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Development of student worksheet on growth and development of drought-stressed plants

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ABSTRACT

This study aimed to determine the validity, practicality, and effectiveness of developing student worksheets on the growth and development of drought-stressed plant material. The subjects of this study were students of 12th grade Science 1 of Senior High School 1 Tapa. The worksheet development used the ADDIE development model. The instruments used were Validation Sheets, Learning Implementation, Student Activities, Student Response Questionnaires, and THB questions. Student worksheet based on drought stressed plant study of growth and development material has met the valid, practical and effective categories. Based on the results obtained from the validation and trial of products on a limited scale, the development of student worksheets on the growth and development of drought-stressed plant material is suitable to be used for learning, as well as practical, and can improve student learning outcomes.



INTRODUCTION

Learning is an activity with educational value. This value colors the interaction that occurs between teachers and students. In essence, learning is a process that organizes, and organizes the environment around students so that it can encourage and grow students in the learning process (Pane & Dasopang, 2017). Learning is an organized combination, including elements of material, equipment, human, material, and procedures that influence each other to achieve the goals of learning (Afrina et al., 2021). Therefore, learning requires components that interact with each other. Components that interact with each other in the learning process include teachers and students. Teachers are the main facilitators in schools that function to explore, develop, and optimize the potential of each learner (Lindsay, 2007). In this case, the teacher is one of the components that play an important role in teaching and learning activities to achieve learning objectives.

Learning can be said to be successful if the learning objectives are able to improve student learning outcomes including results seen from the cognitive, affective, and psychomotor domains in the material they learn. According to Rumapea et al. (2017) learning objectives are student learning outcomes obtained after teaching and learning activities in class for one learning topic. To achieve these goals cannot be separated from the role of the teacher in using various types of learning resources. Learning Resources are one of the components in learning activities that allow individuals to gain knowledge, abilities, attitudes, beliefs, emotions, and feelings (Tafonao, 2017).

Learning resources can be utilized to help teachers and students in an effort to achieve learning objectives. The utilization of learning resources related to increasing knowledge, and students' activities in the learning process is still very lacking. Therefore, it is necessary to make efforts that can improve the learning outcomes of students by bringing learning resources (the material being taught) into a learning device arrangement that contains instructions and explanations about the material being taught.

The results of observations and interviews with biology teachers in class XII IPA Senior High School 1 Tapa stated that in the process of learning and teaching in the classroom on the material of growth and development, especially plants, is one of the materials that are still difficult for students to understand. In the implementation of learning in the classroom, the learning tools used in the form of student worksheet are still general in nature or still adapted to textbooks and modules. In learning, especially growth and development material has not used the developed student worksheet. Examples of plants taught to students are still adjusting to the examples in the package book. The images of plants displayed in the student worksheet are still less interesting (Colorless). As a result, students are more passive and cannot quickly identify examples of plant growth and development from the student worksheet used in learning. Whereas in the revised 2013 curriculum, students are required to be actively involved during learning activities through observing, asking questions, collecting data or experimenting, associating, and communicating (Rizki & Ranu, 2019). Therefore, it is necessary to have a strategy that can be used by teachers in supporting the activeness of students, namely by using student worksheet.

Student worksheets are sheets that contain tasks that must be done by students and can be used as a guide in conducting investigations or problem-solving activities (Fitriyah et al., 2013). With this, the use of student worksheet can provide knowledge, and improve the ability of students to carry out learning activities on growth and development material. Growth and development material need to be taught to students. In this case, growth and development factors greatly affect the productivity of a plant, especially in Gorontalo Province which has quite hot temperatures which have an impact on plant productivity being limited.

According to data from the BAPPEDA Gorontalo Province, corn and rice are food crop commodities that are the leading sectors in the agricultural sector of Gorontalo Province. However, the condition of Gorontalo province, which is located near the equator, has a fairly hot air temperature ranging from 260°C - 280°C, with an average air humidity of 81.74%. In 2019

Gorontalo Province experienced a long drought. Meteorology, Climatology and Geophysics Agency monitored that the drought that occurred during 2019 was longer than the previous year. As a result, corn and rice plants experience drought and crop failure, resulting in reduced crop productivity. Changes in physiological processes due to drought stress are the behavior of photosynthesis, respiration, transpiration, prosyntate partitioning, nutrient, carbohydrate metabolism, as well as hormonal balance and chlorophyll content (Prasad et al., 2008). According to Petrović et al. (2019) Drought stress factors can limit plant productivity and can affect various morphological, physiological, and molecular changes in plants that can reduce the quality of plant production.

Drought stress factors need to be taught to students, to serve as additional information and education in understanding and finding solutions when plants experience drought stress. Indicators of drought stress factors are presented in the form of learning tools in the form of student worksheets to support the learning process. Student worksheet can direct learners to find concepts through their own activities or in working groups (Rando, 2016). So that through the use of student worksheet, problems and solutions when plants experience drought stress can be understood by students. Thus the author wants to conduct research on the development of learning tools in the form of student worksheet based on the study of drought-stressed plants. Furthermore, the student worksheet is collaborated with the growth and development material Basic Competencies 3.1 explaining the influence of internal factors and external factors on the growth and development of living things, and Basic Competencies 4.1 compiling a report on the results of experiments on the influence of external factors on the growth and development process.

METHODS

This research is design-based research that explains the process of developing student worksheet on the material growth and development of drought-stressed plants. Student worksheet development was carried out using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) development model. According to Sari et al. (2017), ADDIE is a development model that is easy to use and easy to apply in a curriculum that teaches about knowledge, attitudes, and skills. The following schematic steps of the ADDIE development model is presented in Figure 1.

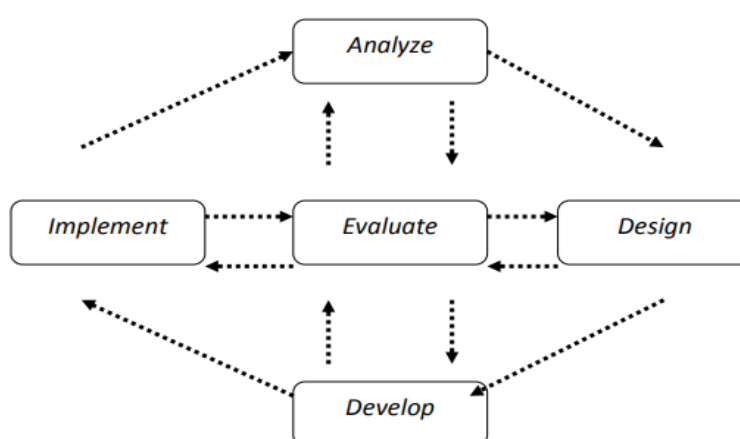


Figure 1. Schematic of the steps of the development model (Tegeh & Kirna, 2013)

Analysis

In the analysis stage, five things are carried out, namely needs analysis, analysis of learner characteristics, curriculum analysis, material analysis and analysis of learning devices. The analysis stage is carried out through interviews with biology teachers and initial observations at school.

Design

At this stage, the initial design of the student worksheet based on the study of drought-stressed plants was produced. The preparation of the student worksheet begins with the content design. The display in the learning steps, especially on the student worksheet, uses pictures of food plants that experience drought stress. The plants shown in the picture are easy to know and close to the students' environment. The student worksheet developed uses the Problem Based Learning (PBL) learning model.

Development

The development stage is a stage in conducting validation and revision that has gone through the design of the previous manufacture. In this stage, the student worksheet was validated by three validators consisting of two biology lecturers and one biology teacher from Senior High School 1 Tapa.

Implementation

At this stage, a limited scale trial was conducted on students, on the student worksheet developed.

Evaluation

The evaluation stage is the final stage in the ADDIE development model. Evaluation is a process carried out to provide value to learning programs (Zhang et al., 2011). This stage is carried out to correct deficiencies in the student worksheet developed.

This research was conducted by 20 students of 12th grade Science 1 of Senior High School 1 Tapa, Bone-Bolango District, Gorontalo Province. To conduct a trial, it needs to be tested on 10-20 students, if less than 10 people, the data obtained does not describe the target population, and if it exceeds 20 people, the analysis in group evaluation is less useful (Putri & Ranu, 2019). Therefore, researchers used 20 students as the subject of a limited trial of student worksheet development of the material of growth and development of drought-stressed plants.

There are five data collection instruments used, namely the first validation sheet. The validation sheet is used by validators to provide an assessment of the student worksheet developed so that the student worksheet can be said to be suitable for use in the learning process. The rating scale in the validation sheet uses a Likert Scale. The scale in the validation assessment is "4" is worth very good, "3" is worth good, "2" is worth quite good, and "1" is worth less good. Based on this scale, the percentage of validation from experts is calculated using the formula:

$$\text{Validity} = \frac{\text{Total number of scores from all validators}}{\sum \text{highest score}} \times 100\%$$

From the results of the calculations carried out, it can be interpreted into the validity criteria in Table 1 as follows:

Table 1. Validity criteria

Criteria	Validity presentation (%)
Very Valid	86-100
Valid	71-85
Moderately valid	56-70
Less Valid	41-55
Not Valid	<40

In the process of analyzing the practicality of the student worksheet developed, three instruments were used in data collection consisting of a student response questionnaire sheet, a student activity sheet, and a learning implementation sheet.

Students' response questionnaire analysis

The analysis of students' response questionnaire is intended to determine the opinion of students on the product development to produce a device that is suitable for use in learning. The scale criteria in the assessment of students' responses are "4" is worth strongly agreeing, "3" is agreeing, "2" is disagreeing, and "1" is worth disagreeing (Septiana et al., 2022). Then the score of each learner response is calculated using the formula:

$$P = \frac{f}{N} \times 100\%$$

From the calculation of the percentage of student response questionnaires, then interpreted in the criteria in Table 2 below:

Table 2. Interpretation of students' questionnaire scores

Criteria	Average score (%)
Very good	81,25-100
Good	62,5-81,25
Less	43,75-62,5
Not good	25-43,75

Analysis of student activity

Analysis of learner activity is obtained through observation of the overall learner actively in the learning process. Assessment of learner activity is in the form of a checklist with scoring using a Likert Scale, which is "4" worth very good, "3" worth good, "2" worth quite good, and "1" worth less good. Then the results obtained from activity observations are calculated using the formula:

$$\text{Analysis of student activity} = \frac{\text{sum of scores}}{\text{maximum score}} \times 100\%$$

From the results of the calculation of the analysis of students' activities, then interpreted in the categories in Table 3 below:

Table 3. Learner activity rating categories

Criteria	Score (%)
Not good	0-20
Less	21-40
Good enough	41-60
Good	61-80
Very good	81-100

Analysis of learning implementation

This analysis is used to assess the implementation of learning by teachers according to the criteria made. This observation uses the answers Yes score 1 and No score 0. The analysis data obtained uses the formula:

$$\text{Percentage (P)} = \frac{\text{Number of Yes answer scores}}{\text{Number of aspects observed}} \times 100\%$$

From the results of the calculation of the learning implementation analysis, it is then interpreted in the categories in table 4 below:

Table 4. Categories of learning implementation based on Yazid et al. (2016)

Category	Implementation presentation
Very good	P > 90%
Good	80% < P < 90%
Good enough	70% < P < 80%
Less	60% < P < 70%
Not good	P < 60%

In the process of analyzing the effectiveness of the student worksheet developed, an instrument is used in data collection in the form of a Learning Outcome Test (LOT) of student learning outcomes obtained through Pre-test and Post-test. Data on students' understanding is calculated using the following formula:

$$\text{LOT} = \frac{\text{Number of scores obtained}}{\text{Maximum Score}} \times 100$$

After analyzing the results of the Pre-test and Post-test, it will then be analyzed using the N-Gain test. The following is as the N-Gain Formula:

$$N - \text{Gain} = \frac{\text{Scor Posttest} - \text{scor Pretest}}{100 - \text{scor pretest}}$$

The results of the N-Gain calculation then categorized into three categories in Table 5:

Table 5. N-Gain criteria based on Mustofa et al. (2019)

Score N-Gain	Gain normality criteria
$0,70 \leq \text{N-Gain}$	High
$0,30 \leq \text{N-Gain} < 0,70$	Medium
$\text{N-Gain} < 0,30$	Low

RESULTS AND DISCUSSION

This research is a development research that aims to produce a product to support the learning process in the classroom. The product produced in this study is a learning tool in the form of the student worksheet on the material of growth and development of drought-stressed plants. The results of the revision of the student worksheet development in the growth and development of drought-stressed plants can be described as follows:

Analysis

The first stage in development research is the analysis stage. The results of this analysis can be used as a guide in the development of the student worksheet on the growth and development of drought-stressed plants. Analysis is carried out through the initial observation stage at school. There are four things that are done in the analysis stage, namely analyzing the characteristics of students, analyzing curriculum, analyzing materials, and analyzing learning tools.

The results of the analysis of the characteristics of students conducted in 12th grade of Senior High School 1 Tapa, namely, students tend to experience difficulties in the learning process. The difficulty experienced by students is in understanding a material. Furthermore, in solving a problem, students have difficulty so that it has an impact on learning outcomes.

Learners are more passive and cannot quickly identify examples of growth and development of a plant used in learning, especially growth and development material. The learning process, especially biology subjects that are carried out in the last hour of learning, makes the learning process in the classroom ineffective, students are more focused on waiting for the learning hours to end than paying attention to the material being taught.

The curriculum analysis stage aims to find out what curriculum is applied at Senior High School 1 Tapa. Based on the results of the interview, Senior High School 1 Tapa has implemented 2013 curriculum (K-13). The implementation of K13 curriculum has not been implemented optimally because the learning process in the classroom is still teacher-centered.

The next stage is material analysis. Based on the results of the analysis carried out in the learning process, the subject matter presented by the teacher is still focused on existing modules and printed books. For example, in the growth and development material, in the learning process in the classroom the plants used in the material still use examples of plants contained in the package book. There is no use of plants in the surrounding environment as an example of growth and development material.

The last stage is the analysis of learning tools used in the process of teaching and learning activities. student worksheet uses the discovery learning model. However, the learning process is not in accordance with the steps in the Discovery Learning model. The student worksheet used in the learning process is only in the form of five- to ten-digit questions. Especially for the material of growth and development, the student worksheet used is only the result of photocopying, so that the display of plant colors becomes unclear. The student worksheet used is not in accordance with the syntax of the learning model used.

Design

This stage is carried out to design learning tools that will be developed including student worksheet. At this stage, the initial design of the student worksheet on growth and development material combined with growth and development material in drought-stressed plants was produced. The preparation of the student worksheet begins with the creation of content design. The display in the learning steps, especially on the student worksheet, uses pictures of food plants that experience drought stress. The plants shown in the picture are easy to recognize and close to the students' environment. Student worksheet developed using the Problem Based Learning (PBL) model.

Development

The development stage is the stage in making lesson plans and student worksheet on growth and development material. The development stage is done with three stages, namely validation, revision, and limited scale trials. The results of prior version and the revision of the student

worksheet development in the growth and development of drought-stressed plants can be seen in Figure 1 and 2.

Membimbing Penyelidikan Individu ataupun Kelompok

Untuk melakukan percobaan tentang pengaruh air/ kadar air terhadap pertumbuhan tanaman jagung. Perhatikan langkah-langkah berikut ini:

- Menyiapkan semua alat dan bahan
- Memberikan tanah pada masing-masing polyback dengan ukuran yang sama
- Menanam biji jagung dalam 3 buah polyback dengan jumlah yang sama
- Memberikan pupuk kompos pada masing-masing polyback dengan jumlah yang sama
- Memberikan label I, II, dan III pada masing-masing polyback
- Memberikan air pada masing-masing polyback kecuali polyback label III, dengan ukuran sebagai berikut:
 - Polyback I, 187 ml
 - Polyback II, 125 ml
 - Polyback III, tidak diberikan air
- Mengamati perbedaan pertumbuhan tanaman jagung dengan indikator: tinggi batang, dan jumlah helaian daun pada ketiga polyback tersebut selama 8 hari.
- Mencatat hasil Pengamatan pada tabel dibawah ini!

1.2. Tabel Pengamatan

No.	Hari/tanggal	Tinggi Batang			Jumlah Daun		
		P. 1	P. 2	P. 3	P. 1	P. 2	P. 3

Figure 1. Student worksheet before revised

Validator and practitioner suggestions for student worksheet before revised, include: (a) There are still many technical writing errors that must be corrected; (b) The instructions on the student worksheet should use the command word instead of verbs. Verbs are used when making reports if asked the sequence of steps taken; (c) Determination of activity steps in the PRSP should use numeric or letter symbols; (d) Pay attention to the identity/attribute used for the two observation indicators, it should be differentiated, do not use the identity of the letter P in both observation indicators.

LANGKAH
3

MEMBIMBING PENYELIDIKAN INDIVIDU ATAUPUN KELOMPOK

Untuk melakukan percobaan tentang pengaruh air/ kadar air terhadap pertumbuhan tanaman jagung. Perhatikan langkah-langkah berikut ini:

- a. Menyiapkan semua alat dan bahan
- b. Setelah semua bahan siap, isi masing-masing polyback dengan tanah, dengan ukuran yang sama.
- c. Rendamlah biji jagung yang akan ditanam didalam gelas aqua bekas selama 30 menit sebelum kegiatan praktikum.
- d. Tanamlah biji jagung dalam 3 buah polyback dengan jumlah yang sama (3 biji/ polyback).
- e. Berikan label I, II, dan III pada masing-masing polyback
- f. Berikan air pada masing-masing polyback kecuali polyback label III, dengan ukuran sebagai berikut:

- g. Amati pertumbuhan tanaman jagung dengan indikator: tinggi batang, dan jumlah helaian daun pada ketiga polyback tersebut selama 8 hari.
- h. Catat hasil Pengamatan pada tabel dibawah ini!

Tabel 1.3 Tabel Pengamatan Tanaman Jagung

No.	Hari/tanggal	Tinggi Batang			Jumlah Daun		
		T. 1	T. 2	T. 3	D. 1	D. 2	D. 3

Figure 2. Student worksheet after revised

The instructions for conducting the experiment in the student worksheet have been revised according to the suggestions of the validator (Figure 2). Then the writing and use of symbols for actionable steps in the student worksheet which still have errors have been corrected. As well as

for the identity of the two observation indicators have been distinguished "T" for plant height and "D" for the number of leaves.

Validation analysis results (Student worksheet)

The validity of the student worksheet on growth and development material that has been developed can be determined based on the assessment on the validation sheet that has been filled in by three validators consisting of two lecturers from the Biology department of Gorontalo State University as material expert validators and educational expert validators, and one Biology teacher as a practitioner validator. The following are the results of the validity test of student worksheet development on drought-stressed plant growth and development material presented in Table 6.

Table 6. Validator's assessment of the validity of the student worksheet based on drought-stressed plant studies on growth and development material

No	Aspects observed content quality	Validator			Average	Percentage (%)	Description
		I	II	III			
1	Correctness of concept	3	3	4	3,33	83,33	Valid
2	Depth of concept	4	3	4	3,66	91,66	Very valid
3	Appropriateness of language	4	3	4	3,66	91,66	Very valid
4	Quality of completeness/ supporting materials	3	4	3	3,33	83,33	Valid
5	Aspects observed	4	3	4	3,66	91,66	Very valid

Table 6 shows the results of the student worksheet validity that the average value of the 5 aspects of the assessment given by three validators obtained results of 3.33 to 3.66 with a percentage of 83.33% to 91.66%. With these percentage results, it can be categorized that the student worksheet is in the valid and very valid category. Table 6 shows the results of the student worksheet validity that the average value of the 5 aspects of the assessment given by three validators obtained results from 3.33 to 3.66 with a percentage of 83.33% to 91.66%. With these percentage results, it can be categorized that the student worksheet is in the valid and very valid category. The student worksheet developed is in accordance with the requirements of the compiler so that it can be said to be valid. This is in line with the opinion according to Salam et al. (2021) which states that the student worksheet developed must meet the requirements from the aspects of didactics, construction, technical, and characteristics.

Based on the analysis of the validation results, it shows that what has been developed is in accordance with the provisions, all components in the preparation of student worksheet are complete and listed, and are in accordance with the steps of student worksheet development, so that the student worksheet developed can be used as a supporting device in the learning process.

Student worksheet practicality analysis results

The practicality of the development of the student worksheet of the material of growth and development of drought-stressed plants can be assessed from the implementation of learning, increased student activity, and student response to the student worksheet developed. According to Yusuf et al. (2019) which states that in measuring the practicality of learning devices, it is seen from observations of student learning activities, student responses, and learning implementation. The opinion according to Zagoto & Dakhi (2018) which states that student worksheet is said to be practical if students easily use and do the tasks on the student worksheet and the teacher is also facilitated in guiding the learning process, so that time in learning becomes effective.

The implementation of student worksheet in learning

The results of the observation of learning implementation in the limited scale trial were obtained through the assessment of the learning implementation observation sheet. The score was given by one biology teacher as an observer. The assessment criteria consisted of 21 aspects which were divided into three learning activities including introductory activities, core activities and closing activities. The results of learning implementation at the first and second meetings can be seen in Table 7.

Table 7. The percentage implementation of learning

Meeting	Average	Percentage (%)
I	100%	100%
II	100%	100%

Table 7 shows the data from the observation of learning implementation conducted for 2 meetings. The first meeting of learning implementation obtained a presentation of 100%, and the second meeting obtained the same presentation of 100%. The overall results of the two meetings conducted obtained as an average result of 100% with a very good category. Hasibuan et al. (2019) stated that learning tools can be said to be practical if the implementation of learning is at least in good criteria. Based on the explanation described above, the student worksheet based on the study of drought-stressed plants is practically used in learning.

Students' activities

Observation of students' activities was carried out to determine the practicality of the student worksheet based on the study of drought-stressed plants on growth and development material. Assessment of learner activity was carried out 2 times a meeting. Assessment of learner activity uses a learner activity observation sheet instrument consisting of 10 aspects of assessment. The learner activity sheet was filled in by three Biology teachers as observers during the learning process. The percentage of observation of students' activities for 2 meetings is presented in Figure 3.

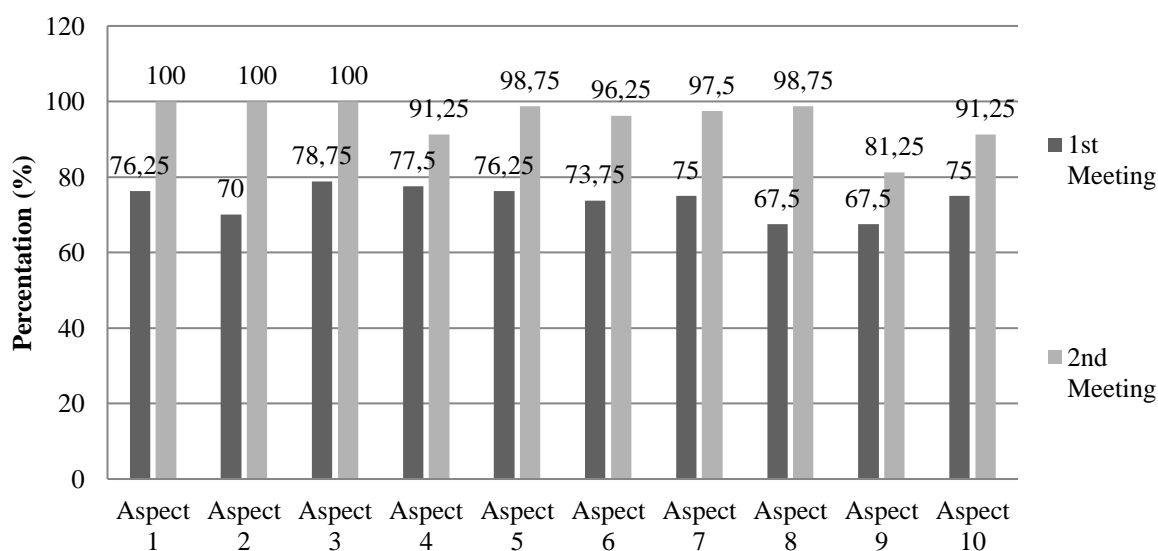


Figure 3. Graph of student activity

Based on the results of observations of student activities at meeting me, the results obtained were 67.5% - 78.75% in the good category. Furthermore, at meeting II the results obtained were 81.25% - 100% with a very good category. Learner activity is very important in the learning process. Learner activity in learning must be improved, especially in increasing students' understanding of the material. Based on the results of observations of student activities at meeting me, the results obtained were 67.5% - 78.75% in the good category. Furthermore, at meeting II the results obtained were 81.25% - 100% with a very good category. Learner activity is very important in the learning process. Learner activity in learning must be improved, especially in increasing students' understanding of the material.

Students response toward worksheet

The results of students' responses were obtained through the instrument of the results of the questionnaire students' responses to the learning process using the student worksheet developed. According to Van der Veer et al. (2013), a questionnaire is a list of statements given to people who respond (Respondents) in accordance with user requests, used to find information on a problem without worrying if the respondent gives an answer that is not in accordance with reality in filling out a list of statements. The following results of the learner response questionnaire are presented in Figure 4.

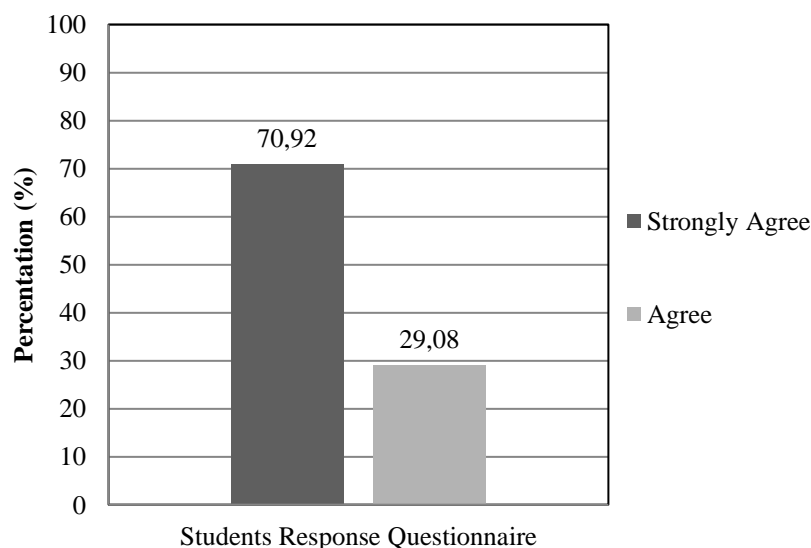


Figure 4. Graph of student response questionnaire

Based on the graph of the response analysis results of 20 students of class XII IPA 1 SMA Negeri 1 Tapa, out of 14 indicators, the average value of Agree is 29.08%, and Strongly Agree is 70.92%. Based on the results of these presentations when viewed in the percentage criteria, it gets good criteria.

This is because the learning process is supported by simple experimental activities that have been collaborating and carried out in groups through the guidelines contained in the student worksheet so that students become motivated to learn. As in the research of Rosmalinda et al. (2013) suggested that the response of students to practicum activities obtained very good results because when the practicum took place all students looked serious in doing the practicum so that it could be said that practicum activities really motivated students to learn.

Student worksheet effectiveness analysis results

Analysis of the effectiveness of student worksheet is done to determine the quality of the student worksheet developed. The effectiveness of the student worksheet based on the study of drought-stressed plants can be obtained through the learning outcomes of students, namely students first fill in the Pre-test question before learning and fill in the Post-test question after learning. According to Effendy & Hamid (2016) states that giving a pre-test and post-test in learning activities can be used as an organizer in learning progress (Advanced Organizations) is useful as a link between what students learn "now" and what will be learned. Pre-test and Post-test were completed by 20 students. The results of the analysis of the Pre-test and Post-test tests of students' concept understanding are presented in Figure 5.

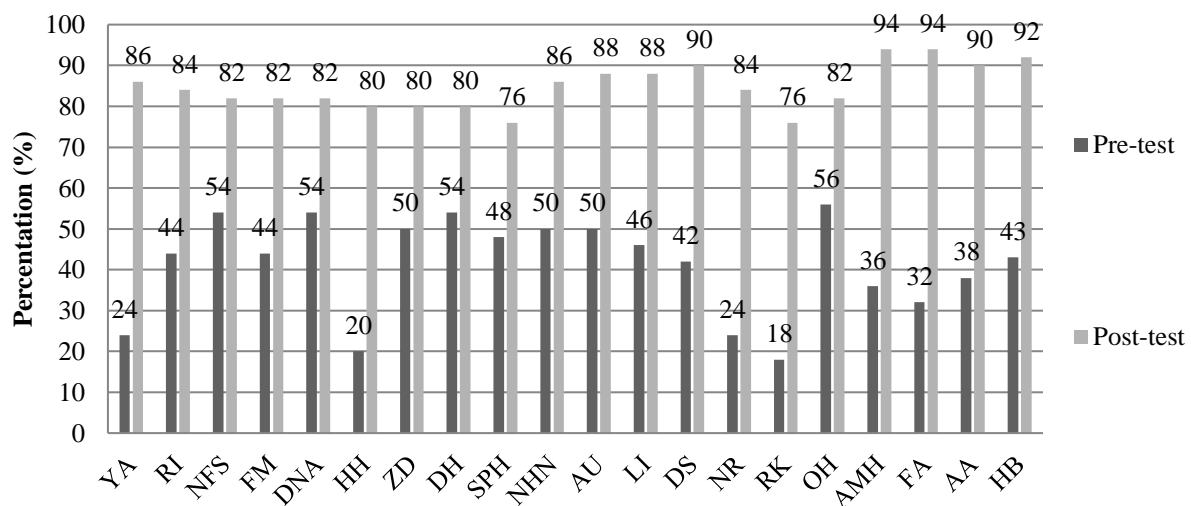


Figure 5. Results of pre-test and post-test analysis

Figure 5 shows the results of students' understanding of the growth and development material based on Pre-test and Post-test scores. The Pre-test score of students obtained the lowest score of 18 and the highest score of 56 with the criteria for the completeness value that students should achieve, namely 75-100. Meanwhile, the Post-test score obtained the lowest score of 76 and the highest score of 94. According to Lufri et al. (2020) that learning by using an effective student worksheet can improve student learning outcomes so that the majority of students are able to achieve completeness. This can be proven by the increase in learning outcomes of 20 students.

The increase in student learning outcomes after being given the Pre-test and Post-test can be seen by analyzing the N-gain calculation. According to Ramadhana & Hadi (2022) that the N-Gain test is carried out to see the increase in student learning outcomes before (pre-test) and after (post-test) in learning. The N-gain value obtained by students in two meetings in the learning process of growth and development material obtained a value of 0.81 with a high category, and the N-Gain score (%) was 81.35%. This shows that the student worksheet developed can show an increase in student learning outcomes.

According to Listiyawati (2012), if there is an increase in the percentage of N-gain values on the learning outcomes of students who use integrated learning tools, it can be said that these learning tools can improve student learning outcomes and can be used in the learning process. The following N-Gain calculation results are presented in Table 8:

Table 8. N-Gain calculation results

Respondent	Average		N-Gain score	N-Gain score (%)
	Pre-test (%)	Post-test (%)		
20	41,3	84,4	0,81	81,35

Based on the results of the pre-test and post-test as well as the N-gain results above, the drought-stressed plants student worksheet developed using the Problem Based Learning (PBL) learning model can train students in analyzing problems and finding solutions if a plant experiences drought stress. In addition, this student worksheet can be used and can improve the learning outcomes of students in the learning process, especially in the material growth and development in 12th grade of Senior High School 1 Tapa.

CONCLUSION

Student worksheet based on drought stressed plant study of growth and development material has met the valid, practical and effective categories. With validation results of 83.33% to 91.66% with valid and very valid categories. The results of the practicality analysis seen from the implementation of the learning obtained an average value of 100% with a very good category, Students' activities at meeting one obtained results of 67.5% - 78.75% in the good category, meeting two obtained results of 81.25% - 100% in the very good category and students' questionnaires reached a score of 70.92% in the good category. The effectiveness analysis is seen from the pre-test and post-test scores with an average pre-test value of 41.3% and post-test of 84.4%, the increase in learning outcomes obtained a percentage value of N-Gain of 81.35. So that the product can be used in the biology learning process of plant growth and development material.

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