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Developing scientific literacy-based concept mastery instruments for high school chemistry subjects

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ABSTRACT
Research on the development of science literacy-based concept mastery instruments in eleventh-grade chemistry subjects in an even semester was conducted to (1) develop a science literacy-based concept mastery instrument, (2) determine student learning outcomes, and (3) determine teacher responses to the developed science literacy-based concept mastery instrument. 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: one teacher of MAN Model Banda Aceh, one teacher of MAN 2 Banda Aceh, one teacher of SMA Inshafuddin, and one teacher of SMAN 5 Banda Aceh. Limited trials on cognitive instruments developed were applied to one class XI from each school. The instruments used were interview guideline sheets, teacher needs analysis questionnaires, and multiple choice test questions based on science literacy. The results showed that the science literacy-based concept mastery instrument was declared valid and feasible to use in a limited trial with an average validation result by validators of 98.70%. The acquisition of limited trial results on students from four SMA/MAN Banda Aceh City was 84.25%, so the instrument of mastery of science literacy-based concepts developed was able to improve student learning outcomes. Teachers responded positively to the science literacy-based concept mastery instrument developed with a very good category.

KEYWORDS
Assessment instrument; scientific literacy; chemistry subject

1. Introduction

Since its inception, education has addressed various challenges and societal changes. The current reality is that the world is constantly changing, so people need

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new knowledge and skills to manage their daily lives (Malwi, 2021). Recent educational changes emphasize the need to improve teaching, which leads students to problem-solving, communication, reasoning skills, knowledge, and attitudes as a measurement of the results of what students have learned (Nasrallah, 2014). Changes in learning outcomes can be observed, proven, and measured in the abilities or achievements experienced by students as a result of learning experiences (Nemeth & Long, 2012) built through the learning process (Singh, Srivastava, & Singh, 2015).

Chemistry is one part of the Natural Sciences (IPA) and is included in the basic sciences that play a significant role in everyday life, science, and technology. It is emphasized that chemistry is the main subject at the upper secondary education level. Chemistry lessons also aim to equip students to think logically, analytically, systematically, critically, and creatively. According to Permendiknas No.22 of 2006, chemistry is part of a group of science and technology subjects at Senior High School (SMA) intended to acquire advanced science and technology competencies and cultivate critical, creative, and independent scientific thinking. By paying attention to these circumstances, chemistry subjects should be mastered by students (Nuraini, 2018).

Chemistry is one of the subjects taught to high school students because it is part of science. The main goal of science learning in the 21st century is the application of science literacy. Therefore, chemistry learning makes science literacy the main goal in improving students' mastery of concepts (Yuliana et al., 2021). Science literacy refers to students' ability to understand and apply the chemical knowledge they learn daily. There are 3 (three) main aspects of chemistry in science literacy: understanding aspects of knowledge, higher-level learning skills, awareness, and application of chemical attitudes in life (Wahyuni & Yusmaita, 2020).

Science literacy can be measured using the Program for International Student Assessment (PISA). PISA is a literacy assessment program held by the Organization for Economic Cooperation and Development (OECD) since the 2000s. Indonesia's science literacy from 2012, 2015, and 2018 is ranked 64th with a score of 382 out of 65 countries, 62nd with 403 out of 70 countries, and 70th with a score of 396 out of 78 countries. Based on the results of these measurements, Indonesia's position is always in the bottom 10 ranks of all countries measured. This data provides the fact that the science literacy skills of students in Indonesia are still deficient (Musayaroh et al., 2021).

In general, students' concept mastery is measured through a concept mastery test to determine whether the student's learning outcomes have improved. In chemistry learning, concept mastery tests are about solving problems of various numbers and problems regarding various facts that occur in life. The 2013 curriculum requires students to identify problems, draw conclusions based on observations, and analyze based on their knowledge. Following the objectives of science literacy, students are directed to improve mastery of concepts, identify questions, conclude data, and be creative in applications related to their environment (Hanum et al., 2017).

Current science literacy is still not optimal in supporting students' mastery of concepts. Teachers have not maximally used concept mastery instruments related to literacy aspects. Data on the acquisition of UN results for the 2016/2017 academic year in SMA/MAN Banda Aceh City is still not optimal, especially in chemistry learning class XI, even semester. This situation requires teachers' efforts to develop students' mastery of concepts so that their learning outcomes can be better. Students' concept mastery can be supported through science literacy-based learning. Science literacy skills are assumed through abstract and logical reasoning and application. Along with developing students' understanding, their intellectual level can be improved. In general, a person's intelligence can be measured through a concept mastery test, where students with good science literacy skills can understand a material concept thoroughly (Yuriza & Sigit, 2018).

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

Developing a science literacy-based concept mastery instrument is needed to determine how much knowledge students have in understanding what they have learned. The goal is to produce an assessment instrument that is valid and able to

measure how good students' science literacy is so that later mastery of the concept can be more varied and stored long in the memory of students' minds (Pertiwi et al., 2018). Research on the Development of Science Literacy-Based Concept Mastery Instruments in Class XI Even Semester Chemistry Subjects are expected to be able to support the improvement of students' scientific literacy.

2. Method

This type of research is R&D, which is research used to obtain specific products and test the effectiveness of products. The development model that researchers use is the 4-D model, which consists of four stages: Define, Design, Develop, and Disseminate. This research was conducted at MAN Model Banda Aceh, MAN 2 Banda Aceh, SMAN 5 Banda Aceh, and SMA Inshafuddin. The selection of the research location was based on the results of interviews with chemistry teachers at MAN Model Banda Aceh, MAN 2 Banda Aceh, SMAN 5 Banda Aceh, and SMA Inshafuddin, which showed that they only used the questions in the package book to assess without developing a science literacy-based concept mastery instrument.

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

Data was collected through interviews, a needs analysis questionnaire, and science literacy-based learning outcomes test questions. Data processing was carried out descriptively and qualitatively to obtain the validity of the assessment instruments that had been developed. The data were collected using interviews, needs analysis questionnaires, and science literacy-based learning outcomes test questions. Data processing was carried out descriptively and qualitatively to obtain the validity of the assessment instruments that had been developed. Criteria for validating concept mastery instruments, analyzing individual student completeness, and analyzing classical student completeness scores based on science literacy were carried out using the following formula.

Criteria for validation of science literacy-based:

$$Percentage\ of\ total\ score = \frac{\text{score obtained}}{\text{maximum score}} \times 100 \quad (1)$$

Analysis of individual student completeness scores:

$$Individual\ completeness = \frac{number\ of\ correct\ answers}{total\ number\ of\ questions} \times 100 \quad (2)$$

Classical student completeness score analysis:

$$Classical\ completeness\ = \frac{number\ of\ students\ completed}{total\ number\ of\ students} \times 100 \quad (3)$$

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

$$Percentage\ of\ science\ literacy\ = \frac{number\ of\ indicators\ per\ category}{total\ number\ of\ indicator\ categories} \times\ 100 \quad (4)$$

3. Results and discussion

3.1. Defining

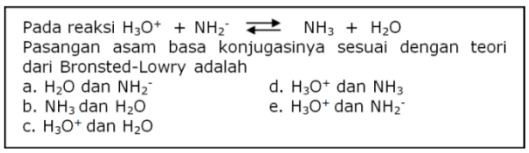
Defining is done by collecting information about the questions used by teachers in supporting the teaching and learning process. Interviews carried out information collection and needs analysis questionnaires. From the results of interviews with chemistry teachers from MAN Model Banda Aceh, MAN 2 Banda Aceh, SMA Inshafuddin, and SMAN 5 Banda Aceh, it is known that teachers are interested in using science literacy-based assessment instruments in the assessment process. However, teachers have difficulty designing or developing questions with science literacy forms. Science literacy-based concept mastery instruments are still not used in learning. The assessment process applied by teachers in chemistry subjects is still in the form of giving questions with the numbers needed to solve them without any understanding of science that can be related to everyday life.

The teacher needs to analyze the questionnaire results to show that the teacher is still unfamiliar with using science literacy-based questions during the assessment process. Teachers still use questions found in textbooks and student worksheets (LKPD), which causes students to understand chemistry learning only in mathematical calculations, not from applying concepts in everyday life. The

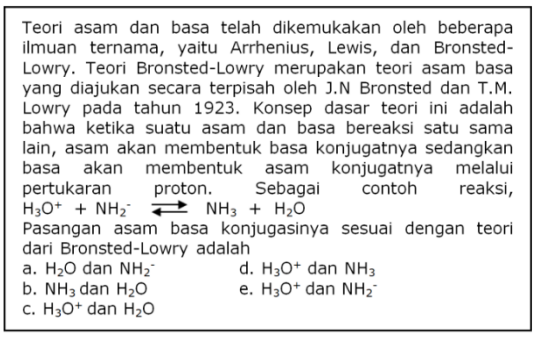
assessment should help motivate students to learn and be more active in making chemistry more accessible.

3.2. Designing

The next stage is the initial design, which determines the product by design prepared to produce a science literacy-based concept mastery instrument in chemistry subjects. The design is based on questions with multiple choice forms that teachers have used so that the resulting instrument products are to the school's needs. The source of questions on the instrument of mastery of science literacy-based concepts developed comes from questions at MAN Model Banda Aceh, SMA Inshafuddin, and SMAN 5 Banda Aceh. So that researchers can develop science literacy-based concept mastery instruments based on questions with multiple choice forms that have been used previously at MAN Model Banda Aceh, SMA Inshafuddin, and SMAN 5 Banda Aceh.


Pada reaksi $H_3O^+ + NH_2^- \rightleftharpoons NH_3 + H_2O$
Pasangan asam basa konjugasinya sesuai dengan teori dari Bronsted-Lowry adalah
a. H_2O dan NH_2^-
b. NH_3 dan H_2O
c. H_3O^+ dan H_2O
d. H_3O^+ dan NH_3
e. H_3O^+ dan NH_2^-

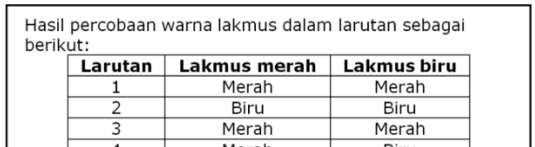
1a. basic questions


Teori asam dan basa telah dikemukakan oleh beberapa ilmuan 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,
$H_3O^+ + NH_2^- \rightleftharpoons NH_3 + H_2O$
Pasangan asam basa konjugasinya sesuai dengan teori dari Bronsted-Lowry adalah
a. H_2O dan NH_2^-
b. NH_3 dan H_2O
c. H_3O^+ dan H_2O
d. H_3O^+ dan NH_3
e. H_3O^+ dan NH_2^-

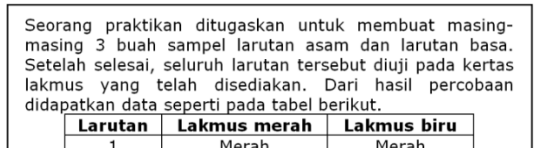
1b. Literacy questions

Figure 1. Examination questions developed by teachers of MAN Model Banda Aceh

Figure 1 is an example of a comparison between problem 1 in the form of literacy and the fundamental problem used by the teacher before. Figure 1.a is the question used by the teacher before trying to be developed by the researcher, whereas the question from MAN Model Banda Aceh was used. Figure 1.b is the result of the question in figure (a), which has been developed by the researcher by including aspects of science literacy such as science as a body of knowledge (presenting facts, concepts, principles and laws; presenting hypotheses, models and theories; asking learners to remember knowledge or information) and science as a way of thinking (describing 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


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

2a. basic questions

2b. literacy questions

Figure 2. Examination questions developed by teachers of SMAN 5 Banda Aceh

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}

3a. basic questions

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.

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

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. $1,0 \times 10^{-6}$

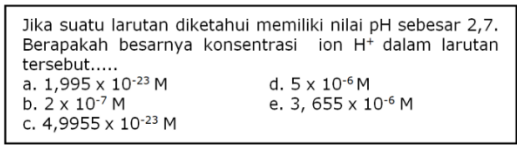
3b. literacy questions

Figure 3. Examination questions developed by teachers of SMA Inshafuddin Banda Aceh

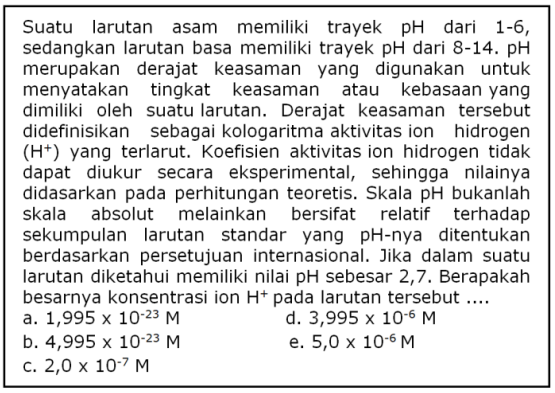
Figure 2 is an example of a comparison between problem number 2 in the form of literacy and the basic problem used by the teacher previously. Figure (a) is the question used by the teacher before trying to be developed by the researcher where the question from SMAN 5 Banda Aceh was used. Figure (b) is the result of the question in figure (a) that has been developed by the researcher by including aspects of science literacy such as science as a body of knowledge (presenting facts, concepts, principles and laws; asking learners to recall knowledge or information), science as a way to investigate (requiring learners to answer questions through the use of graphs, tables, etc.), science as a way of thinking (discussing facts and evidence) and science technology and society interaction (describing the usefulness of science and technology for society).

Figure 3 is an example of a comparison between problem number 3 in the form of literacy with the basic problem used by the teacher before. Figure (a) is the question used by the teacher before trying to be developed by the researcher where

the question from SMA Inshafuddin was used. Figure (b) is the result of the question in figure (a) that has been developed by the researcher by including aspects of science literacy such as science as a body of knowledge (presenting facts, concepts, principles and laws; asking learners to remember knowledge or information), science as a way to investigate (requiring learners 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
b. 2×10^{-7} M
c. $4{,}9955 \times 10^{-23}$ M
d. 5×10^{-6} M
e. $3{,}655 \times 10^{-6}$ M

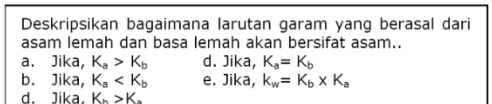
4a. basic questions


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

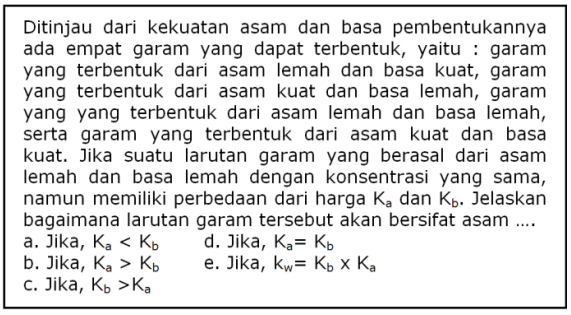
4b. literacy questions

Figure 4. Examination questions developed by teachers of SMAN 5 Banda Aceh

Figure 4 is an example of a comparison between problem number 4 in the form of literacy and the basic problem used by the teacher previously. Figure (a) is the question used by the teacher before trying to be developed by the researcher where the question from SMAN 5 Banda Aceh was used. Figure (b) is the result of the question in figure (a) that has been developed by the researcher by including aspects of science literacy such as science as a body of knowledge (presenting facts, concepts, principles and laws; presenting hypotheses, models and theories), science as a way to investigate (requiring learners to make calculations), science as a way of thinking (showing the historical development of an idea) and science technology and society interaction (describing the usefulness of science and technology for society).


Deskripsikan bagaimana larutan garam yang berasal dari asam lemah dan basa lemah akan bersifat asam..
a. Jika, $K_a > K_b$
b. Jika, $K_a < K_b$
d. Jika, $K_b > K_a$
d. Jika, $K_a = K_b$
e. Jika, $k_w = K_b \times K_a$

5a. basic questions


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 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 ....
a. Jika, $K_a < K_b$
b. Jika, $K_a > K_b$
c. Jika, $K_b > K_a$
d. Jika, $K_a = K_b$
e. Jika, $k_w = K_b \times K_a$

5b. literacy questions

Figure 5. Examination questions developed by teachers of SMAN 5 Banda Aceh

Figure 5 is an example of a comparison between problem number 5 in the form of literacy and the basic problem used by the teacher previously. Figure (a) is the question used by the teacher before trying to be developed by the researcher where the question from SMAN 5 Banda Aceh was used. Figure (b) is the result of the question in figure (a) that has been developed by the researcher by including aspects of science 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).

Analisislah beberapa larutan berikut ini manakah yang terhidrolisis sempurna..
a. NH_4Cl d. NH_4CH_3COO
b. CH_3COONa e. NaCl
c. K_2SO_4

6a. basic questions

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 ....
a. NH_4Cl d. NH_4CH_3COO
b. CH_3COONa e. NaCl
c. K_2SO_4

6b. literacy questions

Figure 6. Examination questions developed by teachers of SMA Inshafuddin Banda Aceh

Figure 6 is an example of a comparison between problem number 6 in the form of literacy with the basic problem used by the teacher before. Figure (a) is the question used by the teacher before trying to be developed by the researcher where the question from SMA Inshafuddin was used. Figure (b) is the result of the question in figure (a) that has been developed by the researcher by including aspects of science literacy such as science as a body of knowledge (presenting facts, concepts, principles and laws; asking learners 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).

Figure 7 is an example of a comparison between problem number 7 in the form of literacy and the basic problem used by the teacher before. Figure (a) is the

question used by the teacher before trying to be developed by the researcher where the question from SMA Inshafuddin was used. Figure (b) is the result of the question in figure (a) which has been developed by the researcher by including aspects of science literacy such as science as a body of knowledge (requiring 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).

Sebanyak 100 mL larutan CH_3COOH 0,2 M dicampur dengan 100 mL larutan NaOH 0,2 M. jika *Ka* CH_3COOH= 1 x 10^{-5}, Hitunglah pH larutan setelah pencampuran.
a. 2 d. 6
b. 4 e. 9
c. 5

7a. basic questions

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 CH_3COOH = 1 x 10^{-5}, maka pH larutan tersebut setelah pencampuran adalah ....
a. 2 d. 9
b. 4 e. 10
c. 6

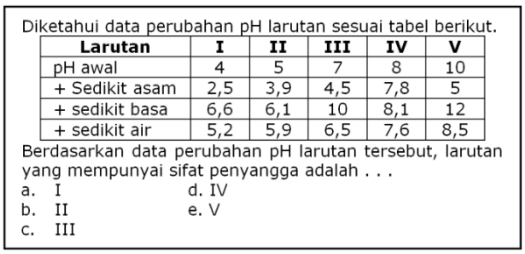
7b. literacy questions

Figure 7. Examination questions developed by teachers of SMA Inshafuddin Banda Aceh

Figure 8 is an example of a comparison between problem number 8 in the form of literacy and the basic problem used by the teacher before. Figure (a) is the question used by the teacher before trying to be developed by the researcher where the question from SMA Inshafuddin was used. Figure (b) is the result of the question in figure (a) that has been developed by the researcher by including aspects of science literacy such as science as a body of knowledge (presenting facts, concepts, principles and laws; asking learners to recall knowledge or information), science as a way to investigate (requiring learners to answer questions through the use of graphs, tables, etc.; involving learners in experiments or thinking activities), 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).

Figure 9 is an example of a comparison between problem number 9 in the form of literacy and the basic problem used by the teacher previously. Figure (a) is the question used by the teacher before trying to be developed by the researcher where the question from MAN Model Banda Aceh was used. Figure (b) is the result of the question in figure (a) that has been developed by the researcher by including aspects

of science literacy such as science as a body of knowledge (presenting facts, concepts, principles and laws; asking learners to recall knowledge or information), science as a way to investigate (requiring learners to make calculations) and science as a way of thinking (describing how a scientist conducts experiments).



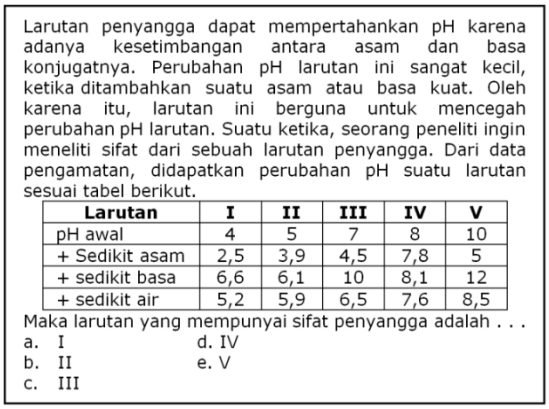
Diketahui data perubahan pH larutan sesuai tabel berikut.

Larutan	I	II	III	IV	V
pH awal	4	5	7	8	10
+ Sedikit asam	2,5	3,9	4,5	7,8	5
+ sedikit basa	6,6	6,1	10	8,1	12
+ sedikit air	5,2	5,9	6,5	7,6	8,5

Berdasarkan data perubahan pH larutan tersebut, larutan yang mempunyai sifat penyangga adalah . . .

a. I
b. II
c. III
d. IV
e. V

8a. basic questions



Larutan penyangga dapat mempertahankan pH karena adanya kesetimbangan antara asam dan basa konjugatnya. Perubahan pH larutan ini sangat kecil, ketika ditambahkan suatu asam atau basa kuat. Oleh karena itu, larutan ini berguna untuk mencegah perubahan pH larutan. Suatu ketika, seorang peneliti ingin meneliti sifat dari sebuah larutan penyangga. Dari data pengamatan, didapatkan perubahan pH suatu larutan sesuai tabel berikut.

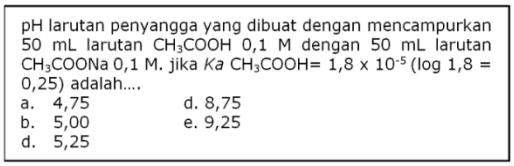
Larutan	I	II	III	IV	V
pH awal	4	5	7	8	10
+ Sedikit asam	2,5	3,9	4,5	7,8	5
+ sedikit basa	6,6	6,1	10	8,1	12
+ sedikit air	5,2	5,9	6,5	7,6	8,5

Maka larutan yang mempunyai sifat penyangga adalah . . .

a. I
b. II
c. III
d. IV
e. V

8b. literacy questions

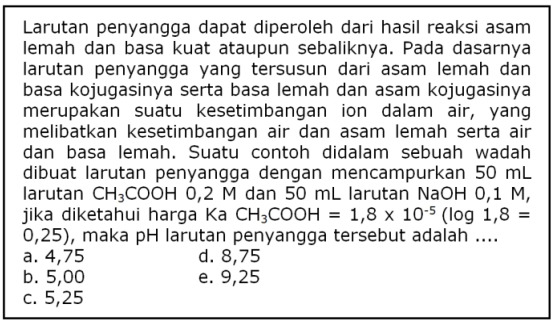
Figure 8. Examination questions developed by teachers of SMA Inshafuddin Banda Aceh



pH larutan penyangga yang dibuat dengan mencampurkan 50 mL larutan CH_3COOH 0,1 M dengan 50 mL larutan CH_3COONa 0,1 M. jika *Ka* CH_3COOH= 1,8 x 10^{-5} (log 1,8 = 0,25) adalah....

a. 4,75
b. 5,00
d. 5,25
d. 8,75
e. 9,25

9a. basic questions



Larutan penyangga dapat diperoleh dari hasil reaksi asam lemah dan basa kuat ataupun sebaliknya. Pada dasarnya larutan penyangga yang tersusun dari asam lemah dan basa kojugasinya serta basa lemah dan asam kojugasinya merupakan suatu kesetimbangan ion dalam air, yang melibatkan kesetimbangan air dan asam lemah serta air dan basa lemah. Suatu contoh didalam sebuah wadah dibuat larutan penyangga dengan mencampurkan 50 mL larutan CH_3COOH 0,2 M dan 50 mL larutan NaOH 0,1 M, jika diketahui harga Ka CH_3COOH = 1,8 x 10^{-5} (log 1,8 = 0,25), maka pH larutan penyangga tersebut adalah ....

a. 4,75
b. 5,00
c. 5,25
d. 8,75
e. 9,25

9b. literacy questions

Figure 9. Examination questions developed by teachers of MAN Model Banda Aceh

Figure 10 is an example of a comparison between problem number 10 in the form of literacy and the basic problem used by the teacher previously. Figure (a) is the question used by the teacher before trying to be developed by the researcher where the question from SMAN 5 Banda Aceh was used. Figure (b) is the result of the question in figure (a) that has been developed by the researcher by including aspects of science literacy such as science as a body of knowledge (asking learners to recall knowledge or information), science as a way to investigate (involving learners in experiments or thinking activities), science as a way of thinking (showing the

historical development of an idea) and the interaction of science, technology and society (mentioning jobs in science and technology).

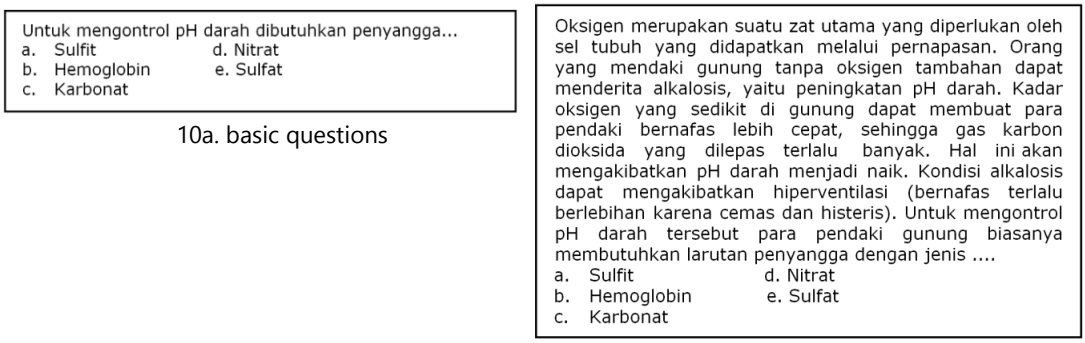


Figure 10. Examination questions developed by teachers of SMAN 5 Banda Aceh

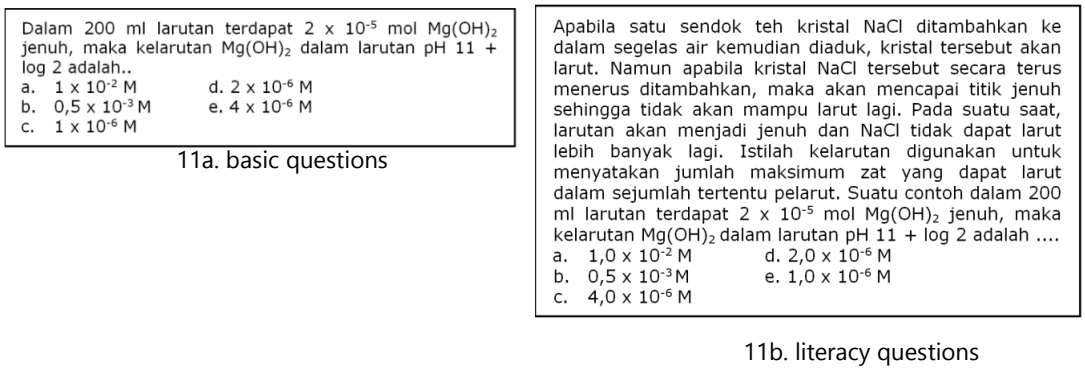


Figure 11. Examination questions developed by teachers of SMAN 5 Banda Aceh

Figure 11 is an example of a comparison between problem number 11 in the form of literacy and the basic problem used by the teacher previously. Figure (a) is the question used by the teacher before being developed by the researcher where the question from SMAN 5 Banda Aceh was used. Figure (b) is the result of the question in figure (a) that has been developed by the researcher by including aspects such as science as a body of knowledge (presenting facts, concepts, principles and laws), science as a way to investigate (requiring learners to make calculations) and science as a way of thinking (describing how a scientist conducts experiments; discussing facts and evidence).

Figure 12 is an example of a comparison between problem number 12 in the form of literacy and the basic problem used by the teacher previously. Figure (a) is the question used by the teacher before trying to be developed by the researcher where the question from SMAN 5 Banda Aceh was used. Figure (b) is the result of the question in figure (a) that has been developed by the researcher by including aspects of science literacy such as science as a body of knowledge (asking learners to recall knowledge or information), science as a way to

investigate (requiring learners to make calculations), science as a way of thinking (describing how a scientist conducts an experiment) and the interaction of science, technology and society (mentioning careers and jobs in science and technology).

Sebanyak 50 mL larutan K_2CrO_4 10^{-2} M masing masing dimasukkan ke dalam lima wadah yang berisi ion Ba^+, Ca^+, Cu^+, Sr^{+2} dan Pb^{2+} dengan volume dan konsentrasi yang sama. Jika diketahui Ksp : $BaCrO_4$=1,2 x 10^{-10} $CuCrO_4$=3,6 x 10^{-6}, $CaCrO_4$=7,1 x 1^{-4}, $PbCrO_4$=2,8 x 10^{-13}, $SrCrO_4$=4 x 10^{-5}
Senyawa yang mengendap adalah...
a. $BaCrO_4$ dan $CaCrO_4$ d. $SrCrO_4$ dan $CuCrO_4$
b. $CaCrO_4$ dan $SrCrO_4$ e. $BaCrO_4$ dan $PbCrO_4$
d. $CaCrO_4$ dan $CuCrO_4$

12a. basic questions

Seorang peneliti ingin melakukan percobaan kelarutan di laboratorium. Peneliti tersebut memiliki larutan baku K_2CrO_4 10^{-2} M sebanyak 50 mL, larutan tersebut dimasukkan ke dalam lima tabung reaksi yang berisi ion Ba^+, Ca^+, Cu^+, Sr^{+2} dan Pb^{2+} dengan volume dan konsentrasi yang sama. Dari hasil percobaan yang dilakukan didapatkan ada 2 larutan yang mengendap. Namun selama melakukan percobaan tersebut peneliti lupa memberikan label nama pada masing-masing larutan yang diuji. Jika diketahui Ksp $BaCrO_4$ = 1,2 x 10^{-10}, Ksp $CaCrO_4$ = 7,1 x 1^{-4}, Ksp $SrCrO_4$ = 4 x 10^{-5}, Ksp $CuCrO_4$ = 3,6 x 10^{-6}, dan Ksp $PbCrO_4$ = 2,8 x 10^{-13}. Maka dari percobaan diatas, manakah dari senyawa berikut yang mengendap adalah
a. $BaCrO_4$ dan $CaCrO_4$ d. $SrCrO_4$ dan $CuCrO_4$
b. $CaCrO_4$ dan $SrCrO_4$ e. $BaCrO_4$ dan $PbCrO_4$
d. $CaCrO_4$ dan $CuCrO_4$

12b. literacy questions

Figure 12. Examination questions developed by teachers of SMAN 5 Banda Aceh

Jika Ksp Ag_2CO_3 = 1 x 10^{-14}, maka kelarutan Ag_2CO_3 dalam AgCl 0,001 M adalah...
a. 5 x 10^{-13} d. 5 x 10^{-9}
b. 1 x 10^{-12} e. 1 x 10^{-8}
c. 2 x 10^{-12}

13a. basic questions

Kelarutan garam dalam larutan yang telah mengandung elektrolit lain dengan ion yang sama dengan salah satu ion garam tersebut, akan lebih kecil dari kelarutan garam dalam air murni. Adanya penambahan zat yang mengandung ion sejenis (senama) maka akan menyebabkan kelarutan zat mengalami penurunan (berkurang) dari kelarutan sebelumnya. Dengan kata lain zat tersebut akan semakin banyak yang mengendap. Hal ini sesuai dengan konsep kesetimbangan bahwa jika konsentrasi zat ditingkatkan maka kesetimbangan akan bergeser dari zat yang ditambahi konsentrasinya. Jika Ksp Ag_2CO_3 = 1 x 10^{-14}, maka kelarutan Ag_2CO_3 dalam AgCl 0,001 M adalah ....
a. 5 x 10^{-13} d. 5 x 10^{-9}
b. 1 x 10^{-12} e. 1 x 10^{-8}
c. 2 x 10^{-12}

13b. literacy questions

Figure 13. Examination questions developed by teachers of SMA Inshafuddin Banda Aceh

Figure 13 is an example of a comparison between problem number 13 in the form of literacy and the basic problem used by the teacher before. Figure (a) is the question used by the teacher before trying to be developed by the researcher where the question from SMA Inshafuddin was used. Figure (b) is the result of the question in figure (a) that has been developed by the researcher by including aspects of science literacy such as science as a body of knowledge (presenting facts, concepts, principles and laws), science as a way to investigate (requiring students to make calculations), science as a way of thinking (describing how a scientist conducts experiments) and the interaction of science, technology and society (describing the usefulness of science and technology for society).

10 ml larutan HCl dititrasi dengan larutan NaOH 0,1 M, ternyata rata-rata volume NaOH yang digunakan 12, konsentrasi HCl yang dititrasi adalah ....
a. 0,10 M d. 1,25 M
b. 0,12 M e. 12,0 M
c. 1,20 M

14a. basic questions

Titrasi adalah prosedur menetapkan kadar suatu larutan dengan mereaksikan sejumlah larutan tersebut yang volumenya terukur dengan suatu larutan lain yang telah diketahui kadarnya (larutan standar) secara bertahap. Titik akhir titrasi ini mendekati titik ekuivalen, tapi biasanya titik akhir titrasi melewati titik ekuivalen. Oleh karena itu, titik akhir titrasi sering disebut juga sebagai titik ekuivalen. Pada saat titik ekuivalen ini maka proses titrasi dihentikan, kemudian catat volume titer yang diperlukan untuk mencapai keadaan tersebut. Sebanyak 10 mL larutan HCl dititrasi pada titik ekivalen dan membutuhkan 5 mL larutan NaOH 0,1 M. Dengan menggunakan data volume titran, volume dan konsentrasi titer maka bisa dihitung konsentrasi larutan HCl tersebut adalah ....
a. 2,0 M d. 0,1 M
b. 1,0 M e. 0,05 M
c. 0,5 M

14b. literacy questions

Figure 14. Examination questions developed by teachers of MAN Model Banda Aceh

Figure 14 is an example of a comparison between problem number 14 in the form of literacy and the basic problem used by the teacher before. Figure (a) is the question used by the teacher before trying to be developed by the researcher where the question from MAN Model Banda Aceh was used. Figure (b) is the result of the question in figure (a) that has been developed by the researcher by including aspects of science literacy such as science as a body of knowledge (presenting facts, concepts, principles and laws; asking learners to remember knowledge or information), science as a way to investigate (requiring learners to make calculations) and the interaction of science, technology and society (describing the usefulness of science and technology for society).

Figure 15 is an example of a comparison between problem number 15 in the form of literacy with the basic problem used by the teacher before. Figure (a) is the question used by the teacher before being developed by the researcher where the question comes from SMAN 5 Banda Aceh. Figure (b) is the result of the question in figure (a) that has been developed by the researcher by incorporating aspects of science literacy such as science as a body of knowledge (presenting facts, concepts, principles, and laws; asking learners to recall knowledge or information) and science as a way to investigate (requiring learners to answer questions through the use of graphs, tables, etc.).

The figure 16 is an example of a comparison between problem number 16 in the form of literacy with the basic problem used by the teacher before. Figure (a) is the question used by the teacher before trying to be developed by the researcher where the question from SMA Inshafuddin was used. Figure (b) is the result of the question in figure (a) which has been developed by researchers by including aspects of science literacy such as science as a body of knowledge (presenting facts, concepts, principles and laws; asking learners to remember knowledge or information), science as a way to investigate (requiring learners

to answer questions through the use of graphs, tables, etc.) and science as a way of thinking (describing how a scientist conducts experiments).

Seorang siswa sedang melakukan percobaan titrasi larutan CH_3COOH dengan larutan NaOH dan menggunakan indikator fenolftalein, titik akhir titrasi dicapai bila . . . .

a. Dalam erlenmeyer terbentuk endapan
b. Dalam erlenmeyer terbentuk gas
c. Larutan dalam erlenmeyer tidak berwarna
d. Warna larutan dalam erlenmeyer menjadi merah tua
e. Warna larutan dalam erlenmeyer menjadi merah muda

15a. basic questions

Titik ekivalen umumnya dapat ditandai dengan perubahan warna dari indikator. Keadaan di mana titrasi harus dihentikan tepat pada saat indikator menunjukkan perubahan warna disebut titik akhir titrasi. Jadi, untuk memperoleh hasil titrasi yang tepat, maka selisih antara titik akhir titrasi dengan titik ekivalen harus diusahakan seminimal mungkin. Hal ini dapat diupayakan dengan memilih indikator yang tepat pada saat titrasi, yakni indikator yang mengalami perubahan warna di sekitar titik ekivalen. Trayek perubahan pH berdasarkan indikator dapat dilihat pada tabel berikut.

Indikator	Trayek pH
BTB	6,0-7,6
PP	8,3-10
MM	4,4-5,2
MJ	3,1-4,4
TP	9,3-10,5

Sebagai contoh seorang siswa sedang melakukan percobaan titrasi larutan CH_3COOH dengan larutan NaOH dan menggunakan indikator fenolftalein, titik akhir titrasi dicapai bila ....

a. Dalam erlenmeyer terbentuk endapan
b. Dalam erlenmeyer terbentuk gas
c. Larutan dalam erlenmeyer tidak berwarna
d. Warna larutan dalam erlenmeyer menjadi merah tua
e. Warna larutan dalam erlenmeyer menjadi merah muda

15b. literacy questions

Figure 15. Examination questions developed by teachers of SMAN 5 Banda Aceh

Figure 17 is an example of a comparison between problem number 17 in the form of literacy and the basic problem used by the teacher before. Figure (a) is the question used by the teacher before trying to be developed by the researcher where the question from SMA Inshafuddin was used. Figure (b) is the result of the question in figure (a) that has been developed by researchers by including aspects of science literacy such as science as a body of knowledge (presenting facts, concepts, principles and laws; presenting hypotheses, models and theories), 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).

Figure 18 is an example of a comparison between problem number 18 in the form of literacy and the basic problem used by the teacher before. Figure (a) is the question used by the teacher before trying to be developed by the researcher where the question from MAN Model Banda Aceh was used. Figure (b) is the result of the question in figure (a) that has been developed by the researcher by including aspects of science literacy such as science as a body of knowledge (presenting facts, concepts, principles and laws; asking learners 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).

Grafik berikut yang menunjukkan kurva titrasi basa kuat dengan asam lemah adalah . . . .

a. 

d. 

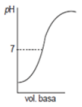
b. 

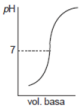
e. 

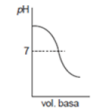
d. 

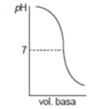
16a. basic questions

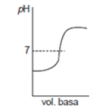
Pada saat larutan basa ditetesi dengan larutan asam, pH larutan akan turun. Sebaliknya, jika larutan asam ditetesi dengan larutan basa, maka pH larutan akan naik. Jika pH larutan asam atau basa diplotkan sebagai fungsi dari volum larutan basa atau asam yang diteteskan, maka akan diperoleh suatu grafik yang disebut kurva titrasi. Kurva titrasi menunjukkan perubahan pH larutan selama proses titrasi asam dengan basa atau sebaliknya. Bentuk kurva titrasi memiliki karakteristik tertentu yang bergantung pada konsentrasi asam dan basa yang bereaksi. Grafik berikut yang menunjukkan kurva titrasi basa kuat dengan asam lemah adalah ....

a. 

d. 

b. 

e. 

c. 

16b. literacy questions

Figure 16. Examination questions developed by teachers of SMA Inshafuddin Banda Aceh

Suatu contoh air sungai setelah disaring diperoleh filtrat yang tampak jernih. Filtrat tersebut ternyata menunjukkan efek Tyndall. Dari data tersebut dapat disimpulkan bahwa air sungai..

a. Tergolong aerosol
b. Tergolong suspensi
c. Tergolong sol
d. Tergolong koloid
e. Mengandung partikel kasar dan koloid

17a. basic questions

Efek Tyndall ditemukan oleh John Tyndall (1820-1893), seorang ahli fisika Inggris. Efek Tyndall adalah gejala penghamburan berkas sinar (cahaya) oleh partikel-partikel koloid. Hal ini disebabkan karena ukuran molekul koloid yang cukup besar sehingga dapat menghamburkan sinar tersebut. Sebaliknya, pada larutan sejati ukuran molekulnya relatif kecil sehingga hamburan yang terjadi hanya sedikit dan sangat sulit diamati. Suatu contoh air sungai setelah disaring diperoleh filtrat yang tampak jernih. Filtrat tersebut ternyata menunjukkan efek Tyndall. Dari data tersebut dapat disimpulkan bahwa air sungai ....

a. Tergolong Aerosol
b. Tergolong Suspensi
d. Tergolong Sol
d. Tergolong Koloid
e. Tergolong Emulsi

17b. literacy questions

Figure 17. Examination questions developed by teachers of SMA Inshafuddin

Figure 19 is an example of a comparison between problem number 19 in the form of literacy and the basic problem used by the teacher before. Figure (a) is the question used by the teacher before trying to be developed by the researcher where the question from SMA Inshafuddin was used. Figure (b) is the result of the question in figure (a) which has been developed by the researcher by including aspects of science literacy such as science as a body of knowledge (presenting facts, concepts, principles and laws), science as a way to investigate (involving students in experiments or thinking activities) and the interaction of

science, technology and society (describing the usefulness of science and technology for society; mentioning careers and jobs in science and technology).

Sifat koloid yang dapat menghamburkan cahaya disebut ...
a. Dialisis
b. Koagulasi
c. Gerak brown
d. Efek tyndall
e. Elektroforesis

18a. basic questions

Koloid memiliki sifat-sifat yang khas dalam sistem koloid. Ada macam-macam atau jenis-jenis koloid yang ada dikehidupan sehari-hari dengan sifat-sifat tertentu yang ada pada sifat-sifat koloid. Ada yang tampak jelas secara fisis dan ada juga yang tampak seperti larutan. Dari kecilnya ukuran partikel-partikel, sistem koloid harus diamati dengan menggunakan mikroskop yang memiliki pembesaran yang tinggi (mikroskop ultra). Sistem koloid mempunyai sifat khas, yang berbeda dengan sifat pada sistem dispersi lainnya. Sifat-sifat koloid adalah Elektroforesis, Efek Tyndall, Gerak Brown, Adsorpsi, dan Koagulasi. Pembentukan delta pada muara sungai terjadi karena partikel koloid mengalami sifat koloid yang kita kenal sebagai ....
a. Gerak Brown
b. Elektroforesis
e. Adsorpsi
d. Efek Tyndall
e. Koagulasi

18b. literacy questions

Figure 18. Examination questions developed by teachers of MAN Model Banda Aceh

Pembuatan koloid di bawah ini yang termasuk cara kondensasi adalah...
a. Sol belerang dibuat dengan mencampurkan serbuk belerang dengan gula kemudian dimasukkan dalam air
b. Sol $Al(OH)_3$ dibuat dengan menambahkan larutan $AlCl_3$ dibuat dengan menambahkan larutan $AlCl_3$ ke dalam endapan $Al(OH)_3$
c. Sol emas dibuat dengan melompatkan bunga api listrik dari elektron Au dalam air
d. Sol agar-agar dibuat dengan memasukkan serbuk agar-agar ke dalam air panas
d. Sol As_2S_3 dibuat dengan mengalirkan gas H_2S ke dalam larutan As_2S_3

19a. basic questions

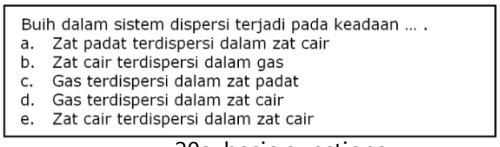
Pembuatan koloid dapat dilakukan dengan dua cara yaitu kondensasi dan cara dispersi. Kedua cara tersebut sangat berbeda dan berlawanan arah. Pembuatan dengan kondensasi berasal dari molekul-molekul kecil yang bergabung dengan membentuk partikel berukuran koloid. Sedangkan pembuatan dengan cara dispersi adalah pemecahan molekul besar menjadi partikel berukuran koloid. Pembuatan koloid di bawah ini yang termasuk cara kondensasi adalah ....
a. Sol belerang dibuat dengan mencampurkan serbuk belerang dan gula lalu dimasukkan dalam air
b. Sol $Al(OH)_3$ dibuat dengan menambahkan larutan $AlCl_3$ ke dalam endapan $Al(OH)_3$
c. Sol emas dibuat dengan melompatkan bunga api listrik dari elektron Au dalam air
d. Sol agar-agar dibuat dengan memasukkan serbuk agar-agar ke dalam air panas
e. Sol As_2S_3 dibuat dengan mengalirkan gas H_2S ke dalam larutan As_2S_3

19b. literacy questions

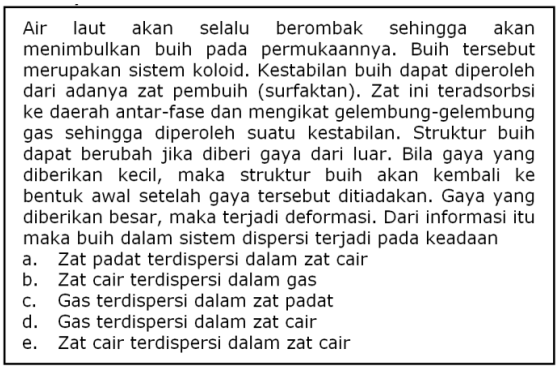
Figure 19. Examination questions developed by teachers of MAN Model Banda Aceh

Figure 20 is an example of a comparison between problem number 20 in the form of literacy and the basic problem used by the teacher previously. Figure (a) is the question used by the teacher before trying to be developed by the researcher where the question from SMAN 5 Banda Aceh was used. Figure (b) is the result of the problem in figure (a) that has been developed by the researcher by including aspects of science literacy such as science as a body of knowledge (presenting facts, concepts, principles and laws), science as a way to investigate (providing cause and effect relationships) and the interaction of science, technology and society (describing the usefulness of science and technology for society). All of the questions developed have contained indicators of science literacy. The researcher developed

a science 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.


Buih dalam sistem dispersi terjadi pada keadaan ... .
a. Zat padat terdispersi dalam zat cair
b. Zat cair terdispersi dalam gas
c. Gas terdispersi dalam zat padat
d. Gas terdispersi dalam zat cair
e. Zat cair terdispersi dalam zat cair

20a. basic questions


Air laut akan selalu berombak sehingga akan menimbulkan buih pada permukaannya. Buih tersebut merupakan sistem koloid. Kestabilan buih dapat diperoleh dari adanya zat pembuih (surfaktan). Zat ini teradsorbsi ke daerah antar-fase dan mengikat gelembung-gelembung gas sehingga diperoleh suatu kestabilan. Struktur buih dapat berubah jika diberi gaya dari luar. Bila gaya yang diberikan kecil, maka struktur buih akan kembali ke bentuk awal setelah gaya tersebut ditiadakan. Gaya yang diberikan besar, maka terjadi deformasi. Dari informasi itu maka buih dalam sistem dispersi terjadi pada keadaan
a. Zat padat terdispersi dalam zat cair
b. Zat cair terdispersi dalam gas
c. Gas terdispersi dalam zat padat
d. Gas terdispersi dalam zat cair
e. Zat cair terdispersi dalam zat cair

20b. literacy questions

Figure 20. Examination questions developed by teachers of SMAN 5 Banda Aceh

The initial step taken to design a science literacy-based concept mastery instrument is to adjust the core competencies (KI) and basic competencies (KD) in chemistry subjects for class XI even semester students. The next step is to determine the lattice of questions in accordance with the KD and the formulation of indicators. Then the researcher made a question card based on the predetermined grid. There are some shortcomings in the initial design such as the lack of sequential answer choices in the form of numbers; then there are still questions that are not in accordance with the indicators; and the subject matter is still wrong and unclear. Furthermore, the development stage is carried out revisions to the LKPD by expert validators 1 and 2.

3.3. Developing

The design stage is then continued at the development stage. The assessment instrument developed based on the design stage is continued by being validated by two expert validators from the chemical education department of FKIP Unsyiah, to find out whether the instrument of mastery of science literacy-based concepts is valid, and whether or not it is feasible to use in the learning process, especially in the assessment process. The results of the validation of the science literacy-based concept mastery instrument can be seen in Table 2.

The results of validation by the two expert validators on each item reviewed had a percentage of 98.70% with very high criteria and were declared valid so that the

assessment instrument was categorized as very feasible to use. The assessment results are in accordance with the research of Sumaryatun et al. (2016) There are four aspects of literacy in science literacy-based authentic assessment instruments, which are classified as very feasible to use and declared valid by expert validators with a percentage of 95% and have very high reliability. The assessment instrument developed is not burdensome for teachers and students and can be accepted and used in learning activities.

Table 2. Results of Validation of Science Literacy-Based Concept Mastery Instrument

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

Source: Results of the research

3.4. Disseminate

The dissemination stage is the last stage in the 4-D development model. This stage uses the developed science literacy-based concept mastery instrument on a larger scale. The components of the assessment instrument that have been validated based on the development stage are continued to be validated by four chemistry teachers from each school. This is done to find out how teachers respond to science literacy-based assessment instruments and to find out whether they can be used in the learning process at school.

Researchers in this case spread the instrument of mastery of science literacy-based concepts in four SMA / MA schools in Banda Aceh city. Furthermore, the instrument can be used at school by chemistry teachers in class XI even semester with the hope that students can be more motivated and learning outcomes can improve. Researchers accompanied by chemistry teachers distributed science literacy-based assessment test questions to students to be done for 60 minutes. Before working on the questions students have been given time to prepare themselves and orderly work and finish it at the specified time.

3.5. Learning outcomes

The science literacy-based concept mastery instrument after being developed was given to students for testing on even semester class XI material. Student learning outcomes using the instrument of mastery of science literacy-based concepts in class XI even semester students at SMA/MA Kota Banda Aceh were obtained from

20 items with multiple choice forms. Before students are given time to work on questions on a predetermined day, students are first given information about the learning outcomes test using a science literacy-based concept mastery instrument. This is done like just before the semester exam, students are given time to prepare themselves so that later the learning outcomes obtained get the best scores. The 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 figure.

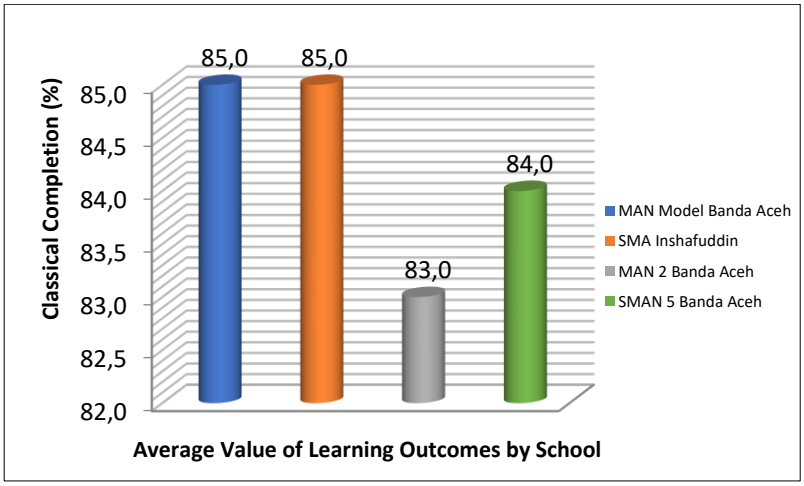


Figure 21. Examination questions developed by teachers of MAN Model Banda Aceh

Based on Figure 21 obtained classical percentage values between each school is already above 80%. This means that students who are still not complete from all students who take the test are at 20%. This can be caused by students who are still not familiar with the form and type of science literacy questions. Science literacy-based concept mastery instruments after being applied to the learning process are able to show significant changes in student learning outcomes. Therefore, teachers are expected to continue to apply and use science literacy-based instruments so that students can get used to the types of science literacy questions.

There is an increase in student learning outcomes, because the questions given by researchers already contain science literacy. This value states that students at the school are not treated with special learning treatment, meaning that they are students with low, medium, and high levels of intellectual ability who are combined in certain classes. Therefore, learning, especially in the assessment process using science 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. Science literacy-based concept mastery instruments have a positive influence on students in the learning process. This is evidenced after being applied to students there is a significant change in student learning outcomes.

3.6. Percentage of science literacy

The characteristics of the science literacy-based concept mastery instrument are that there are four aspects of literacy in a complete and balanced manner. 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 science literacy analysis can be seen in Table 3.

Table 3. Data Analysis of Science Literacy Based Concept Mastery Instrument

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

Source: Results of the research

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

3.7. Teacher response analysis

This stage is carried out after students have completed the science literacy-based concept mastery instrument test. The goal is for researchers to get responses or responses and feedback from chemistry teachers on previously developed assessment instruments. At this stage the teacher without filling out the response

questionnaire because it will make it easier for the teacher to convey feedback along with improvements to the science literacy-based concept mastery instrument. The teacher gave a response after filling out the instrument validation sheet. The results of the validation of science literacy-based concept mastery instruments by teachers can be seen in Table 4.

Table 4. Results of Validation of Science Literacy-Based Concept Mastery Instrument by teachers in SMA/MA Banda Aceh City

Instrument Validation Results				Average
Validator I	Validator II	Validator III	Validator IV	
99,90 %	99,90 %	99,90 %	99,90 %	99,90 %

Source: Results of the research

Validator I is an XI grade chemistry teacher at MAN Model Banda Aceh. Validator II is an XI grade chemistry teacher at SMA Inshafuddin. Validator III is an XI grade chemistry teacher at MAN 2 Banda Aceh. While Validator IV is a chemistry teacher of class XI at SMAN 5 Banda Aceh. The four validators gave a positive response to the science literacy-based concept mastery instrument that had been developed. The results of the validation of science literacy-based concept mastery instruments assessed by teachers as validators were declared 99.90% valid so that the assessment instrument was categorized as very feasible and the teacher agreed to be applied at school.

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

4. Conclusion

Based on the results of the research that has been conducted on the development of science literacy-based knowledge assessment instruments in chemistry class XI even semester (case study in SMA/MAN Banda Aceh city), it can be concluded that the percentage of feasibility of science literacy-based concept mastery instruments

in chemistry subjects for each question is above 80% with very high criteria and declared valid so it is very feasible to use. The completeness of student learning outcomes classically obtained an average percentage of 84.25% of a total of 103 students, meaning that the development of science literacy-based concept mastery instruments can increase student learning outcomes. The science literacy-based concept mastery instrument developed already contained four aspects of science literacy completely 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 the interaction of science, technology and society of 17.85%. Teachers responded very well to the science literacy-based concept mastery instrument. The results of validation of questions by teachers show that the instrument of mastery of science literacy-based concepts is feasible to be applied in chemistry subjects.

Conflict of interest

The authors declare that they have no conflict of interest.

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