

## DEVELOPMENT OF ELECTRONIC WORKSHEETS WITH ENVIROMENTAL APPROACH IN STRUCTURE AND FUNCTION PLANT TISSUES MATERIAL TO TRAIN CRITICAL THINKING OF GRADE 2<sup>nd</sup> HIGH SCHOOL STUDENTS

*Pengembangan E-LKPD melalui Pendekatan Lingkungan Materi Struktur dan Fungsi Jaringan Tumbuhan untuk Melatihkan Berpikir Kritis Siswa Kelas XI SMA*

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### Abstract

The Student worksheet is one of the teaching materials that are useful for supporting learning activities in the form of observation, research, and experiments aimed at solving problems that are related to living things and the environment. This research is development research using the ADDIE method (Analysis, Design, Development, Implementation, and Evaluation). The product developed is an electronic Student Activity Sheet. The purpose of this study was to develop electronic student worksheet teaching materials, describe the validity of electronic student worksheets, and test their practicality using student and teacher response questionnaires. The validity of the electronic student worksheet is reviewed from the results of the validation which were assessed by the material expert lecturers and education experts. Practicality is viewed from the response of the teacher as a practitioner and 11 students of 2nd-grade at Al Azhar senior high school Menganti Gresik. Data analysis techniques were carried out using quantitative description methods. The results of the study show that the electronic student worksheet is declared valid with a score percentage of 96.6% in the very valid category. an electronic student worksheet is also stated to be very practical given the teacher's response of 100% and students of 98.5%. thus electronic student worksheet with an environmental approach to the material structure and function of plant tissue to train students' critical thinking is declared valid and practical for teaching and learning activities.

**Keywords:** Electronic worksheet, Stucture and function of plant tissue, Enviromental approach, Critical Thinking.

### Abstrak

LKS merupakan salah satu bahan ajar yang berguna untuk menunjang kegiatan pembelajaran berupa observasi, penelitian, dan eksperimen yang bertujuan untuk memecahkan masalah yang berkaitan dengan makhluk hidup dan lingkungan. Penelitian ini merupakan penelitian pengembangan dengan menggunakan metode ADDIE (Analysis, Design, Development, Implementation, and Evaluation). Produk yang dikembangkan adalah Lembar Kegiatan Siswa elektronik. Tujuan dari penelitian ini adalah mengembangkan bahan ajar LKS elektronik, mendeskripsikan keabsahan LKS elektronik, dan menguji kepraktisannya dengan menggunakan angket respon siswa dan guru. Validitas LKS elektronik ditinjau dari hasil validasi yang dinilai oleh dosen ahli materi dan ahli pendidikan. Kepraktisan dilihat dari respon guru sebagai praktisi dan 11 siswa kelas 2 SMA Al Azhar Menganti Gresik. Teknik analisis data dilakukan dengan menggunakan metode deskripsi kuantitatif. Hasil penelitian menunjukkan LKS elektronik dinyatakan valid dengan persentase skor 96,6% dalam kategori sangat valid. LKS elektronik juga dinyatakan sangat praktis mengingat respon guru 100% dan siswa 98,5%. Dengan demikian LKS elektronik pendekatan lingkungan materi struktur dan fungsi jaringan tumbuhan untuk melatih berfikir kritis siswa dinyatakan valid dan praktis untuk kegiatan belajar mengajar.

**Kata Kunci:** LKPD, Struktur dan Fungsi Jaringan Tumbuhan, Pendekatan Lingkungan, Berpikir Kritis.

## INTRODUCTION

Critical thinking is one of the several skills demands that students must have. According to Redhana (2019), 21st-century learning requires the implementation of the 2013 curriculum, where students are required to learn by referring to 4C (Collaboration, Creativity, Communication Critical Thinking) skills. Critical thinking is the skill of students in processing information, analyzing and interpreting the results of observations, reasoning, experience, and even communication to make decisions whether the information that has been obtained is credible and the truth is real (Purwati *et al.*, 2016). Providing experience, observation, and reasoning in learning will influence students in critical thinking, the importance of critical thinking skills is a special concern in the world of education.

Survey results from TIMSS (Trends in International Mathematics and Science Study) and PISA (Program for International Student Assessment), the quality of education in Indonesia is still low (TIMSS, 2007; PISA, 2009 in Norhasanah, 2018). Currently in Indonesia, the ability of students' level of science was ranked 48 out of 56 countries, and the ability to solve problems (Problem Solving) and critical thinking were ranked 39 out of 40 countries. Based on data on the low achievement of critical thinking described above, it becomes a reference that there is a need for some efforts to train critical thinking skills in today's education system. Preparing students to be able to think critically is one of the main goals in the system of higher education (Changwong *et al.*, 2018).

Biology learning reveals natural phenomena that are related to concrete scientific facts and facts (Supriadi and Lismawati, 2018). The characteristics of biological material require high-order thinking skills, namely thinking critically, analytically, logically, and also requiring combinatorial or relational thinking (Sudarisman, 2015). The material for the structure and function of plant tissue reveals the relationship between the plant's living environment and the tissue structure that is in it. The material with the object of observing the anatomy of plant tissue structures has been packaged in an Electronic worksheet which is composed only of basic theories and concepts, not leading to a critical thinking level. So far, the electronic worksheet that has been compiled not represented an electronic worksheet with an environmental approach that trains critical thinking on the material of plant tissue structure and function. The electronic worksheet that was prepared previously was the worksheet to train critical thinking but on the material of environmental change (Puspitadewi, 2014).

A worksheet is one of the teaching materials that are useful for supporting learning activities in the form of observations, research, and experiments aimed at solving problems that are related to living things and the environment (Rohmawati, 2018). The worksheet will be packaged electronically because it is adjusted to the current conditions specifically the COVID-19 pandemic which requires online learning so that electronic teaching materials greatly support distance learning called daring. The electronic worksheet will package that contain problems adapted from the surrounding environment, particularly the phenomena of plants that have variations in their anatomical structures. Therefore, studying plant anatomy which contains plant tissue structures that can be seen, recognized, and can be sensed by its unique phenomena, reflects learning with an environmental approach.

An environmental approach is an approach to the learning process, which in the process utilizes the environment as a learning tool and resource (Lily, 2008). Utilization of the environment can result in a more meaningful learning process because the conditions showed by students are real (Uno *et al.*, 2013). The environmental approach itself can train students to understand the role of the environment in science, learning that raises problems from the environment can train students to think globally (Eliyanti *et al.*, 2018).

The indicators of the environmental approach used are as follows: Teaching materials or topics are presented based on the phenomena found in the student's environment, specifically by utilizing plants in the daily environment. This phenomenon is in the form of anatomical variations of plant tissue structure based on where it lives. Plants that are used as learning resources are plants that are often encountered by students in their daily environment. Students are directed to explore through a Virtual Laboratory and make observations of plant tissue in their daily environment. Learning with an environmental approach can help students solve problems and encourage students to improve higher-order thinking skills (HOTS), That's way one of the critical thinking skills (Usmeldi *et al.*, 2017).

Based on Pangaribowosakti (2014) the indicators of critical thinking abilities are classified into several categories, including providing simple explanations (elementary clarification), building basic skills (basic support), concluding (inference), providing further explanations (advanced clarification), developing strategies and tactics (strategy and tactics). Among these indicators, the critical thinking indicator that will be trained later is the ability to provide simple explanations

(elementary clarification), where there are points to analyze arguments, particularly in the form of identifying a problem then providing an evaluation analysis related to solving the problem.

The electronic worksheets that will be compiled will have an exploration feature through a Virtual Laboratory, which is a feature that attracts students to explore various plant tissues (sclerenchyma and aerenchyma) in a different place of life, and also the tissues in the epidermal derivatives (stomata) of plant leave around the students' daily environment. Then proceed with analyzing the results of the exploration. This feature represents the achievement of critical thinking indicators. This is an inferred train of critical thinking because students identify environmental problems, correlate, analyze and provide rational thinking for the problems presented. Following Cahyono's opinion (2015) the characteristics of critical thinking include identifying a problem and solving it with a specific goal. Analyze and generalize based on facts and be able to make conclusions related to solving a problem with systematic, accurate, and rational arguments.

Based on the background, it is required to develop the electronic worksheet with an environmental approach, describe the validity of electronic student worksheets, and test their practicality using student and teacher response questionnaires.

## METHOD

This research is development research that aims to develop an electronic worksheet of biology subjects for high school students in class 2<sup>nd</sup> based on the 2013 curriculum. This research uses the ADDIE development model proposed by (Mulyatiningsih, 2016). This model consists of 4 stages, this is Analysis, Design, Development, Implementation, and Evaluation. The subject of this research is the student activity sheet based on an environmental approach on the Material of Structure and Function of plant tissues. Validity is tested by material expert lecturers and education experts also the teacher of the biology of senior high school. Then in the practicality test to 11 students of class 2<sup>nd</sup> Science Al Azhar Senior High School in Menganti Gresik with questionnaires respons .

The research instrument used the validation sheet which contained questions about the requirements of a good electronic worksheet, specifically didactic requirements, design construction, environmental approach indicators, critical thinking indicators, and compliance with electronic formats. The data collection method used was by distributing validation instruments

which were carried out to determine the theoretical feasibility of student activity sheets. The validation score uses the 1-4 Likert scale criteria. The percentage of an average score can be calculated using the formula:

$$P \text{ Validation score } (\%) = \frac{\sum \text{Score}}{\text{Maximal score}} \times 100$$

Then the data is analyzed and the results will be analyzed based on the Likert scale calculation according to Riduwan (2016) as in Table 1.

**Tabel 1.** Criteria Validation of Electronic Worksheet

Percentage Score validity (%)	Category
0-20	Invalid
21-40	Less Valid
41-60	Valid Enough
61-80	Valid
81-100	Very valid

(Riduwan, 2016)

The Practicality test uses the method of distributing student and teacher response questionnaires. Student response questionnaires are packaged in Google Formulir using the Guttman scale. The practicality score uses the 1-4 Likert scale criteria. The percentage of an average score can be calculated using the formula:

$$P \text{ Respons score } (\%) = \frac{\sum Ya' \text{ Answer}}{\text{Maximal score}} \times 100$$

Then the data were analyzed and the results will be analyzed according to Riduwan (2013) as in the calculations obtained in Table 2.

**Tabel 2** Interpretation Criteria

Worksheet Practicality Percentage (%)	Criteria
≤25-40	Not practical
41-55	Less practical
56-70	Practical enough
71-85	Practical
86-100	Very practical

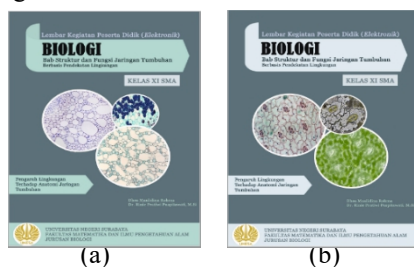
(Riduwan, 2013)

## RESULT AND DISCUSSION

This study produced an output of an electronic worksheet with an environmental approach to the structure and function of plant tissues to train valid and practical empirical and theoretical thinking of critical thinking for 2nd high school students. This study resulted in 2 electronic worksheets. The electronic worksheets that were successfully developed contained material on the Structure and Function of the plant tissues by raising the topic of plant tissues (Sklerenkim and aerenchyma) for electronic worksheet 1, and the topic of epidermal derivatives (stomata) for electronic worksheet 2. The results



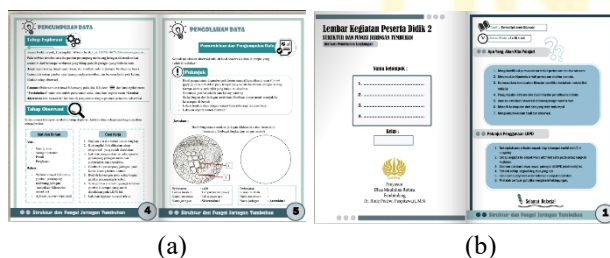
of the development of two electronic worksheets can be seen in Figure 1.



**Fig. 1.** (a) Electronic Worksheet 1 (b) Electronic Worksheet 2

Both electronic worksheets have several stages based on the Discovery Learning model with an environmental approach. An indicator of the environmental approach used of learning materials or topic was adapted from plants that are encountered every day, namely of a phenomenon of variations in the structure of plant tissues that live in different places. Each electronic worksheets is arranged in several stages. Starting from the "stimulation" stage, there is an explanation in the form of a problem that exists in the surrounding environment, which aims to attract students to construct problem formulations based on reading.

The stages of "Formulating Problems" and "Formulating Hypotheses" invites students to formulate problems related to plant tissues based on the environment in which they grow, as well as formulate temporary assumptions based on the problem formulations that have been made. The "Exploration" stage invites students to be able to find and identify their discovery. The "Analysis" stage invites students to logically analyze the results of exploration, and the last stage "Formulating Conclusions" invites students to conclude what has been obtained based on the activities carried out in the previous stage. All of stages in the electronic student worksheets attract students to follow the interactive teaching and learning activities. The content of both electronic worksheets can be seen in Figure 2.



**Fig. 2 :** (a) Content of electronic worksheet 1 (b) Content of electronic worksheet 2

In electronic worksheet 1, there is a "Virtual Laboratory" feature that functions as a student

exploration page to replace practicum in a real laboratory (online practicum). This feature is found in the "Exploration" stage in an electronic worksheet, students are given a link that can lead to the website "Virtual Laboratory". This feature presents a cross-sectional image of plant tissue from various growth conditions, ranging from wet, dry, and well-drained environments. This facilitates students to see environmental phenomena concretely.

The unique characteristic of the electronic worksheet that has been developed is that it includes a virtual laboratory to replaced for real practicum, and by presenting cross-sectional images of plant tissues from various living environments, students can identify and analyze. This is intended to train higher-order thinking skills. As explained by Mahmuzah (2015), activities that contain critical thinking skills are identifying problems correctly, then analyzing what problems are the main points and how to find out the truth.

The electronic worksheets are designed using the Adobe Photoshop application and the layout in Microsoft Word then imported and converted using the Flip PDF Professional software. So that it becomes an interesting electronic worksheet and looks 3D (Three Dimensional), there are can be opened like a real worksheet. given the conditions of the COVID-19 pandemic, online learning requires innovative and not boring teaching materials. As stated by the Ministry of Education and Culture (2020) that educators must be able to create learning innovations and a pleasant atmosphere to study at home online.

Electronic worksheets which are prepared through an environmental approach to the material structure and function of plant tissue to train critical thinking have gone through the validation stage. The Electronic worksheet is validated to two validators, education expert lecturers and material experts. based on the content, language, and presentation components. The following are the results of the electronic worksheet validation recapitulation data with the environmental approach to the material structure and function of plant tissues to practice critical thinking for class 2<sup>nd</sup> senior high school students.

**Table 3.** The Result of Electronic Worksheet Validation

No	Criteria	Average (%)	Caterogy
1.	Presentation	94	Very valid
2.	Content	90	Very valid
	Enviromental Approach Aspect		

Critical Thinking Aspect	100	Very valid
3. Language	100	Very valid
<b>All Aspect Validation Percentage</b>	<b>96.6%</b>	<b>Very valid</b>

Based on the recapitulation of the electronic worksheet validation results with the environmental approach of structure and function plant tissues material, the overall score percentage is 96.6% with the very valid category. This interprets that the electronic worksheet that has been developed is suitable for use in the teaching and learning process. This is in line with Hidayah and Nurtjahyani's research (2018) that student worksheets with an environmental approach obtain very valid criteria with a percentage score of 84%.

The presentation aspect obtained a percentage score of 94%. This shows that the electronic worksheet presentation is appropriate. Illustration images are used following the concept, clear font size, and a title that is representative of the topic. However, it is not following the electronic format, because the electronic worksheet is only prepared in PDF format, not in the format on an application that can be accessed by certain hyperlinks. As explained by Sriwahyuni et al. (2019) electronic teaching materials must be arranged as attractive as possible and able to help clarify material that cannot be conveyed directly. The author has been able to solve this problem, by exporting the file immediately, using Flip PDF Professional.

The content aspect of the two electronic worksheets obtained a percentage score of 96%. This shows that the content aspects of the electronic worksheet are following the concept of the material chosen. The depth of the material used is following the concept. Conformity of the concept with indicators of critical thinking and environmental approaches. Critical thinking indicators can be seen at every stage of the electronic worksheet, from formulating problems to conclusions. Students are presented with a logical analysis of contextual problems, as well as an analysis of two variables due to consequences. Meanwhile, environmental approach indicators can be seen in exploration activities in the virtual laboratory, and plant phenomena with variations in tissue structure based on where they live. Plants that are used in teaching materials are plants that are the environment around students. However, in the stimulation section, Both validators are stated that the orientation did not lead students to the problem, because the explanatory sentences were specifically about the tissue structure to be discussed. In total, the content aspects of the two electronic worksheets

have been able to correlate the environmental approach with critical thinking. The environmental approach can make it easier for students to solve problems and encourage the improvement of higher-order thinking skills, one of which is critical thinking skills (Usmeldi *et al*, 2017). The electronic worksheets are also following the aspects of education, which can be used by students homogeneously. So the homogeneous's student can be a parameter of success in compiling the electronic student worksheet.

The linguistic aspect of the two electronic worksheets gets a perfect score percentage of 100%. This shows that the language, terms, and sentences used in the electronic worksheet are following the rules of writing EYD. According to Maulana and Suparman (2018) language in student activity sheets must be easy to understand because it determines the delivery of material. The linguistic aspect is also a constructive requirement of teaching materials that have criteria that are not double, easy to understand, and can be conveyed well (Rossa, 2019).

The validation process is carried out, there are several suggestions or input from the validators against the electronic worksheets that has been developed. Data suggestions from the validators are summarized in Table 4.

**Table 4.** Validator Suggestions

No.	Validator Suggestions
1.	Electronic worksheet 1 is given a brief description of the environmental approach
2.	Text that must-read is given regarding the influence of environmental factors on adaptation plant
3.	The "stimulation" section is given more explanation to lead students in constructing problems.
4.	Improved electronic worksheet format with additional access links, not just PDF
5.	Related to bibliography and grammar.

Based on the improvement table above, there are several suggestions from the three validators. After that, revisions are made according to the suggestions. The first suggestion has been added with a brief explanation regarding the description of the electronic worksheet with an environmental approach on the initial page before entering into electronic worksheet activities. The second suggestion has been added with a brief explanation of "External Links" about environmental factors to the response or adaptation of plants in anatomy. The third suggestion has been added an explanatory sentence regarding the different tissue structures due to differences

in plant life. Fourth input The electronic worksheet file format has been changed, which can be accessed via a link so looks 3D and interesting. Is converted and imported by Flip PDF Profesional Application. The link is as follows <https://online.flipbuilder.com/ppce/rmwi/> and electronic worksheet 2 <https://online.flipbuilder.com/ppce/dhbg/>. Then regarding the writing of the bibliography, it has been corrected based on the rules of writing the APA bibliography.

Validation test is carried out, then the practicality test with questionnaire method . This practicality test aims to see the practical of the student activity sheets that have been considered. In the practicality test using the questionnaire method, the electronic worksheet was assessed by one biology teacher and eleven homogeneous students. The results of the questionnaire responses of teachers and students to an electronic worksheet are presented in Table 5.

**Tabel 5.** Result of Respons Teacher and Student

No.	Aspect	Teacher (%)	Criteria	Students (%)	Criteria
1.	Presentat ion	100	Very practi cal	97.9	Very practical
2.	Content	100	Very practi cal	98	Very practical
3.	Langu age	100	Very practi cal	100	Very practical
<b>All Aspect Practicality Precentage</b>		<b>100</b>	Very practi cal	<b>98.5</b>	Very practical

Based on the results of the responses of teachers and students of electronic student worksheet, it was stated that it was practical because it obtained a percentage of the practicality of all aspects of 98.5% from students and 100% teacher with very practical criteria. This interprets that electronic student worksheets can be used practically in teaching and learning activities. Teaching materials that are presented practically and properly can make it easy for students to be interested and happy with the learning being carried out (Nyeneng, 2018).

This practicality is viewed from several aspects. The presentation aspect obtained a score of 97.9% from students and 100% from teachers, in the very practical category. This shows that the way of presenting the electronic student worksheet is following the format of electronic teaching materials. electronic student

worksheet can be opened like a real book, impressed 3D. This makes students not get bored quickly because they see interesting teaching materials. Nurhairunnisah's (2018) statement states that the more interactive the teaching materials used, the greater the learning motivation that is built-in students. The practicality of teaching material in terms of its format. The electronic student worksheet has used an electronic format that utilizes the Professional PDF flip application which provides an access link for students so that students can easily access it from anywhere. Especially in the condition of COVID-19 which requires learning from home, this electronic student worksheet is very practical to use. Then the material used in this worksheet is material that requires practicum so that students understand the material, but due to pandemic conditions, the practicum is replaced with virtual by only accessing the "virtual laboratory" website on this electronic student worksheet. This makes a practical solution for teachers and students to carry out practicum during a pandemic. Online learning activities can be easily accepted if there are interactive and illustrative teaching materials (Kim, 2020).

The content aspect obtained a score of practicality from the student questionnaire by 98% and the teacher by 100%. The categories obtained are very practical. This shows that the electronic student worksheet prepared is in accordance with the practicality indicators of teaching material. Practical teaching materials are those that can be used individually and suit the time used (Alfianika *et al.*, 2014). The electronic student worksheet with an environmental approach to the structure and function of plant tissue contains several learning steps that refer to the environmental approach indicators. Practicality can be seen in the results of the response questionnaire survey that all students can follow the electronic student worksheet stage well, as evidenced by 10 students answering "Yes" to indicators of critical thinking and indicators of environmental approaches. There was 1 student who answered "no" with the comment "The electronic student worksheet cannot lead me to formulate problems just by reading the text at the stimulation stage". This is in line with the validator's comments that the lack of detail in the sentence is stimulated so that it does not lead students to think about problems.

The practicality of the content of the electronic student worksheet is viewed from the critical thinking aspect, which presents several analysis questions related to student observation data. So that students actively express their opinions through these questions. It is practically used to capture students' critical opinions



because the questions asked are not too long and only have a small number. The electronic student worksheet is not complicated for the purposes and objectives at each stage. So that practicality appears in each phase used.

The language aspect obtains a score of 100% from the responses of teachers and students. This shows that the electronic student worksheet is very practical to be used in teaching and learning activities. As for the practicality of the language aspect, it is also a condition for the education of the content of teaching material. Therefore it is necessary to give more attention to the language used. Starting from the use of sentences, sentences do not contain multiple meanings, and the language used is easy to understand. This is in line with the statements of Maulana and Suparman (2018) which state that language that used in student activity sheets must be easy to understand because it determines the delivery of material and determine student understanding.

The result of this research is that electronic student worksheet has been developed that is valid in terms of content, presentation, and language. Stated that it is practical from the results of the teacher and student response questionnaires. This suggests that electronic student worksheet with an environmental approach can be used as appropriate teaching materials in the learning process. According to the koderi *et al.*, (2020) the teaching materials developed have been declared valid under the terms of didactic, construction, and language can be used in teaching and learning activities.

## CLOSING

### Conclusion

The electronic student worksheet with an environmental approach to the structure and function of plant tissue that has been developed is suitable for use in teaching and learning activities with the acquisition of a validation score of 96.6% with a total percentage of all aspects that have been declared very valid. The electronic student worksheet process is also stated to be practical, by obtaining a statistical score from the student response questionnaire of 98.5% and teacher 100%, with the achievement of all indicators of critical thinking and environmental approaches.

### Suggestion

There are suggestions from the researchers that it is hoped that the research can be continued for the implementation stage. So that the electronic worksheet with an environmental approach to the structure and function of plant tissue can be useful for both educators and students, it can be used as a reference for the

preparation of teaching materials with a similar approach for the future.

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