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DEVELOPMENT OF E-STUDENTWORKSHEET BASED ON SCIENCE LITERACY (E-SWBSL) OF ACID BASE TOPIC TO IMPROVE STUDENT LEARNING OUTCOME

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Abstract

This study aims to develop (E-SWBSL) electronic student worksheets based on scientific literacy to improve student learning outcomes on acid-base materials that are appropriate for use. The principle of scientific literacy in the E-SWBSL includes several domains: the content knowledge domain, context domain, scientific phenomena domain, and attitude domain. The research method used a 4-D development model (Define, Design, Develop, and Disseminate), but the research only reached the development stage. The results of the E-SWBSL were tested on 22 students in the eleventh grade of pharmacy vocational school. The feasibility of E-SWBSL is viewed from three aspects, namely aspects of validity, practicality, and effectiveness. The results of the development of E-SWBSL found that the eligibility of the E-SWBSL was assessed from its validity was stated to be very valid with a validity percentage of 81.25%. The practicality of this E-SWBSL shows practical results with the value shown by the positive response questionnaire results of students with a percentage of 78.7%. The effectiveness of the E-SWBSL states very effective results based on a significant increase in student learning outcomes through the paired sample t-test, so that the developed E-SWBSL is declared feasible for use in the teaching and learning process, especially acid-base topics.

Keywords: Student worksheets, Science Literacy, Acid and Base

INTRODUCTION

In the 21st century, digitalization skills have been needed to compete globally. Thus encouraging people to know science and technology. In this case, the literacy level is one of the benchmarks for developing these abilities [1]. In addition, these technological advances also raise various issues regarding morals, ethics, and others. So that to deal with these multiple problems, the community must have scientific literacy skills [2].

Based on the 2018 PISA research, Indonesian students obtained an average score of 396, below the PISA average score, which is 500, with a rank of 72 out of 77 participating countries [3]. According to the OECD, the PISA scientific literacy assessment assesses competence, knowledge, and context-related attitudes.

Aspects of scientific competence refer to the mental processes involved when answering a question or solving a problem [4].

In the world of education, scientific literacy skills guide students to be able to apply the science they learn as a basis when making decisions in today's life that are influenced by developments in science and technology [4]. Chemistry learning needs scientific literacy because chemistry as a process includes ways of thinking, reasoning, formulating problems, conducting experiments and observations, analyzing data, and concluding to obtain scientific products [5]. This is also supported by the statement, following the goals of scientific literacy, where students' abilities can increase in terms of thinking critically in accepting. Various information is then correlated with the knowledge that has been obtained to solve or find a problem [6]

Good chemistry learning is learning that gives meaning to students. Meaningful learning can occur if students can connect new knowledge with prior knowledge [7]. Chemistry subject in Vocational High Schools is an adaptive subject or

can be called a supporting subject. Following this function, chemistry subjects should be able to contribute to developing productive subjects [8]. According to the elucidation of Law Number 20 of 2003 Article 15, vocational education is secondary education that prepares students especially to work in specific fields. Vocational education consists of Vocational High Schools and Vocational Aliyah Madrasas. All of these goals can be achieved if students can apply the knowledge they get to solve problems in everyday life. Scientific literacy is the primary capital for vocational students to face global challenges in the business and industrial world [8].

One of the factors that can support the learning process of chemistry or science to provide meaning and shape students' scientific literacy skills is providing quality teaching materials in accordance with the context of chemistry or science education [9]. Student worksheets are the learning resource most often encountered by students besides student books. Student worksheets, which attract funds according to the needs of students, will provide good learning outcomes [2]. A student worksheet is a guide to facilitate students in carrying out teaching and learning activities based on scientific problems and steps to solve a problem [10].

Development student worksheets needs to pay attention to two aspects: the design and development steps. The two things that need to be considered in designing the development of student worksheets include students' reading ability and knowledge [11]. With the rapid growth of technology, ICT's role in teaching and learning activities can achieve learning objectives with better results. The results of current technological developments in the field of education, one of which is modifying the printed module into an electronic format [12]. This can also be applied to print student worksheets into electronic student worksheets because e-student worksheets can simplify and narrow space and time so that learning becomes more efficacious [13].

Based on the results of observations at the one of Vocational School, in Sidoarjo, on chemistry learning, one of the difficult chapters is the acid-base chapter because there is a lot of memorization, and it requires good analysis. Acid-base material contains factual, conceptual, and procedural knowledge [12]. The results of interviews with chemistry teachers indicated that students had never received scientific literacy-based learning.

Based on the background that has been described, this study aims to develop student worksheets based on scientific literacy that is suitable for use in learning.

METHOD

This research uses a 4-D Research and Development (R&D) model for device development. There are four stages: Define, Design, Develop, and Disseminate. The limitation of this research is only at the development stage. Data collection on

This research was conducted at a private vocational school in Sidoarjo with a total of 22 students in class XI Pharmacy 1. In this study, the instruments used were study sheets, student observation sheets, pretest and posttest questions, student response results, and validation sheets.

Three validators carried out student worksheets validation. Then, the validation results were analyzed quantitatively in the form of numbers, expressed in percentages, and calculated using a Likert scale assessment as in table 1.

Table 1. Likert scale

Criteria	Value
Very good	5
Good	4
Sufficiently	3
Bad	2
Very bad	1

[14]

In calculating the percentage of student worksheets, eligibility can be calculated using the formula

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$$P(\%)= \frac{the\ total\ value\ obtained}{criterion\ score})$$

Criteria score = maximum score x number of aspects assessed x number of respondents.

Furthermore, the validation results can be interpreted using the criteria in table 2.

Table 2. Interpretation Criteria

Criteria	Value
Very bad	0-20
Bad	21-40
Sufficiently	41-60
Good	61-80
Very Good	80-100

The developed student worksheets can meet the validity criteria if it gets a percentage score≥ 61%.

Student worksheets practicality data is taken through the results of student responses taken after learning. Assessed using the Guttmann calculation scale in table 3.

Tabel 3. Gutman scale

Answer	*Value*
Yes	1
No	0

[14]

Furthermore, the percentage of student responses was obtained using the formula

$$P(\%)= \frac{jthe\ total\ value\ obtained}{totals\ of\ students})x\ 100\%$$

The developed student worksheets will be declared practical if it gets a percentage of ≥ 61%.

The data analysis technique used is the paired sample t-test. Data were analyzed using SPSS. The data were obtained from the results of the students' pretest and posttest. The hypothesis in this calculation is:

Ha: there are significant changes/ differences related to the pretest-posttest

Ho: no significant changes/differences related to the pretest and posttest

RESULTS AND DISCUSSION

The results of research on the development of electronic student worksheets based on scientific literacy in the form of student worksheets products are equipped with student worksheet's validity data and learning outcomes. Developing these student worksheets using a Research and Development (R&D) approach that aims to introduce scientific literacy and improve student learning outcomes of acid-base material. The development of these student worksheets refers to the 4-D Models, according to Thiagarajan. 4-D Models consist of four stages, namely the definition stage, the design stage, the development stage, and the deployment stage. With the results are described below.

A. Defining stage

The defining stage aims to determine and define learning requirements by analyzing students' and teachers' problems in teaching chemistry in class. This analysis is based on data obtained through student pre-research questionnaires and pre-research interviews with teachers. The results of the student questionnaire stated that 74% of students thought that acid-base material was challenging to learn, and 82.6% of students did not know about scientific literacy. This is one of the underlying reasons for this research, which also refers to literature studies. Scientific literacy learning can better understand students about science concepts and apply them to actual, new, and different conditions [14]. The results of interviews with teachers stated that acid-base material is one of the chemical materials where the average score of students is still low, and students have never been given scientific literacy-based learning

B. Design stage

The second stage is designs. The preparation at this stage is based on the results of the analysis in the previous stage, which consists

of selecting media, instruments, and the initial design of the student worksheets. For the selection of media used, namely scientific literacy-based acid-base material worksheets with selected sub-chapters, namely acids and bases according to experts, salts, and indicators studied in class XI with KD 3.1 Understanding the properties of acid, base, and salt solutions with several indicators and KD 4.1 Shows the nature of acid-base and salt solutions with several indicators. In the initial design, the preparation of learning tools was carried out to support the implementation of student worksheets in students. The tools used consisted of syllabus and lesson plans. At this stage also designed the student worksheets designed. The student worksheets design can be seen in Figure 1 and Figure 2.

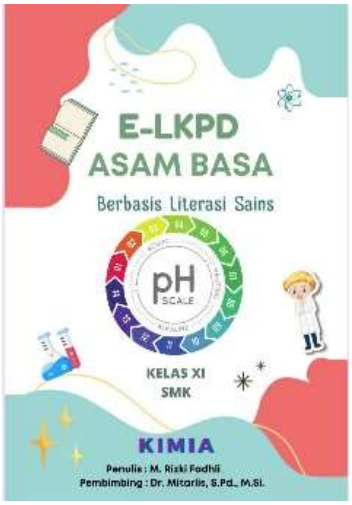

Figure 1. Cover student worksheets

Figure 2. Example of content of student worksheets

C. Review and Validation Stage

The next stage is development, a process of review and validation. The assessment is carried out by the supervising lecturer, whose process goes hand in hand with the development stage of the student worksheets design. After reviewing, the student worksheets will be validated by two lecturers. A chemistry subject teacher at one of Vocational School in Sidoarjo, The validation assessed by the lecturer is about the content and design of the student worksheets. In contrast, the validation carried out by the teacher is about practicality to assess the practicality and effectiveness of the student worksheets for participants' education. The results of the validation of 2 lecturers obtained the following assessment as in Table 4.

Table 4. Content Validation

Statement	*V1*	*V2*	*Average*	*Category*
Content Aspect	80%	80%	80%	Very Valid
Aspects of scientific literacy	80%	80%	80%	Very Valid
Serving quality	92.5%	100%	96.5%	Very Valid
Linguistic quality	80%	92.5%	86.25%	Very Valid

Table 5. Media Validation

Statement	*V1*	*V 2*	*Average*	*Category*
E-SWBSL	80%	80%	80%	Very Valid
Cover Design	80%	80%	80%	Very Valid
Fill illustration	80%	86.6%	83.3%	Very Valid
Content Design	80%	100%	90%	Very Valid

while the results of the validation of teacher practicality are obtained as presented in Table 6.

Table 6. Practicality Validation by the teacher

Statement	*Value*	*Category*
Content Quality	80%	Very Valid
Cover Design	76%	Valid
Fill illustration	80%	Very Valid
Content Design	80%	Very Valid

Based on the results of lecturer validation, a value of 83.5% was obtained with a very valid category. At the same time, the results of the practicality of the teacher obtained a validation value of 79% with a valid category, so an average validation value of 81.25% was obtained with a very valid variety.

D. Effectiveness

In assessing this effectiveness using pretest and posttest research instruments. The questions in the pretest and posttest are five essay questions that fall into the categories C4 to C5. After the pretest and posttest results are obtained, they will be analyzed using SPSS. With the hypothesis, Ha states that there are significant changes/differences related to the pretest-posttest, and Ho states that there are no significant changes/differences related to the pretest and posttest.

Table 7. Result Pretest and Posttest Score

	Number of students	*Average score*	*lowest score*	*highest score*	*Std Deviation*	Sig. (2-tailed)
Pretest	22	53.95	23	70	11.341	.000
Postest	22	74.95	51	96	10.755	

Based on the Table 7, the value of Sig. (2-tailed) < 0.05 so that it can be stated that there is a very significant difference between the pretest result value and the posttest result value. Thus, Ha is accepted, stating that there are significant changes/differences related to the pretest and posttest.

E. Practicality

The practicality assessment of the E-SWBSL was obtained from a research instrument in the form of a student response questionnaire. Filling in the response questionnaire was taken after all the learning processes were completed

. This questionnaire has 14 aspects that must be filled in by students with a "Yes" or "No" answer. The results of the student response questionnaire are in Table 8.

Table 8. Student Questionnaire

No	Statement/Question	P%	Criteria
1.	Learning using the E-SWBSL can make it easier for you to understand the concept of acids and bases	81.8%	Very practical
2.	Learning using the E-SWBSL increases interest in reading	77.2%	Practical
3.	Learning using the science E-SWBSL can add insight and experience to your learning.	90.9%	Very practical
4.	Learning using the E-SWBSL media makes you more motivated to learn.	81.8%	Very practical
5.	Learning to use the E-SWBSL is a new experience for you.	90.9%	Very practical

No	Statement/Question	P%	Criteria
6.	Can you express ideas when discussing with groups?	90.9%	Very practical
7.	Are you more interested in learning by relating material to everyday life?	86.3%	Very practical
8.	You want to learn chemistry in other materials to be as fun as this	86.3%	Very practical
9.	Do you think the design of the E-SWBSL is attractive?	86.3%	Very practical
10.	Is the writing of this E-SWBSL following the General Guidelines for Indonesian Spelling?	81.8%	Very practical
11.	Is using E-LKPD better than printed LKPD?	77.2%	Practical
12.	Learning using E-SWBSL can make it easier for you to find new material	86.3%	Very practical
13.	Using the E-SWBSL is easy and practical	86.3%	Very practical
14.	In this E-LKPD, the language used is straightforward, easy to read and understand	77.2%	Practical

Based on the Table, it can be seen that the developed student worksheets are suitable for use with a percentage of ≥ 61%, namely 78.7%, with practical criteria.

In the student response questionnaire, statements numbers 1, 2, 3, 4, 12, and 13 in the student response questionnaire explained the benefits of using literacy-based student worksheets. In statement number 1, as many as 18 students stated "Yes," and four students stated "No." In statement number 2, as many as 17 students stated "Yes," and five students stated "No." In statement 3, as many as 20 students stated "Yes," and two students stated "No." In statement 4, as many as 18 students stated "Yes," and four students stated "No." In statement 12, as many as 19 students stated "Yes," and three students stated "No." In statement 13, as many as 19 students stated "Yes," and three students stated "No."

In the student response questionnaire, statements numbers 5, 6, 7, and 8 in the student response questionnaire explain the learning process using Literacy-based student worksheets. In statement number 5, as many as 20 students stated "Yes," and two students stated "No". In statement number 6, as many as 20 students stated "Yes," and 2 students stated "No". In question 7 as many as 19 students stated "Yes," and three students stated "No". In statement 8, as many as 19 students stated "Yes," and three students stated "No."

In the student response questionnaire, statements numbers 9, 10, 11, and 14 in the student response questionnaire explained the literacy-based E-LKPD assessment them. In statement number 9, as many as 19 students stated "Yes," and three students stated "No." In statement number 10, as many as 18 students stated "Yes," and four students stated "No." In question 11, as many as 17 students stated "Yes," and five students stated "No". In question 14, as many as 17 students stated "Yes," and five students stated "No."

CONCLUSION

Based on the results of the research that has been done, the developed E-SWBSL are feasible to use. It can be concluded that:

1. Based on the results of the three validators, a validation value of 81.25% with a very valid category.
2. The effectiveness of this student worksheets shows very effective results based on a very significant increase in student learning outcomes through the T-test with a Sig value. (2-tailed) 0.000.
3. The practicality of this student worksheets shows practical results with scores taken on student response questionnaires with a percentage of ≥ 61%, namely 78.7%.

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