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DEVELOPMENT OF WORKSHEET INTEGRATED SCIENTIFIC LITERACY FOR PHYSICS PRACTICUM KIT ON ELASTICITY MATERIALS

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ABSTRACT

Education in the era of the industrial revolution 4.0 is not enough just to read and write and numeracy. One of the 16 life skills that students must have in this industrial revolution era is scientific literacy. The aim of the study was to test the effectiveness of using the developed worksheet integrated with scientific literacy. However, worksheets that support literacy activities in the process of learning are still relatively rare and do not support practicum activities. One of the solutions to the problems expressed is to develop scientific literacy integrated worksheets for the use of physics practicum KIT on the material elasticity of materials.The researchtype used was research and development (Research and Development) or known as R&D. The object of research is worksheets that are integrated with scientific literacy for the use of physics practicum KIT on material elasticity for class XI high school. Research is limited to the product trial stage with a limited scale. Based on the research conducted, 3 conclusions can be drawn. First, the integrated scientific literacy worksheet for the use of physics practicum KITon material elasticity is very valid with a validity value of 0.85. Second, the practical value of integrated worksheets with scientific literacy obtained from teachers is 94% in the very practical category. The practicality value by students obtained a value of 92% with a very practical category. Furthermore, the use of scientific literacy integrated worksheets is effective in improving student outcomes of learning.

Keywords :*Student worksheet; Scientific Literacy; Physics Practicum KIT; Material Elasticity*

I. INTRODUCTION

Education is a very important pillar in building a quality country. Education can also be interpreted as a process for changing individuals so that they can adapt to their environment which is marked by changes in behavior and the level of knowledge in these individuals. Therefore, several efforts are needed to improve the educationquality.

One of the efforts to improve the quality of education is to improve the curriculum along with the times. This is in line with Rudi's Opinion who stated that one of the efforts to overcome educational problems is to change the curriculum[1]. In the 2013 revised 2017 curriculum, there are educational demands to be able to have 4C skills (Critical thinking, Creativity, Collaboration, and Communication), higher order thinking skills or what are called Higher Order Thinking Skills (HOTS), and Strengthening Character Education (PPK). In addition, it was explained that literacy was included in the 2013 Curriculum revision[2].

The abilities that students must have in the era of the industrial revolution 4.0 are not enough to just read and write and numeracy[3]. One of the abilities that can be mastered after studying science is literacy of scientific[4]. Broadly speaking, the 2013 Curriculum is considered capable of realizing literacy of scientific[5]. Meanwhile, literacy of scientific is one of the 16 life skills that students must possess[6]. Literacy of scientific

can be interpreted as a person's ability to understand and apply the knowledge he has in everyday life[7]. Therefore, the use of literacy of scientific is very necessary in the process of learning.

However, in reality, students literacy of scientific skills in Indonesia are still relatively low. Data from the latest PISA study results in 2018 proves that Indonesia is ranked 70 out of 78 countries listed in PISA[8]. Research results Angraini(2014)shows the low ability of students' literacy of scientific caused by the process of learning implemented does not support the development the literacy of scientific [9]. Therefore, an appropriate strategy is needed to improve literacy of scientific skills in students [10].

Improving the quality of education can also be done by improving the availability of facilities and infrastructure. Educational facilities are anything that is used by teachers to facilitate the delivery of material, such as books and material of teaching. While educational infrastructure is all equipment used to facilitate the implementation of education, such as laboratories and libraries. One of the material of teaching that can be used is Student worksheets.

Student worksheet is a printed teaching material that can be used for each subject by containing the basic activities that must be conducted by students. Student worksheets are one of the learning resources related to students directly [11]. The activities in question can be in the form of observation (observation), experimentation, and asking questions. The importance of using student worksheet in learning is related to its usefulness. Worksheets have several functions, including: 1) as material of teaching that activate the role of learners; 2) make it simpler for kids to comprehend the information; 3) facilitate the implementation of teaching to students; 4) an alternative for the teacher to introduce an activity as a learning activity; and 5) use time effectively [12]. Literacy of scientific integrated worksheet is a worksheet that contains several stages of literacy of scientific in its activities[5]. In general, student worksheet consists of 2 forms, namely student worksheetused for knowledge development exercises and experimental or demonstration guides [13].

Practicum can be interpreted as an activity that is used to equip students to gain an understanding of a lesson from perceived experience. Nugrohoin his research stated that the practicum learning method is one way to improve literacy of scientific skills in students[14]. Some advantages in doing practicum, including 1) practicum activities can train skills, 2) Provide opportunities for students to apply and integrate their knowledge and skills in practice, 3) prove something scientifically, and 4) Appreciate knowledge and inquiry skills[15]. Based on the advantages stated, the use of student worksheet will help students in the process of learning, especially in physics subjects.

Physics is a branch of IPA (Natural Science) which studies natural phenomena and the interactions that accompany these phenomena. Learning physics describes and analyzes the structure of natural events and their surroundings so that natural laws are found that can explain the phenomena based on logic. Physics is expected to be a place for students to solve problems in everyday life.

Learning physics using literacy of scientific is very necessary so that students can more easily understand the material[16]. The use of practicum worksheets that are integrated with literacy of scientific generally has an attractive appearance and can attract students to improve literacy skills. This shown by the results of his research which suggests that the use of worksheets with literacy of scientific obtains a high value of validity.

During the PLK (Educational Field Practice) at Senior High School of IT Darul Hikmah especially for class XI students, several real conditions were obtained in the field through observation and interviews, and supported by filling out questionnaires. First, based on the interviewresults with one of the physics teachers, it is known that students are not actively involved in the physics process of learning. Most students find it difficult to develop their ability to understand the material. This is because they tend to only gain knowledge from what is conveyed by the teacher and added from the textbook.

Second, it was found that schools already used student worksheetin learning, especially in physics subjects. The student worksheetused is a worksheet developed by a publisher. The student worksheet covers all the material that students will study for one semester. However, the student worksheetused does not support practicum activities, it only supports student discussion activities.

The third fact is that students tend to feel bored in learning physics because there are no practical activities in learning. Based on the questionnaire that was filled out by class XI students, it was also found that 100% of students tended to like physics learning related to everyday life. With that, learning physics is not just theory in school, but also problems that can be found in everyday life.

The fourth fact is obtained based on observations made in the laboratory. First is the laboratory room which is also used as a reading room or library for students. Second, the school has provided practicum KIT to support practicum activities at school. Some of the KIT available include Ohm's Law Experiment KIT, Hooke's Experiment KIT, Mechanics KIT, and Electricity and Magnetism KIT. In general, the KITavailable are suitable for use although some KITdo not have manuals, such as the Ohm's Law Experiment KIT and the Hooke Experiment KIT.

The results of the initial study indicated that there was a gap between the expected conditions and the actual conditions in the field. The solution taken to overcome the problems found is to develop material of teaching in

the form the literacy of scientific -based worksheets that can support student practicum activities. Thus, the use the literacy of scientific integrated worksheets in practicum activities is expected to improve students' literacy of scientific abilities. The title of the research is "Development of student worksheetIntegrated Scientific Literacy for the Use of Physics Practicum KITon Material Elasticity".

II. METHOD

The researchtype that will be used in this study is Research and Development (R&D) with research methods that aim to develop new products or improve existing products and test the effectiveness of these products. The object of this research is a worksheet that integrates scientific literacy for the use of the physics practicum KITon material elasticity for Class XI High School. The research procedure to be conducted is guided by the research and development steps describes the research procedure in ten stages which the researcher then limits to six stages namely potentials and problems, data collection, product design, design validation, design revision, and product trials [17].

The instruments used to collect data in this study consisted of 3 parts, namely: instruments for testing the validity of material of teaching by experts, questionnaires for testing the practicality of teachers and students, and questionnaires for the effectiveness of the use thematerial of teaching through learning achievement tests. The technique of data analysis used in this research was descriptive statistical analysis and correlation test analysis. The resulting product is assessed based on a questionnaire that has been filled in by the validator.

Descriptive Analysis

A. Validity Analysis

Validity analysis uses a Likert scale which has a detailed score as follows.

Table1. Likert scale

Score	Category
1	Very less
2	Not enough
3	Enough
4	Well
5	Very good

(Source: Ref[18])

$$V = \frac{\Sigma\, s}{n(c-1)} \quad (1)$$

$$S = r - I_0 \quad (2)$$

Information:

V = Rater agreement index

r = Number given by appraiser

I_0 = The lowest rating score of validity (in this case = 1)

n = Number of raters

c = The highest rating score of validity (in this case = 5)

The validity value can be interpreted based on the following table:

Table2. Decision Based on Aiken's V Index

Correlation Criteria	Validity Interpretation
$V \leq 0.4$	Invalid
$0.4 < V \geq 0.8$	Valid
$0.8 < V$	Very Valid

(Source: Ref[18])

B. Practicality Analysis

The practicality analysis is divided into 2 questionnaires, namely teacher practicality and student practicality. The practicality questionnaire consists of 5 rating scales. Rating strongly disagree was given a score of 1, disagree was given a score of 2, neutral was given a score of 3, agreed was given a score of 4, and strongly

agreed was given a score of 5. Based on the questionnaire data that has been filled in by teachers and students, the data is processed using the following equation:

$$Percentage = \frac{\text{Score obtained}}{Max\ score} \times 100\% \quad (3)$$

After getting the percentage value from the equation above, the practical results will be made in graphical form. The numbers obtained are categorized as shown in Table 6 below.

Table3. Practicality Test Interpretation Criteria

Percentage (%)	Practical Interpretation
0 – 20	Impractical
21–40	Less Practical
41–60	Medium Practical
61–80	Practical
81–100	Very Practical

(Source: Ref[18])

III. RESULTS AND DISCUSSION

Research result

The validation results of physics material of teaching in the form of scientific literacy integrated worksheets were obtained from validation sheet instruments filled in by 3 experts. The experts in question are 3 physics lecturers at FMIPA UNP. The validation test aims to evaluate the worksheets that have been developed. This test was conducted by assessing the 4 assessment components in the developed student worksheet. The four components in question are content feasibility, language, presentation, and graphics.

The first step in the assessment is to validate the validity questionnaire which shown in Appendix 6. This instrument validation is conducted to determine the feasibility of the validity questionnaire that has been made. There are several aspects of assessing the validity of the instrument, including clarity, accuracy of content, relevance, validity of content, no bias, and accuracy of language. The validity questionnaire used in this study was considered feasible as a team.

After validating the validity questionnaire, then validating the product in the form of worksheets that are integrated with scientific literacy. The validation results for the obtained student worksheet shown in Appendix 10 by assessing the four components previously mentioned. Each assessment component consists of several indicators with the lowest value weight being 1 and the highest value weighting being 5. Based on the total weights obtained from the three validators, the value of each indicator can be determined in the range of 0.00 – 1.00 using the aiken v formula. Then the value of each component is averaged so that the product validity value is obtained in the form of scientific literacy integrated worksheets that have been made.

A. Content Eligibility Components

The first component in validation is the content feasibility component. The content feasibility component consists of seven assessment indicators, namely 1) The material presented is in accordance with Basic Competency; 2) Materials are arranged in accordance with scientific developments; 3) The problems discussed in the student worksheetare in accordance with the mindset of student development; 4) The practicum KITpresented is in accordance with the student worksheetmaterial; 5) student worksheetcontains material with accurate sources; 6) The use of student worksheetguides students to develop scientific literacy skills; 7) student worksheetcan instill a responsible attitude in students. The graph of the content feasibility indicator values shown in Figure 1.

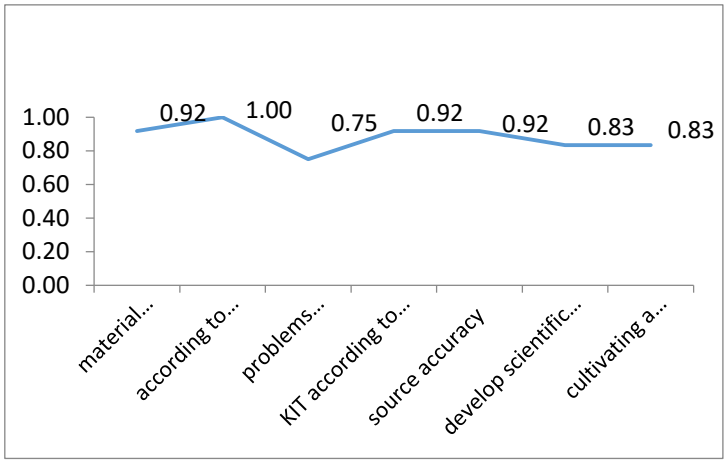

Fig.1.Graph of Content Feasibility Component Validation Results

Figure 1 shows the values for each indicator of the content feasibility component are 0.75 and 1.00. There are 2 categories of the seven indicators assessed, namely valid and very valid. Thus, the average validation results obtained from the content feasibility component is 0.88. These the content feasibility component lies at a very valid validity level.

B. Componentlanguage

The next assessment component is the linguistic component using five indicators. The five indicators include: 1) The terms and information presented in the student worksheetare well read; 2) The information provided in the student worksheetis easy to understand; 3) Student worksheetuses standard Indonesian; 4) Student worksheetuses the correct vocabulary and sentence structure; 5) The sentences used in student worksheetare simple and easy to understand. The graph of language indicator values shown in Figure 2.

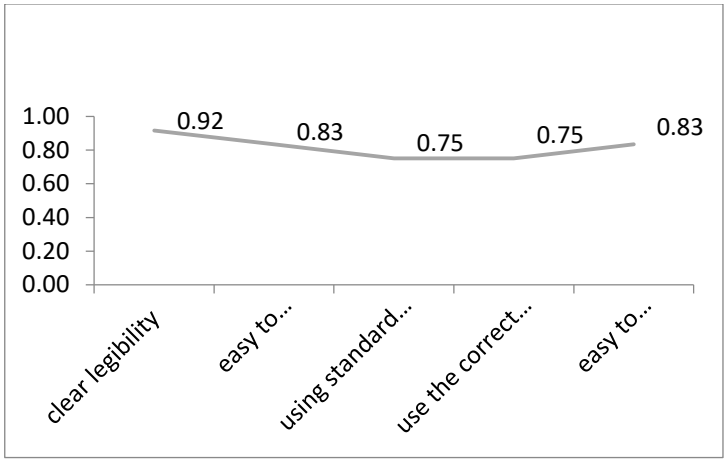

Fig.2. Graph of Language Component Validation Results

Based on Figure 2 it shown that the five indicators of the language component have a value of 0.75 and 0.92. The five indicators are divided into 2 categories, namely valid and very valid categories. The average value obtained for the linguistic component is 0.82. Thus, the linguistic component is at a very valid level.

C. Student Worksheet Presentation Components

Third, in the presentation assessment component there are six indicators. The six indicators are located on the horizontal axis in the chart. The indicators referred to include: 1) Student worksheethas clear learning practicum objectives; 2) The minimum structure of the student worksheetis appropriate based on the 2008 Ministry of National Education; 3) Systematic presentation of sequences and according to student worksheet rules; 4) Student worksheetcan have an appeal to read; 5) The tools and materials in the student worksheet are in accordance with the practicum KIT; 6) The practicum KITis presented clearly and easily understood in the student worksheet. In the student worksheetpresentation component there are assessment indicators regarding aspects of scientific literacy consisting of 3 scientific context assessment indicators, 4 scientific process

assessment indicators, and 4 scientific concept assessment indicators. The results of the presentation component validation can be seen in the following table.

Table4. The results of the validation of the presentation components of worksheets

Indicator Number	Validation Number	Category
1	0.92	Very Valid
2	1.00	Very Valid
3	0.92	Very Valid
4	0.83	Very Valid
5	1.00	Very Valid
6	0.83	Very Valid
7	0.92	Very Valid
8	0.83	Very Valid
9	0.83	Very Valid
10	1.00	Very Valid
11	0.92	Very Valid
12	0.92	Very Valid
13	0.92	Very Valid
14	1.00	Very Valid
15	0.92	Very Valid
16	0.83	Very Valid
17	0.83	Very Valid

Table above shows the value of each indicator of the student worksheetpresentation component ranging from 0.83 to 1.00. There is one category of the six indicators assessed, which is very good. Thus, the average validation results obtained from the components of the worksheet presentation were 0.91. Thus the presentation component of the student worksheetlies at a very valid level of validity.

D. Graphical components

Lastly is the graphical assessment component with five indicators. The five indicators are located on the horizontal axis in the chart. The indicators in question are, 1) The typography of the letters used in the student worksheetis correct; 2) Lay Out and layout on student worksheetis correct; 3) There is a balance between the text and images contained in the student worksheet; 4) The message conveyed in the image is clear and understandable and in accordance with the material; 5) Illustrations and symbols presented in worksheets can build students' understanding. Graphical indicator value graphs shown in Figure 3.

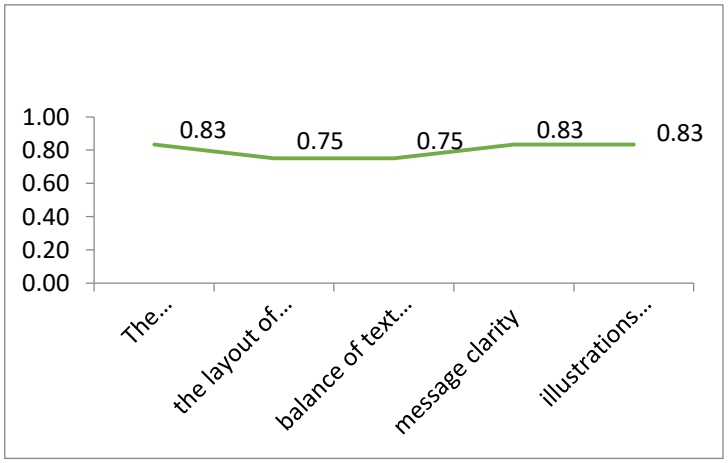

Fig.3. Graph of Graphical Component Validation Results

Based on Figure 3 it shown that the five indicators of the graphical component have a value of 0.75 and 0.83. The five indicators are divided into 2 categories, namely valid and very valid categories. The average value obtained for the language component is 0.80. Thus, the linguistic component is at a valid level.

The validity value is obtained by calculating the average value of the four components, namely 1) Content feasibility; 2) Language; 3) Presentation; and 4) Graphic. Based on the four components, a graph is obtained from the average value of the components presented in Figure 4 below.

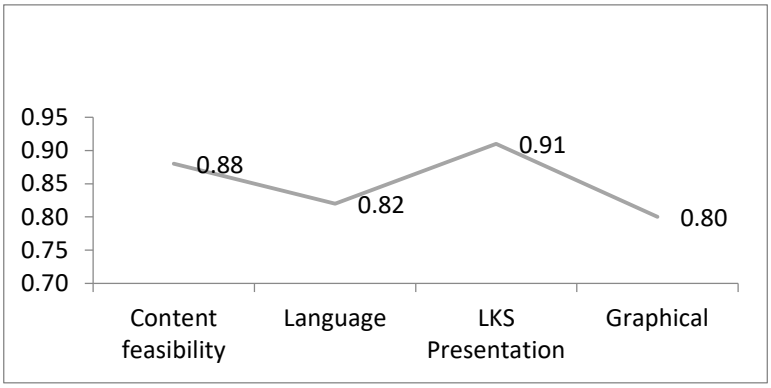

Fig.4. Graph of Average Validation Results for Each Component

Based on Figure 4, it shown that the average value of each assessment component on the student worksheetranges from 0.80 to 0.91. The average value of the four components is 0.85. Based on the values obtained, it can be concluded that the student worksheetcomponents are generally in the very valid category. Thus, physics worksheets integrated with scientific literacy for the use of physics practicum KITon material elasticity have high validity.

The next stage of development is the practicality test of teachers and students. The practicality test on the teacher is conducted by one teacher by filling out the practicality sheet instrument based on a rating scale of 1 to 5. The teacher's practicality sheet instrument consists of 4 indicators, namely 1) Ease of use; 2) attractiveness; 3) Clarity; and 4) Benefits. Each component consists of several indicators related to the teacher's response to the product made. The following table shows the results of practicality tests conducted on teachers.

Table5. Teacher Practicality Test Results

No	Aspect	Practicality Score(%)	Criteria
1	Ease of Use	94	Very Practical
2	Attractiveness	93	Very Practical
3	Clarity	93	Very Practical
4	Benefit	94	Very Practical
	Average	94	Very Practical

Based on Table 5 it shown that the four components of the scientific literacy integrated worksheet developed are in the very practical category. The average score of the four practicality components by teachers is 94%. Thus, the practicality of the practicality component according to the teacher is in the very practical category.

In addition to teacher practicality, there is a practicality test conducted on students. The practicality test assessment was conducted by 10 students from class XI high school. The rating scale given ranges from 1 to 5. The student practicality sheet instrument consists of 4 indicators, namely 1) Ease of use; 2) attractiveness; 3) Clarity; and 4) Benefits. Each component consists of several indicators related to students' responses to the products made. The following table shows the results of practicality tests conducted on students.

Table6. Student Practicality Test Results

No	Aspect	Practicality Value (%)	Criteria
1	Ease of Use	91	Very Practical
2	Attractiveness	92	Very Practical
3	Clarity	94	Very Practical
4	Benefit	92	Very Practical
	Average	92	Very Practical

Based on Table 6 it shown that the four components of the scientific literacy integrated worksheet developed are in the very practical category. The average score of the four practicality components by students is 94%. Thus, the practicality of the practicality component according to students is in the very practical category.

The next stage is to test the effectiveness of the use of scientific literacy integrated worksheets. The effectiveness test used is a limited trial or known as a small scale trial with 10 students. A limited trial was conducted to see the effectiveness of using scientific literacy integrated worksheets in the process of learning.This effectiveness can be done by comparing the scores of students' pretest and posttest. Data analysis of students' pretest and posttest results can be seen in the table below.

Table7. Results of Statistical Data Analysis of Daily Values

No.	Statistical Parameters	Pretest Value	Posttest Value
1	Average	56,67	88,67
2	Standard Deviation	15,15	8,34
3	Variance	229,64	69,62
4	Lowest Vlue	40,00	80,00
5	Highest Value	80,00	100,00
6	Median	53,33	90,00
7	Mode	40,00	80,00
8	Value Range	40,00	20,00

Based on the results of statistical data in the table above, it can be seen the difference in student scores before and after using the worksheet. The posttest average score is higher than the pretest average score. The difference between the two class averages has a very significant difference, which is equal to 32.00. This shows that there is a significant difference for the sample.

After carrying out the normality test, homogeneity test, and comparison of the two averages, a conclusion will be obtained regarding the developed student worksheet. The following table shows the results of the effectiveness test conducted on students with the normality test, homogeneity test, and two average comparison tests.

Table8. Effectiveness Test Results

Evaluation	Normality	Homogeneity	Comparison of Two Averages
Pretest Posttest	0.200 0.075	0.115	0.00
Condition	a > 0.05, normal a < 0.05, not normal	a > 0.05, homogeneous a < 0.05, not homogeneous	a > 0.05, H_0 accepted and H_a rejected a < 0.05, H_0 rejected and H_a accepted
Conclusion	Normal	Homogeneous	H_0 rejected and H_a accepted "There is Influence"

Discussion

The results of the first study are at the validation test stage. The worksheetvalidation is carried out using a validation instrument filled in by the validator. The validators in this study consisted of 3 experts. The results obtained at this stage are scientific literacy integrated worksheets for the use of physics practicum KITon material elasticity material which is in a very valid category with a value of 0.85. The validation stage consists of 4 assessment components. The four components in question are the feasibility of content, language, presentation of the worksheet, and graphics.

The content feasibility component consists of seven indicators, namely 1) The material presented is in accordance with Basic Competency; 2) Materials are arranged in accordance with scientific developments; 3) The problems discussed in the worksheet are in accordance with the mindset of student development; 4) The practicum KITpresented is in accordance with the worksheet material; 5) The worksheet contains material with accurate sources; 6) The use of the worksheet guides students to develop scientific literacy skills; 7) The worksheet can instill a responsible attitude in students. Based on the indicators above, it can be concluded that the developed worksheet has paid attention to the formulation of basic competencies and preparation of the material [19].

The next assessment component is the linguistic component using five indicators. The five indicators include: 1) The terms and information presented in the worksheet are well read; 2) The information provided in the worksheet is easy to understand; 3) The worksheet uses standard Indonesian; 4) The worksheet uses the correct vocabulary and sentence structure; 5) The sentences used in worksheet are simple and easy to understand. The linguistic component is at a very valid level. This shows that the worksheet already uses good and correct language to make it easier for readers to obtain information [20].

Third, in the presentation assessment component there are six indicators. The six indicators are located on the horizontal axis in the chart. The indicators referred to include: 1) The worksheet has clear learning practicum objectives; 2) The minimum structure of the worksheet is appropriate based on the 2008 Ministry of National Education; 3) Systematic presentation of sequences and according to worksheet rules; 4) The worksheet can have an appeal to read; 5) The tools and materials in the worksheet are in accordance with the practicum KIT; 6) The practicum KITis presented clearly and easily understood in the worksheet. The presentation component is in a very valid category, which means that the worksheet has been systematically arranged and uses appropriate writing and pictures to attract students' interest in reading worksheet[20].

The result of the next research is the practicality test stage of the scientific literacy integrated worksheet. At this stage there are two practicality test assessments, namely the practicality test by the teacher and the practicality test by students. The teacher practicality test was carried out by 1 physics teacher in class XI Senior High School of IT Darul Hikmah West Pasaman. The student practicality test was conducted on 10 students of class XI Senior High School of IT Darul Hikmah.

The practicality sheet consists of 4 major components. The four components are ease of use, attractiveness, clarity, and benefits. Based on the results of the practicality test conducted, the teacher's practicality value was 0.91 in the very practical category. The results of the student practicality test obtained a value of 0.90 in the very practical category. Based on the two results it can be concluded that the scientific literacy integrated worksheet developed is very practical.

The result of the next study is the effectiveness test of scientific literacy integrated worksheets. At this stage a small-scale trial or limited trial was carried out on 10 students of class XI. This effectiveness test was carried out to see the effect of using scientific literacy integrated worksheet on student learning outcomes.

The effectiveness test begins with giving pretest questions before learning is carried out. After the pretest is carried out, students will be given learning to use scientific literacy integrated worksheets for the use of physics practicum KITrelated to the material elasticity of materials. In the next stage, students are again given a test in the form of posttest questions to determine the level of students' understanding after using the worksheet that was developed. Information regarding the results of the pretest and posttest can be seen in Table 7.

Based on the data in Table 7, it can be seen the comparison of student scores before and after using the worksheet that was developed. The lowest student score after using the developed worksheet is 40 points superior to before using the developed worksheet. Evaluation in learning determines how well students receive learning[11]. Evaluation can also determine the descripton of learning that must be corrected.

The pretest and posttest data were tested for normality, homogeneity test, and two average comparison tests. Based on the test, it was found that H_0 was rejected and H_a was accepted. This means that there is a significant difference in the cognitive level of students in using the developed worksheet. This shows that the use of of worksheet that is integrated with scientific literacy can improve student's abilities in the cognitive domain. The use of worksheet also serves to guide students to improve their mastery of science concepts[21].

Based on the results of the research that has been described, students experience an increase in learning outcomes before and after using the developed worksheet. This is in line with research conducted by Sari (2021) which states that scientific literacy integrated worksheets are very suitable for use in learning. This is reinforced by the practicum activities using KIT that make students have experience in observing a phenomenon directly. In addition, learning outcomes will also be stored longer [22].

During carrying out the research found several obstacles and limitations. The first obstacle, the guideline for using Hooke's experimental KITcould not be found in the KITbox. Hooke's experimental KITis a practicum tool which is rarely used compared to the mechanics KIT. The second obstacle, the practicality test phase of the worksheet was carried out by one teacher and ten students. This is because only one teacher teaches and the number of students in class XI is relatively small. The third obstacle, the effectiveness stage which is carried out is only based on the scores of ten class XI students. This is also due to the limited number of students who are classified as low and limited research time.

IV. CONCLUSION

Based on the research that has been done and the results of data analysis obtained some research conclusions. The validity value of the integrated scientific literacy worksheet for the use of physics practicum KITon material elasticity material is 0.85 with a very valid category based on the feasibility aspects of content, language, presentation, and graphics. The practicality value of using student worksheetintegrated with scientific literacy for the use of physics practicum KITon material elasticity consists of 2 assessments. The practicality test by the teacher scored 94% in the very practical category. The practicality test which was filled in by students scored 92% in the very practical category in the aspects of ease of use, clarity, attractiveness, and benefits.So, the developed scientific literacy integrated worksheets are included in the category of valid, practical, and effective for improving student learning outcomes.

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