 dan H_2O	e. H_3O^+ dan NH_2^-
c. H_3O^+ dan H_2O	

b) Soal Dasar

Teori asam dan basa telah dikemukakan oleh beberapa ilmuwan ternama, yaitu Arrhenius, Lewis, dan Bronsted-Lowry. Teori Bronsted-Lowry merupakan teori asam basa yang diajukan secara terpisah oleh J.N Bronsted dan T.M. Lowry pada tahun 1923. Konsep dasar teori ini adalah bahwa ketika suatu asam dan basa bereaksi satu sama lain, asam akan membentuk basa konjugatnya sedangkan basa akan membentuk asam konjugatnya melalui pertukaran proton. Sebagai contoh reaksi, $\text{H}_3\text{O}^+ + \text{NH}_2^- \rightleftharpoons \text{NH}_3 + \text{H}_2\text{O}$
Pasangan asam basa konjugasinya sesuai dengan teori dari Bronsted-Lowry adalah

a. H_2O dan NH_2^-	d. H_3O^+ dan NH_3
b. NH_3 dan H_2O	e. H_3O^+ dan NH_2^-
c. H_3O^+ dan H_2O	

a) Soal bentuk literasi

The image above is an example of a comparison between question number 1 in the form of literacy and the basic questions used by previous teachers. Figure (a) is a question used by the teacher before it was tried to be developed by researchers, where questions from the MAN Model Banda Aceh were used. Image (b) is the result of the question in image (a) which has been developed by researchers by including aspects of scientific literacy such as science as a body of knowledge (presenting facts, concepts, principles and laws; presenting hypotheses, models and theories- theory; asks students to remember knowledge or information) and science as a way of thinking (describes how a scientist conducts experiments).

Hasil percobaan warna lakmus dalam larutan sebagai berikut:

Larutan	Lakmus merah	Lakmus biru
1	Merah	Merah
2	Biru	Biru
3	Merah	Merah
4	Merah	Biru
5	Biru	Biru
6	Merah	Merah

Berdasarkan data di atas, maka larutan yang bersifat asam adalah.....

a. 3, 5 dan 6 d. 1, 3 dan 6
b. 3, 4 dan 6 e. 1, 2 dan 6
c. 2, 4 dan 6

a) Soal dasar

Seorang praktikan ditugaskan untuk membuat masing-masing 3 buah sampel larutan asam dan larutan basa. Setelah selesai, seluruh larutan tersebut diuji pada kertas lakmus yang telah disediakan. Dari hasil percobaan didapatkan data seperti pada tabel berikut.

Larutan	Lakmus merah	Lakmus biru
1	Merah	Merah
2	Biru	Biru
3	Merah	Merah
4	Merah	Biru
5	Biru	Biru
6	Merah	Merah

Berdasarkan data di atas, maka larutan yang bersifat asam adalah.....

a. 3, 5 dan 6 d. 1, 3 dan 6
b. 3, 4 dan 6 e. 1, 2 dan 6
c. 2, 4 dan 6

b) Soal bentuk literasi

The image above is an example of a comparison between question number 2 in the form of literacy and the basic questions used by previous teachers. Figure (a) is a problem which was used by teachers before it was tried to be developed by researchers, where questions from SMAN 5 Banda Aceh were used. Image (b) is the result of the questions in image (a) which have been developed by researchers by including aspects of scientific literacy such as science as a body of knowledge (presenting facts, concepts, principles and laws; asking students to remember knowledge or information), science as a way of investigating (requiring students to answer questions through the use of graphs, tables, etc.), science as a way of thinking (discussing facts and evidence) and the interaction of science, technology and society (describing the usefulness of science and technology for society).

Suatu asam lemah HA dengan konsentrasi 0,1 terionisasi sebanyak 1 %. Tetapan kesetimbangan asam lemah tersebut adalah...

a. $2,5 \times 10^{-7}$ d. 1×10^{-5}
b. 5×10^{-7} e. $2,5 \times 10^{-5}$
c. 1×10^{-6}

a) Soal dasar

Asam lemah adalah asam yang tidak terionisasi secara signifikan dalam larutan. Misalnya jika sebuah asam dilambangkan dengan HA, maka dalam larutan masih terdapat sejumlah besar HA yang belum terdisosiasi/terionisasi. Menurut Arrhenius, asam lemah hanya sedikit terionisasi atau mempunyai derajat ionisasi yang kecil di dalam larutannya.

$$\text{HA}_{(aq)} \rightleftharpoons \text{H}^+_{(aq)} + \text{A}^-_{(aq)}$$

Jika suatu asam lemah HA dengan konsentrasi 0,1 terionisasi sebanyak 1%. Tetapan kesetimbangan asam lemah tersebut adalah

a. $2,5 \times 10^{-7}$ d. $5,0 \times 10^{-7}$
b. $1,0 \times 10^{-5}$ e. $2,5 \times 10^{-5}$
c. $1,0 \times 10^{-6}$

b) Soal literasi sains

The image above is an example of a comparison between question number 3 in the form of literacy and the basic questions used by previous teachers. Figure (a) is a question used by the teacher before trying to be developed by researchers, where questions from Inshafuddin High School were used. Image (b) is the result of the questions in image (a) which have been developed by researchers by including aspects of scientific literacy such as science as a body of knowledge (presenting facts, concepts, principles and laws; asking students to remember knowledge or information), science as a way of investigating (requiring students to make calculations) and science as a way of thinking (describing how a scientist conducts experiments).

Jika suatu larutan diketahui memiliki nilai pH sebesar 2,7. Berapakah besarnya konsentrasi ion H^+ dalam larutan tersebut....

a. $1,995 \times 10^{-23} M$ d. $5 \times 10^{-6} M$
b. $2 \times 10^{-7} M$ e. $3,655 \times 10^{-6} M$
c. $4,9955 \times 10^{-23} M$

a) Soal dasar

Suatu larutan asam memiliki trayek pH dari 1-6, sedangkan larutan basa memiliki trayek pH dari 8-14. pH merupakan derajat keasaman yang digunakan untuk menyatakan tingkat keasaman atau kebasaaan yang dimiliki oleh suatu larutan. Derajat keasaman tersebut didefinisikan sebagai kologaritma aktivitas ion hidrogen (H^+) yang terlarut. Koefisien aktivitas ion hidrogen tidak dapat diukur secara eksperimental, sehingga nilainya didasarkan pada perhitungan teoretis. Skala pH bukanlah skala absolut melainkan bersifat relatif terhadap sekumpulan larutan standar yang pH-nya ditentukan berdasarkan persetujuan internasional. Jika dalam suatu larutan diketahui memiliki nilai pH sebesar 2,7. Berapakah besarnya konsentrasi ion H^+ pada larutan tersebut

a. $1,995 \times 10^{-23} M$ d. $3,995 \times 10^{-6} M$
b. $4,995 \times 10^{-23} M$ e. $5,0 \times 10^{-6} M$
c. $2,0 \times 10^{-7} M$

b) Soal literasi sains

The image above is an example of a comparison between question number 4 in the form of literacy and the basic questions used by previous teachers. Figure (a) is a question used by the teacher before it was tried to be developed by researchers, where questions from SMAN 5 Banda Aceh were used. Image (b) is the result of the question in image (a) which has been developed by researchers by including aspects of scientific literacy such as science as a body of knowledge (presenting facts, concepts, principles and laws; presenting hypotheses, models and theories- theory), science as a way of investigating (requiring students to make calculations), science as a way of thinking (showing the historical development of an idea) and the interaction of science, technology and society (describing the usefulness of science and technology for society).

<p>Deskripsikan bagaimana larutan garam yang berasal dari asam lemah dan basa lemah akan bersifat asam..</p> <p>a. Jika, $K_a > K_b$ d. Jika, $K_a = K_b$ b. Jika, $K_a < K_b$ e. Jika, $K_w = K_b \times K_a$ c. Jika, $K_b > K_a$</p>	<p>Ditinjau dari kekuatan asam dan basa pembentukannya ada empat garam yang dapat terbentuk, yaitu : garam yang terbentuk dari asam lemah dan basa kuat, garam yang terbentuk dari asam kuat dan basa lemah, garam yang terbentuk dari asam lemah dan basa lemah, serta garam yang terbentuk dari asam kuat dan basa kuat. Jika suatu larutan garam yang berasal dari asam lemah dan basa lemah dengan konsentrasi yang sama, namun memiliki perbedaan dari harga K_a dan K_b. Jelaskan bagaimana larutan garam tersebut akan bersifat asam</p> <p>a. Jika, $K_a < K_b$ d. Jika, $K_a = K_b$ b. Jika, $K_a > K_b$ e. Jika, $K_w = K_b \times K_a$ c. Jika, $K_b > K_a$</p>
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a) Soal dasar

b) Soal literasi sains

The image above is an example of a comparison between question number 5 in the form of literacy and the basic questions used by previous teachers. Figure (a) is a question used by the teacher before it was tried to be developed by researchers, where questions from SMAN 5 Banda Aceh were used. Image (b) is the result of the question in image (a) which has been developed by researchers by including aspects of scientific literacy such as science as a body of knowledge (requiring students to explain answers) and science as a way of thinking (illustrating the use of assumptions).

<p>Analisislah beberapa larutan berikut ini manakah yang terhidrolisis sempurna..</p> <p>a. NH_4Cl d. NH_4CH_3COO b. CH_3COONa e. $NaCl$ c. K_2SO_4</p>	<p>Hidrolisis adalah reaksi kimia yang memecah molekul air menjadi kation hidrogen dan anion hidroksida melalui suatu proses kimia. Hidrolisis terbagi pada tiga, hidrolisis sebagian, total dan tidak terhidrolisis. Hidrolisis garam adalah penguraian garam oleh air atau reaksi ion-ion garam oleh air. Garam-garam yang mengalami hidrolisis adalah garam yang mengandung ion dari asam lemah atau basa lemah. Sedangkan garam yang berasal dari asam kuat atau basa kuat tidak bisa mengalami reaksi hidrolisis. Analisislah beberapa larutan garam berikut ini manakah yang terhidrolisis sempurna</p> <p>a. NH_4Cl d. NH_4CH_3COO b. CH_3COONa e. $NaCl$ c. K_2SO_4</p>
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a) Soal dasar

b) Soal literasi sains

The image above is an example of a comparison between question number 6 in the form of literacy and the basic questions used by previous teachers. Figure (a) is a question used by the teacher before trying to be developed by researchers, where questions from Inshafuddin High School

were used. Image (b) is the result of the questions in image (a) which have been developed by researchers by including aspects of scientific literacy such as science as a body of knowledge (presenting facts, concepts, principles and laws; asking students to remember knowledge or information), science as a way of thinking (discussing facts and evidence) and the interaction of science, technology and society (describing the usefulness of science and technology for society).

Sebanyak 100 mL larutan CH_3COOH 0,2 M dicampur dengan 100 mL larutan NaOH 0,2 M. jika $K_a \text{CH}_3\text{COOH} = 1 \times 10^{-5}$, Hitunglah pH larutan setelah pencampuran.

a. 2 d. 6
b. 4 e. 9
c. 5

a) Soal dasar

Suatu larutan garam yang terbentuk dari asam kuat dengan basa kuat akan bersifat netral sehingga nilai pH-nya adalah 7. Garam yang terbentuk dari asam kuat dengan basa lemah akan bersifat asam sehingga nilai pH berada di bawah 7, sedangkan garam yang terbentuk dari basa kuat dengan asam lemah akan bersifat sebaliknya. Garam yang terbentuk dari asam lemah dengan basa lemah ditentukan sifatnya berdasarkan kekuatan asam lemah dan basa lemahnya (konstanta kesetimbangannya). Jika diketahui sebanyak 100 mL larutan CH_3COOH 0,2 M dicampur dengan 100 mL larutan NaOH 0,2 M. Nilai K_a dari $\text{CH}_3\text{COOH} = 1 \times 10^{-5}$, maka pH larutan tersebut setelah pencampuran adalah

a. 2 d. 9
b. 4 e. 10
c. 6

b) Soal literasi sains

The image above is an example of a comparison between question number 7 in the form of literacy and the basic questions used by previous teachers. Figure (a) is a question used by the teacher before trying to be developed by researchers, where questions from Inshafuddin High School were used. Image (b) is the result of the question in image (a) which has been developed by researchers by including aspects of scientific literacy such as science as a body of knowledge (requires students to make calculations), science as a way of thinking (discussing facts and evidence) and the interaction of science, technology and society (describing the usefulness of science and technology for society).

All of the questions developed contain scientific literacy indicators. Researchers developed a scientific literacy-based knowledge assessment instrument based on multiple choice questions that had been used previously at MAN Model Banda Aceh, SMA Inshafuddin, and SMAN 5 Banda Aceh.

The initial step taken to design a concept mastery instrument based on scientific literacy was to adapt KI and KD to chemistry subjects for class XI even semester students. The next step is for the researcher to determine the question grid according to the KD and indicator formulation. Then the researcher made question cards based on a predetermined grid. There were several shortcomings in the initial design, such as not having sequential answer choices in the form of numbers; then there are still questions that do not match the indicators; as well as the main questions that are still wrong and unclear. The next stage of development is revision of the LKPD by expert validators 1 and 2

Develop

The design stage then continues with the development stage. The assessment instrument developed based on the design stage was continued with validation by two expert validators from the chemistry education, to find out whether the scientific literacy-based concept mastery instrument was valid and suitable for use or not in the learning process, especially in the assessment process. The validation results of the scientific literacy-based concept mastery instrument can be seen in Table 2.

Table 2. Results of Validation of Concept Mastery Instruments Based on Scientific Literacy

Font Instrument Validation Results		Average value
Validator I	Validator II	98,70%
99,90%	97,50%	

The validation results by the two expert validators for each question item reviewed had a percentage of 98.70% with very high criteria and was declared valid so that the assessment instrument was categorized as very suitable for use. The assessment results are in accordance with research by Sumaryatun et al., (2016), there are four aspects of literacy in the scientific literacy-based authentic assessment instrument, which is classified as very suitable for use and declared valid by expert validators with a percentage of 95% and has very high reliability. The assessment instruments developed are not burdensome for teachers and students and can be accepted and used in learning activities.

Disseminate

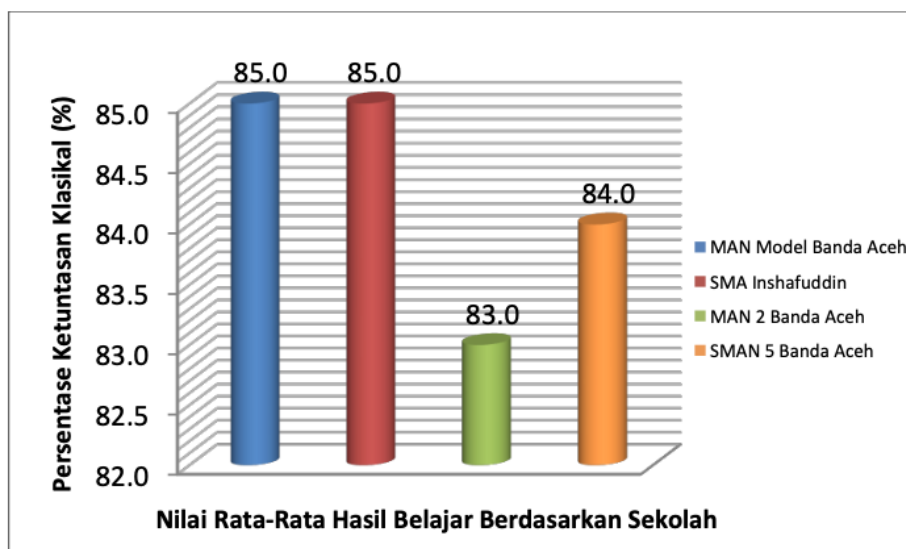
This uses a scientific literacy-based concept mastery instrument that was developed on a larger scale. The components of the assessment instrument that had been validated based on the development stage were continued to be validated by four chemistry teachers from each school. This was done to find out how teachers responded to scientific literacy-based assessment instruments and to find out whether they could be used in the learning process at school.

In this case, researchers distributed scientific literacy-based concept mastery instruments to four high school/MA schools in the city of Banda Aceh. In future, this instrument can be used at school by chemistry subject teachers in class XI even semester with the hope that students will be more motivated and learning outcomes can improve. Researchers accompanied by chemistry teachers distributed scientific literacy-based assessment test questions to students to work on for 60 minutes. Before working on the questions, students are given time to prepare themselves and work on them in an orderly manner and complete them at the specified time.

Learning Outcomes

After being developed, the scientific literacy-based concept mastery instrument was given to students for testing on class XI even semester material. Student learning outcomes using scientific literacy-based concept mastery instruments for class Before students are given time to work on questions on the appointed day, students are first given information about the learning outcomes test using scientific literacy-based concept mastery instruments. This is done just before the semester exam, students are

given time to prepare themselves so that the learning results they obtain will get the best grades. A recapitulation of student learning outcomes at MAN Model Banda Aceh, MAN 2 Banda Aceh, SMA Inshafuddin, and SMAN 5 Banda Aceh can be seen in the following picture.



Based on the picture above, the classical percentage value between each school is above 80%. This means that the number of students who have not yet completed the test is 20%. This could be because students are still not familiar with the form and types of scientific literacy questions. After being applied to the learning process, the scientific literacy-based concept mastery instrument was able to show significant changes in student learning outcomes. Therefore, teachers are expected to continue to implement and use scientific literacy-based instruments so that students can become familiar with the types of scientific literacy questions.

There is an increase in student learning outcomes, because the questions given by researchers already contain scientific literacy. This value states that students at the school are not treated with special learning treatment, meaning they are students with low, medium and high levels of intellectual ability who are combined into certain classes. Therefore, learning, especially in the assessment process, using scientific literacy-based instruments can help students to remember information, facts and concepts and then stimulate thinking and ask students to find out independently to be able to describe the relationship between science and everyday life. Scientific literacy-based concept mastery instruments have a positive influence on students in the learning process. This was proven after being applied to students, there were significant changes in student learning outcomes.

Percentage of Scientific Literacy

The characteristics of the scientific literacy-based concept mastery instrument are that there are four complete and balanced aspects of literacy. The aspects in question are science as a cognitive body, science as a way of investigating, science as

a way of thinking and science as interaction, technology and society. The results of the scientific literacy analysis can be seen in Table 3.

Table 3. Data Analysis of Instruments for Mastery of Concepts Based on Scientific Literacy

No	Scientific Literacy Indicators	Total Scientific Literacy	Percentage of Scientific Literacy
1	Science as a body of knowledge	35	41,67
2	Science as a way of inquiry	16	19,05
3	Science as a way of thinking	18	21,43
4	Interaction of science, technology and society	15	17,85
	total	84	100

The instrument developed has complete scientific literacy aspects. There is the largest percentage in the aspect of science as a body of knowledge, namely 41.67%, while the lowest percentage is in the interaction aspect of science, technology and society, namely 17.85%. This means that there is still a tendency between these four aspects and is not in accordance with the statement made by Wilkinson (1999), namely that the proportion that is close to the scientific literacy category is 42% for scientific knowledge, 19% for investigating the nature of science, 19% for the category of science as a way of thinking, and 20% of the interaction of science, technology and society or the scientific literacy aspect in the book is 2:1:1:1.

Teacher Response Analysis

This stage is carried out after students have completed the science literacy-based concept mastery instrument test. The aim is for researchers to get responses and feedback from chemistry subject teachers on the assessment instruments that have been developed previously. Meanwhile, at this stage the teacher does not fill out the response questionnaire because it will make it easier for the teacher to provide feedback accompanied by improvements to the scientific literacy-based concept mastery instrument. The teacher provides a response after filling in the instrument validation sheet. The results of the validation of scientific literacy-based concept mastery instruments by teachers can be seen in Table 4.

Table 4. Results of Validation Instruments for Mastery of Science Literacy Based Concepts by teachers in SMA/MA Banda Aceh City

Hasil Validasi Instrumen				Average value
Validator I	Validator II	Validator III	Validator IV	99,90%
99,90%	99,90%	99,90%	99,90	

Validator I is a class XI chemistry teacher at MAN Model Banda Aceh. Validator II is a class XI chemistry teacher at Inshafuddin High School. Validator III is a class XI chemistry teacher at MAN 2 Banda Aceh. Meanwhile, Validator IV is a

class XI chemistry teacher at SMAN 5 Banda Aceh. The four validators gave positive responses to the scientific literacy-based concept mastery instruments that had been developed. The validation results of the scientific literacy-based concept mastery instrument assessed by teachers as validators were declared 99.90% valid so that the assessment instrument was categorized as very appropriate and teachers agreed that it could be applied in schools.

The validation percentage value of scientific literacy-based concept mastery instruments by teachers in SMA/MA Banda Aceh City is 99.9%. Overall, the teacher gave a positive response and the instrument was categorized as very good and suitable for use, which was analyzed based on the overall score on each question. The scientific literacy-based concept mastery instrument in chemistry subjects that was developed includes scientific literacy components. The components of scientific literacy in question include science as a body of knowledge, science as a way of investigating, science as a way of thinking, and science as interaction, technology and society (interaction of science). , technology, and society).

CONCLUSION

Based on the results of research that has been carried out regarding the development of scientific literacy-based knowledge assessment instruments in class XI chemistry subjects in the even semester (case study at SMA/MAN in Banda Aceh), it can be concluded that:

- 1) The percentage of feasibility of scientific literacy-based concept mastery instruments in chemistry subjects for each question is above 80% with very high criteria and is declared valid so it is very suitable for use.
- 2) Completeness of classical student learning outcomes obtained an average percentage of 84.25% from a total of 103 students, meaning that the development of scientific literacy-based concept mastery instruments was able to increase student learning outcomes.
- 3) The scientific literacy-based concept mastery instrument that was developed contained four complete aspects of scientific literacy with a percentage of science as a body of knowledge of 41.67%, science as a way of investigating 19.05%, science as a way of thinking 21.43%, and interaction of science, technology and society was 17.85%.
- 4) Teachers responded very well to the scientific literacy-based concept mastery instrument. The results of the validation of the questions by the teacher show that the scientific literacy-based concept mastery instrument is suitable for application in chemistry subjects.

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