



The Potential of the Human Respiratory System e-Worksheet based on the Guided Inquiry in Empowering Critical Thinking Skills

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Abstract: The presence of the covid pandemic, technological advances, and the complexities of the 21st century demand renewal of teaching materials in schools. Guided Inquiry learning models can also bridge the empowerment of critical thinking skills. This study aims to: 1) describe the feasibility of the e-worksheet based on expert judgment, 2) describe the practicality of the e-worksheet based on the teacher's assessment, and 3) describe the results of the e-worksheet readability assessment by students. This development research refers to the ADDIE development procedure. However, this research was only carried out up to the development stage due to limitations. The results of the feasibility assessment by material experts, teaching materials experts, and linguists showed that the e-worksheet was categorized as valid with a score of 80.00, 74.00, and 90.00, respectively. Then, the teacher's assessment results showed that the e-worksheet was in the practical category, scoring 92.00 and 94.00. Finally, the student readability test results showed that the e-worksheet could be read well, with scores of 93.61 and 93.88. Thus, the respiratory system e-worksheet based on the developed guided inquiry model can be recommended to improve students' critical thinking skills.

Abstrak: Kehadiran pandemi covid, kemajuan teknologi, dan kompleksitas abad 21 menuntut pembaharuan bahan ajar di sekolah. Bahan ajar harus terintegrasi dengan model pembelajaran agar mampu menjembatani pemberdayaan keterampilan berpikir kritis peserta didik. Penelitian ini bertujuan untuk: 1) mendeskripsikan kelayakan Lembar Kerja Peserta didik (LKPD) elektronik berdasarkan penilaian ahli; 2) mendeskripsikan kepraktisan LKPD elektronik berdasarkan penilaian guru; serta 3) mendeskripsikan hasil penilaian keterbacaan LKPD elektronik oleh peserta didik. Penelitian merupakan jenis penelitian pengembangan yang mengacu pada prosedur pengembangan ADDIE. Namun, karena keterbatasan, penelitian ini hanya dilakukan sampai pada tahap develop. Hasil penilaian kelayakan oleh ahli materi, ahli bahan ajar, dan ahli bahasa menunjukkan bahwa LKPD elektronik materi sistem pernapasan manusia terintegrasi model pembelajaran guided inquiry dikategorikan valid dengan skor masing-masing 80.00, 74.00 dan 90.00. Kemudian, hasil penilaian guru menunjukkan bahwa LKPD elektronik yang dikembangkan berada pada kategori praktis dengan skor 92.00 dan 94.00. Terakhir, hasil uji keterbacaan peserta didik menunjukkan bahwa LKPD elektronik yang dikembangkan dapat dibaca dengan baik dengan skor 93,61 dan 93,88. Dengan demikian, LKPD elektronik yang dikembangkan dapat direkomendasikan untuk digunakan dalam upaya untuk meningkatkan kemampuan berpikir kritis peserta didik.

A. Introduction

The era of 4.0, closely related to the rapid development of technology, has started long enough. However, it is the Covid-19 pandemic that has succeeded in forcing teachers and students to be proficient in technology. Even after Covid, teachers and students need help to get away with technology. Technology makes learning unlimited by place and time, so it is hoped that learning outcomes will be more optimal. On the other hand, the 21st century demands changes in learning objectives that place more emphasis on mastering 21st century skills, which include being creative, critical, productive, independent, collaborative, and communicative (Afandi et al., 2019; Nawawi et al., 2022; Zubaidah, 2018). One of the important 21st century skills to be empowered is critical thinking skills. Critical thinking skills are related to rational and logical thinking activities to reflect so that the best decisions are obtained (Ennis, 1993). Critical thinking skills are also defined as thinking skills that involve cognitive activity by considering logical and objective aspects to obtain reliable conclusions (Saputri et al., 2020). Critical thinking skills are urgently needed to train because they relate to students' problem-solving abilities (Chen, 2017). However, Sofiatin, Azmi, & Roviati (2016) revealed that students' understanding of learning the real world and critical thinking skills still needs to be improved. Efforts to train students' critical thinking skills often escape teachers' attention. Putra et al (2019) research results indicate that teachers still need to be more optimal in training students to think critically and analyze and evaluate problems in learning biology. The low fact about empowering students' critical thinking is also revealed in the research of Budi & Ghofar (2017), Falah et al (2018), Kurniawati et al (2015), Nuraini (2017), and Sudin et al (2018).

Based on the SMA Muhammadiyah 2 Palembang observation results, students still need to be more active in learning. In addition, based on the results of interviews with biology teachers revealed that the student worksheets used were not based on learning models, did not encourage critical thinking skills in the form of printed teaching materials, and were not equipped with Higher Orderer Thinking Skills (HOTS) questions. Teachers generally use learning models, such as problem based-learning and discovery learning. However, during the pandemic, learning activities were dominated by discussions and questions and answers via Google Classroom and WhatsApp groups. Online learning requires technological devices, so teachers must create a conducive atmosphere, learn creatively, and be innovative. Students write on the questionnaire sheet that one of the biology materials they find difficult is the material on the respiratory system because there are many components related to the body's organs associated with the respiratory system, respiratory mechanisms, and respiratory system disorders. Students hope that there are teaching materials that can help them learn online. Therefore, teaching materials are needed that can help students learn anywhere while at the same time being able to empower students' critical thinking skills.

The student worksheet itself is simple and systematic teaching material. Student worksheets can be packaged electronically to become more attractive and can be accessed through the technological devices owned by students. E-worksheets can make for a

successful learning experience. E-worksheets facilitate students to develop investigative skills and apply concepts they have learned, empowering students' critical thinking skills (Dwijayanti et al., 2023). E-worksheets can be alternative teaching materials that teachers can provide to students, and participants can access them using gadgets anywhere and anytime (Wahyuni et al., 2021).

Integrating learning models in student worksheets can provide a learning framework for higher-order thinking processes. Students' critical thinking skills can be empowered using a guided inquiry learning model (Anjarwati & Nasrudin, 2022; Febri et al., 2020). Guided inquiry is a learning model that focuses on critical and analytical thinking processes to seek, investigate, and find answers or solutions to the problems posed (Rambe et al., 2020). In applying the guided inquiry learning model, students are encouraged to change their way of learning to be more active and participatory (Anjarwati & Nasrudin, 2022). Guided inquiry involves exploring a phenomenon, focusing on inquiry, conducting an investigation, analyzing the data and evidence, constructing new knowledge, and communicating new knowledge (Llewellyn, 2013). In the guided inquiry learning model, the teacher guides students to be more active in collecting various information and constructing new and complete knowledge to impact student learning outcomes (Mulyana et al., 2018). Some of the results of previous studies indicate that the guided model integration inquiry on student worksheets can foster students' critical thinking skills, including the research of Firdaus & Wilujeng (2018) and Yuniar et al (2021). E-worksheets integrated with the guided inquiry learning model are different from conventional e-worksheets. In the e-worksheet, the stages of learning activities are structured by the syntax of the guided inquiry learning model, where students will carry out investigations with the help of the teacher.

Based on the problems and literature review that has been done, research will be carried out to find out the potential of the e-worksheet human respiratory system based on the guided inquiry learning model in order to find solutions to empower students' critical thinking skills based on the level of validity, practicality, and readability. The e-worksheet in this study was developed with the help of professional Canva and Flip FDF applications. This research question is

1. What is the validity of the e-worksheet based on the guided inquiry model developed to improve students' critical thinking skills?
2. How practical is the e-worksheet based on the guided inquiry model developed to improve students' critical thinking skills?
3. How is the readability of the e-worksheet based on the guided inquiry model developed to improve students' critical thinking skills?

The results of this study are expected to reveal the potential of the developed e-worksheet in improving students' critical thinking skills. In addition, it is expected to be a reference for teachers in using technology-based teaching materials.

B. Method

This research and development type refers to the ADDIE (Analyze, Design, Develop, Implement, & Evaluation) development procedure (Branch, 2009). Product development starts from the analysis, design, and development phases. Implement phases were not carried out due to time and cost constraints. However, formative evaluation is still carried out at each stage to minimize errors in the product development process. A description of the development procedure according to ADDIE is as follows.

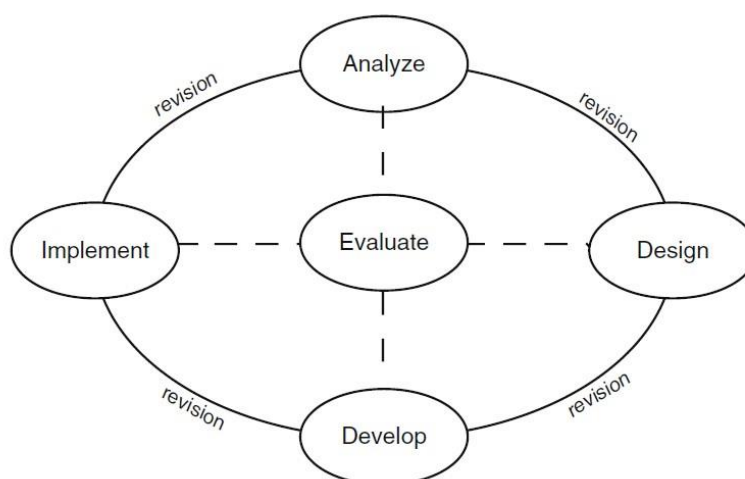


Figure 1. The ADDIE developmental procedure
(Source: Branch, 2009)

1. Analyze

The analysis stage aims to find the causes of discrepancies in the learning process. At this stage, the researcher analyzed the performance of the research subjects, in this case, the teachers and students. At this stage, the solution to the problems faced by teachers and students was also determined. After that, the results of analysis activities are evaluated before moving on to the design stage.

2. Design

A brief product design is carried out at the design stage, including testing methods suitable for the product. The straightforward design of teaching material that has been designed will be evaluated to see its suitability with the objectives or problems to be solved.

3. Develop

At the stage of development, a feasibility or validity test is carried out on the products being developed by material experts, linguists, and teaching materials experts, teachers conduct practicality tests, and students conduct readability tests.

Product validity data is obtained through the provision of validation sheets. Practicality data is collected by filling out the practicality sheet for biology teachers. Readability data was collected by asking for responses from 12 SMA 2 Muhammadiyah Palembang students, divided into students with upper and lower academic ability. The

collected data were analyzed descriptively to reveal the potential of the developed product, and the criteria of validity, practicality, and readability of the product can be seen in Table 1 and Table 2.

Table 1. e-Worksheet Teaching Material Validation Criteria

Score (%)	Category	Description
25.00-40.00	Tidak valid	Not valid cannot be used
41.00-55.00	Kurang valid	Less valid cannot be used
56.00-70.00	Cukup valid	Valid enough allowed to use after major revision
71.00-85.00	Valid	Valid Allowed to use after minor revision
86.00-100.00	Sangat valid	Very valid to use

Source: Akbar (2017)

Table 2. The Practicality of e-Worksheet by Teachers and Readability by Students

Score (%)	Category
0-20	Very impractical, unusable
20,01-40	Impractical, not usable
40,01-60	Less practical, it is recommended not to use
60,01-80	Fairly practical and usable but needs improvement
80,01-99,99	Practical and usable but requires minor repairs
100	Very practical and can be used without repair

Source: Akbar (2017)

C. Result and Discussions

Result

The results of this study are described in the same way as the ADDIE procedure, which is limited to the analysis, design, and development stage.

1. Analyze

At the analysis stage, it was determined that the teacher needed to train students to think critically. In addition, the teacher also revealed that the teaching materials used were still conventional and had not been integrated with the learning model. The e-worksheet learning model and teaching materials each stand alone. Teachers prefer discussion and question-and-answer activities during the implementation of online learning. Student learning outcomes about the human respiratory system still need to be improved. Teachers and students revealed they needed technology-based teaching materials to increase students' thinking activities. After evaluating the analysis results, the researchers tried to develop an e-worksheet based on the guided inquiry model.

2. Design

At this stage, the design of the e-worksheet is carried out. The developed e-worksheet contains a cover (student identity, title, subject), table of contents, learning

instructions, basic competence, learning indicators (GPA), steps of learning activities with guided inquiry and assessment models, and a bibliography. The final student worksheet is then transformed into electronic form using Flip PDF Professional and Canva. An overview of the syntax integration of the guided inquiry learning model in the human respiratory system material e-worksheet is presented in Figure 2. At this stage, validation sheets, practicality assessment sheets, and readability assessment sheets were also designed to test the products being developed.



Figure 2. E-Worksheet based on the Guided Inquiry Learning Model

3. Develop

Product development activities in the e-worksheet have been carried out at this stage. Rochmad (2012) stated that a development product must fulfill the elements of

validity, practicality, and effectiveness. In this study, the potential of the developed e-worksheet is limited by its validity and practicality.

a. Product Validity

The results of the validity test for e-worksheet products are presented in Table 3. Based on Table 3, Table 4, and Table 5, it is known that e-worksheet obtained valid to very valid ratings from experts in material, teaching materials, and language. Some suggestions and revisions from material experts include adjustments to basic competence, material adjustments according to the order, and adding material to the respiratory system. Then, suggestions and revisions from linguists include improvements to the terms and language used to make them easier to understand. In contrast, in expert teaching materials, no revisions are given.

Table 3. Material Expert Validation

No	Indicator	Score
1.	Suitability of the material with KD and indicators	4
2.	Material breadth	4
3.	Material depth	4
4.	Accuracy of concepts and definitions	4
5.	Accuracy of facts and data	4
6.	Accuracy of control and cases	4
7.	Accuracy of drawings, diagrams, and illustrations	4
8.	Encourage curiosity	4
9.	Encourage questioning skills	4
10.	Encourage critical thinking skills	4
Total		40
Percentage		80.00

Table 4. Expert Validation of Teaching Materials

No	Indicator	Score
1	The suitability of the material with the KD used	4
2	Suitability of student activities with the selected model	5
3.	Clarity and sequence of learning activity steps in e-LKPD	5
4.	Sufficient time in each step of the activity	4
Total		18
Percentage		90.00

Table 5. Language Expert Validation

No	Indicator	Score
1.	Accurate sentence structure	4
2.	Sentence effectiveness	4
3.	Terminology	3
4.	Understanding of messages or information	4
5.	Ability to motivate students	4
6.	Appropriateness with the level of emotional development of students	3

No	Indicator	Score
7.	Grammatical accuracy	3
8.	Spelling accuracy	4
9.	Consistency in the use of terms	3
10.	Consistent use of symbols or icons	5
	Total	37
	Percentage	74.00

b. Product Practicality

The practicality test results for the e-worksheet products are shown in Table 6 and Table 7. Table 6 and Table 7 indicate that the teacher assessed the e-worksheet practically from the material and teaching materials aspects. The suggestions and revisions include improving sentences to be easier to understand, improving text size and typeface, improving the syntax of the guided inquiry model on the e-worksheet, and improving basic competence, indicators, and materials.

Table 6. Teacher Assessment of Material Aspects

No	Indikator	Score
1.	Suitability of the material with KD and indicators	4
2.	The material is presented systematically	4
3.	The accuracy of sentence structure and language is easy to understand	5
4.	The material is what is formulated	4
5.	Material according to the level of critical thinking skills	5
6.	Clarity of material description of the respiratory system	4
7.	The scope of the material relates to the subchapters discussed	5
8.	Material is clear and specific	5
9.	The images used are by the material	5
10.	Examples are given according to the material	5
	Total	46
	Percentage	92.00

Table 7. Teacher Assessment of Teaching Material Aspects

No	Indicator	Score
1.	Text can be read properly	4
2.	Background design selection	5
3.	Text size and font type	4
4.	Colors and graphics	5
5.	Clarity of instructions	5
6.	The appearance of the e-LKPD is interesting	5
7.	Placement and use of buttons	5
8.	Ease of use of teaching materials	5
9.	Guided inquiry learning activity steps in e-LKPD	5
10.	Guided inquiry learning activity steps to critical thinking skills	4
	Total	47
	Percentage	94.00

c. Product Readability

The results of the readability test for e-worksheet products are shown in Table 8. Based on Table 8, the developed e-worksheet was considered very well readable by students with low, medium, and high academic abilities.

Table 8. Student Readability Test

No	Class	Average Score
1.	APS	95.00
2.	AG	93.33
3	L	95.00
4	MFR	90.00
5	PE	95.00
6	WAPS	93.33
7	ASP	96.66
8	DAZ	93.33
9	LA	93.00
10	MKAP	95.00
11	MQRR	91.66
12	RR	93.33
Total average score		93,72

Discussion

The test results show that the e-worksheet material for the human respiratory system based on the guided inquiry learning model is valid or feasible to improve students' critical thinking skills. These follow the research results of [Ikhwani & Kuntjoro \(2021\)](#) and [Wahyuni et al \(2021\)](#) which state that experts consider the developed e-worksheet valid. Testing this validity is important so that the product developed is feasible based on the theory and constructs of connected components consistently ([Rochmad, 2012](#)).

Furthermore, the results of testing practicality by teachers indicate that e-worksheets have practical value and are easy to use by students later in their learning. Several other researchers also conducted practicality tests before the product was applied to field tests, including research on [Firdaus & Wilujeng \(2018\)](#), [Ikhwani & Kuntjoro \(2021\)](#), and [Wahyuni et al \(2021\)](#). Tests on the level of practicality provided information that the products developed were theoretically easy to apply in the field and tended to be liked by users ([Rochmad, 2012](#)).

The last test of the product in this study is its practicality, as seen from the legibility of the e-worksheet. The results show that e-worksheets can be read very well by students, both by students with low academic ability, medium academic ability, and high academic ability. Assessments from various student academic levels illustrate that this e-worksheet can be used by all students, given the diversity of students' academic abilities in class. Therefore, based on the three tests, the e-worksheet developed by integrating the guided inquiry model can promote students' critical thinking skills.

The guided inquiry learning model bridges students to carry out investigative activities with guidance from the teacher. Integrating the guided inquiry model into the student worksheet has encouraged students to participate in investigative activities, facilitating the development of cooperative attitudes and students' critical thinking (Firdaus & Wilujeng, 2018). A student worksheet equipped with a guided inquiry model differs from a conventional student worksheet, which generally only contains material and questions that must be answered. Based on the guided inquiry model, the student worksheet contains a series of syntaxes closely related to critical thinking skills: interpretation, analysis, inference, and explanation (Yuniar et al., 2021). The transition from printed to electronic makes student worksheets more interactive and interesting, as student worksheets can now include video links that students can access. The research results of Ikhwani & Kuntjoro (2021) show that the developed e-worksheet received a positive response from students and is theoretically believed to facilitate the development of student's critical thinking skills.

D. Conclusion

The potency of guided inquiry learning models in empowering students' critical thinking skills in this study was seen from the results of expert validation, the results of the practicality test by the teacher, and the results of the readability test by the students. Based on the research that has been done, the developed e-worksheet is in the right category, with an average score of 80.00 from material experts, 74.00 from language experts, and 90.00 from teaching materials experts. The results of this study also reveal that the developed e-worksheet is practical, with a score of 92.00 and 94.00. Finally, the students' readability test results indicated that the e-worksheet was in the very good category with scores of 93.61 and 93.88; in other words, it could be read well. Thus, the developed e-worksheet is feasible or potentially theoretically and constructively and can be an alternative teaching material to improve students' critical thinking skills.

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