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Development of E-Worksheet Oriented Guided Inquiry using Liveworksheet on Electrolyte and Non-Electrolyte Solution Materials

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Abstract: This research was conducted against the background of the facts in the field that the teaching materials used in learning chemistry use printed LKS / textbooks so that the chemistry learning felt by students is ordinary; the teaching model used is still teacher-centered which causes less active participation of students in learning. It causes the lack of development of critical thinking skills due to the lack of training for students to develop thinking skills. This study aimed to produce guided inquiry-oriented e-worksheets that are feasible as a learning media using live worksheets on electrolyte and non-electrolyte solution material that were reviewed through validity and practicality testing. This research uses the Research and Development (R&D) method based on the Borg and Gall method modified by Sukmadinata until the product trial stage. The product trial was limited to 28 students in class XI at Ta'miriyah Surabaya High School. The novelty of this research is the development of an e-worksheet, which can improve learning outcomes and train critical thinking skills; all 6 indicators of critical thinking skills, according to Facione, with the help of a live worksheet, so it is interactive. This study involved validators, namely 1 person from a chemistry teacher and 2 chemistry lecturer experts, respondents, namely 28 students, and 3 observers. E-worksheet validation results get modes 4 and 5 to be included in the valid and very valid categories. The practical results of the learner response questionnaire get a percentage between 92.86 - 100%, so it is said to be very practical. This is also supported by the learner activity observation sheet, which the observer observes. The research results show that a guided inquiry-oriented e-worksheet using live worksheets can train students' critical thinking skills on electrolyte and non-electrolyte solution materials.

Keywords: Critical Thinking Skills; Guided Inquiry; E-Worksheet; Electrolyte and Non-Electrolyte Solutions; Liveworksheet

Introduction

In the 21st century, the development of Science and Technology (Science and Technology) has experienced a significant increase, including in the education sector. Teachers are expected to adapt to these changes to improve the quality of teaching and learning activities. Along with the advancement of Information and Communication Technology (ICT), integrating ICT into the learning process has changed the teacher's role from a teacher to a facilitator, collaborator, mentor, coach, director, and learning partner [1]. This allows teachers to provide more choices and responsibilities to students in experiencing the learning process, so it is expected that students can become more active in learning activities. ICT in education covers all teaching aspects, including the chemistry learning process [2].

Chemistry is a branch of science that discusses problems in everyday life related to natural phenomena and their laws [3]. The process of learning chemistry that analyzes the symptoms and phenomena requires students to have critical thinking skills to consider and analyze carefully [4]. Findings from the pre-research showed that 71.4% of students in class XI-Meditek experienced difficulties in learning the subject. This fact is a problem that can be a barrier to progress in the teaching and learning process.

Electrolyte and non-electrolyte solution materials are related to problems that occur in daily life [5]—through the questionnaire also obtained data ranking the most challenging material where most students consider electrolyte and non-electrolyte solutions to be one of the most challenging chemical materials. This statement is also reinforced by the results of the pre-research test of learning completeness of electrolyte and non-electrolyte solution material, where the classical completeness of 28 students is 3.57% or only 1 student whose score is complete. In the Merdeka curriculum, the Flow of Learning Objectives (ATP) that needs to be mastered in the material of electrolyte and non-electrolyte solutions is to analyze the electrical conductivity properties of solutions, both electrolyte and non-electrolyte solutions in everyday life. The ATP is consistent with that chemistry learning requires critical thinking skills to analyze the occurring symptoms and phenomena.

Critical thinking is the act of gathering, interpreting, analyzing, and assessing information to draw reliable and valid conclusions [6]. Facione has identified 6 indicators of critical thinking skills, namely interpretation, analysis, explanation, evaluation, self-regulation, and inference. According to Facione, critical thinking skills refer to a person's ability to analyze and synthesize information to resolve specific situations within a predetermined framework [7].

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From the results of pre-research that has been carried out, the critical thinking skills of students in chemistry are considered to be at a low level, namely in the interpretation skills obtained a percentage of 58% with a sufficient category; inference obtained a percentage of 58% with enough; explanation obtained a percentage of 56% with an adequate category; evaluation obtained a percentage of 39% with a deficient category; analysis obtained a percentage of 46% with an adequate category; and self-regulation obtained a percentage of 47% with an acceptable category. This shows that students need to be trained in critical thinking skills. Therefore, students need to be trained in critical thinking skills.

Based on Permendikbud No. 65 of 2013, learning process standards include the preparation of Learning Implementation Plans (RPP) or teaching modules, preparation of learning media, learning assessment, and learning models. Educators must prepare learning models, teaching materials, and media before learning activities occur.

The guided inquiry learning model is a learning model that leads students to be active during the teaching and learning process and urges them to optimize all their skills and abilities to solve everyday problems and equip them with the ability to construct concepts so that critical thinking skills will be trained [8].

Based on interviews with chemistry teachers at Ta'miriyah Surabaya High School, the teaching materials used in learning chemistry are LKS / printed textbooks. The chemistry learning experience felt by students is expected. This is supported by pre-research data stating that 82.1% of students in class XI Meditek feel normal in chemistry learning carried out so far.

From this fact, LAPD (Learner Activity Sheet) innovation is needed with the use of electronic media that can be accessed via computers, laptops, and smartphones. Therefore, LAPD changed its name to e-worksheet (Electronic Learner Activity Sheet), which can display images, videos, and relevant questions that students can answer directly [9]. Using e-worksheets in the learning process makes students' learning activities fun, thus making the ongoing learning process more interactive [10].

E-Worksheet can be created using various applications, including Liveworksheet. This application can be run online, making it easier for learners to access it [11]. Liveworksheet is a free website that can display videos on learner activity sheets to make it look more interactive so that students are more interested in the subject matter [12].

In research conducted by Yuzan and Jahro (2022), 5 indicators in critical thinking skills have increased using the guided inquiry learning model assisted by live worksheets; it is said to be effective [13]. Another study by Arviana Ramadhanti and Rudiana Agustini (2021) concluded that using guided inquiry models during learning can improve students' critical thinking skills on 4 essential indicators of thinking: interpretation, inference, explanation, and analysis [14].

Based on previous research and the facts that occur in the field that the critical thinking skills of high school students are still low, and the learning experience of students is felt to be ordinary because they use printed worksheets/textbooks, the novelty of this research is the development of e-worksheets that can not only improve learning outcomes but can also train critical thinking skills all 6 indicators of critical thinking skills according to Facione with the help of interactive live worksheets on the material of electrolyte and non-electrolyte solutions using the guided inquiry learning model.

The author needs to conduct research with the novelty carried out is "Development of Guided Inquiry-Oriented E-Worksheet Using Liveworksheet on Electrolyte and Non-Electrolyte Solution Material to Train Learners' Critical Thinking Skills". This study aimed to obtain e-worksheets that were developed based adequately on validity in terms of content and construct, based on practicality in terms of student response questionnaires supported by observation of student activity and observation of learning implementation.

Research Methods

This development research develops guided inquiry-oriented electronic Learner Activity Sheets using live worksheets on electrolyte and non-electrolyte solution materials to train students' critical thinking skills. This research uses the Research and Development (R&D) method based on the Borg and Gall method modified by Sukmadinata (2013) into three stages: preliminary studies, model development, and research model testing. However, this study only went up to the product trial stage [15].

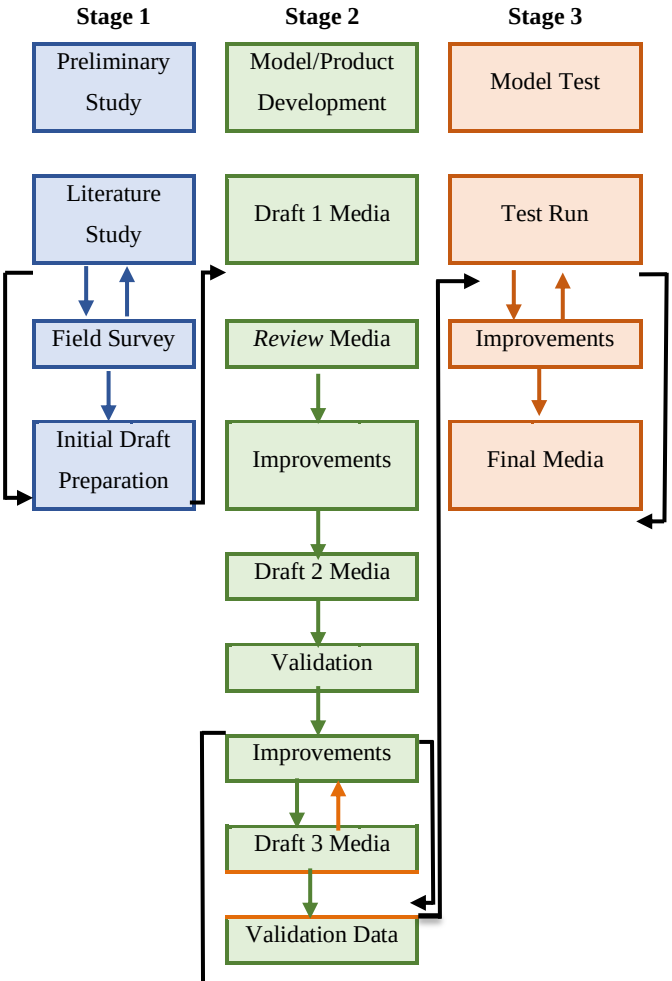

Figure 1. Steps for Using the Research and Development Method [15]

The preliminary study stage is the initial stage or preparation for development. This stage consists of three steps: literature study, field survey, and preparation of initial products. A literature review is a study that aims to understand the concepts or theories related to the product or model to be developed. The field survey was conducted to collect information about the planning and implementation of the learning process in schools, especially those related to development. Data was collected through interviews, documentary studies, and observation of teachers' teaching. Based on the data obtained from the field survey and referring to the theoretical foundations or concepts concluded from the literature study results, the research team then compiled an initial draft of the product to be developed [15].

At the model development stage, a media review was conducted in the form of validation, which the researcher then improved. Based on the validator's input, the researcher improved the media draft. The refined draft was then subjected to model testing [15].

The model or product test is the stage of testing the efficacy of the resulting product. The design used in this study is "One Group Pretest-Posttest Design". Researchers will conduct learning using e-worksheets by giving a pretest before and a posttest after learning without a comparison class.

$$O_1 \times O_2$$

Keterangan:
O_1: Pretest before learning using e-worksheet
X: Learning using e-worksheet
O_2: Posttest after learning using e-worksheet

In this study, validation was carried out in the chemistry department of Surabaya State University and Ta'miriyah Surabaya High School on February 18, 2024 - March 13, 2024. At the same time, the product trial was conducted at Ta'miriyah Surabaya High School on April 19, 2024.

The subjects in this study were 3 validators consisting of 2 chemistry lecturers at Surabaya State University and 1 chemistry teacher at Ta'miriyah Surabaya High School. In contrast, the target of product trials was carried out on 28 students of class XI-Meditek at Ta'miriyah Surabaya High School.

The data analysis techniques used in this study are:

Validation Data Analysis

Validation was carried out by 2 chemistry lecturers and 1 chemistry teacher on the e-worksheet using a Likert scale [16]. The validation results from the validators were analyzed using quantitative descriptive methods.

Table 1. Likert Scale Score Validation Result Data

Statement	Scale Value
Invalid	1
Less valid	2
Quite	3
Valid	4
Very valid	5

The data obtained in validation is in the form of ordinal data, which has the nature that mathematical operations cannot be performed (added, subtracted, multiplied, and divided), so the determination is made by mode, which means that the decision is made on the most significant number [14]. E-Worksheet is considered valid if the minimum criterion obtained is 4 or the valid category.

Analysis of Learner Response Questionnaire

The learner response questionnaire data was collected on a Guttman scale to obtain clear and consistent answers [13]. Positive and negative statements were used in the learner response questionnaire.

Table 2. Guttman Scale Positive Statement

Answer	Scale Value
Yes	1
No	0

Table 3. Guttman Scale Negative Statement

Answer	Scale Value
Yes	0
No	1

Table 4. Learner Response Criteria

Percentage (%)	Criteria
81-100	Very practical
61-80	Practical
41-60	Less practical
21-40	Not practical
0-20	Very impractical

E-Worksheet is said to be practical if it provides a percentage result of ≥ 61%.

Analysis of Student Activity Observation Sheet Results

The learner activity observation sheet results were used to support the practicality response questionnaire from the activities carried out by learners during the trial, which observers observed during the activity. The observation process is carried out using an e-worksheet. The data from the observations made by the observer on the activities of the learners were then analyzed descriptively with the criteria referring to the Likert scale [16].

Table 5. Likert Scale Score for Student Activity

Statement	Scale Value
Not Implemented	0
Not good	1
Simply	2
Good	3
Very good	4

Table 6. Interpretation of Learner Activity Criteria

Criteria	Score
Less	0-1
Simply	1.1-2
Good	2.1-3
Very good	3.1-4

The observation results of students' activities support the response questionnaire if all statements are carried out with an average score of students' activities ≥ 2.1.

Analysis of Learning Implementation Observation Sheet Results

The purpose of this data analysis is to determine the implementation and suitability of the teacher's learning process with all the syntax contained in the teaching module using the guided inquiry learning model. Data from observations made by observers on implementing guided inquiry learning were then analyzed descriptively with criteria referring to the Likert scale [16].

Table 7. Likert Scale Score Learning Implementation

Statement	Scale Value
Not Implemented	0
Not good	1
Simply	2
Good	3
Very good	4

Table 8. Interpretation of Learning Implementation Quality Criteria

Criteria	Score
Less	0-1
Simply	1.1-2
Good	2.1-3
Very good	3.1-4

Learning implementation is exemplary if all phases of the guided inquiry learning model have been implemented with an average score of learning implementation ≥ 2.1.

Results and Discussion

E-Worksheet Development

The guided inquiry-oriented e-worksheet development research used the Borg and Gall method modified by Sukmadinata (2013). The stages in this study only reached the product trial stage. This includes examining the results of this development, including the e-worksheet design and its feasibility.

Preliminary Study Stage

In the preliminary study stage, there are 3 stages: the literature study stage, the field survey stage, and the initial draft stage. The literature study stage examines relevant literature studies to the research plan. The field survey stage aims to identify potential problems. The field survey was conducted at SMA Ta'miriyah Surabaya by giving a pre-research questionnaire to students of class XI-Meditek. In addition, interviews were also conducted with chemistry teachers regarding media, facilities, learning resources for students, and student analysis. The results obtained from questionnaires and interviews are the basis for the background of media selection developed as teaching media. Based on field surveys and literature studies, the initial design of the media to be created can be carried out. The steps to be taken in preparing the initial draft of e-worksheet learning media development are curriculum analysis, concept analysis, and analysis of learning objectives. The applicable curriculum at Ta'miriyah Surabaya High School is the independent curriculum. The flow of Learning Objectives (ATP) on electrolyte and non-electrolyte solution material is to analyze the electrical conductivity properties of a solution in everyday life.

Furthermore, concept analysis where analysis aims to determine the material content that will be included in the guided inquiry-oriented e-worksheet media using the developed live worksheet. Next, analyze learning objectives. Analysis of learning objectives to summarize the results of concept and task analysis, thus enabling the identification of research subject behavior. The objects collected become the basis for compiling tests and learning tools applied to e-worksheets developed by researchers in the form of learning objectives.

Product Development Stage

The continuation of product development after walking through the preliminary study stage is the design stage of teaching materials in the form of an e-worksheet based on guided inquiry learning using the developed live worksheet. Make a guided inquiry-oriented e-worksheet with Canvas help and insert it into the live worksheet. Researchers used the help of a color palette so that the color combination on the e-worksheet could give a harmonious impression when viewed. The color combination on the cover design is light blue and navy blue because it shows a bright impression. The blue color symbolizes the sea and sky and conveys the values of peace, loyalty, justice, and intelligence, but cold. The navy color gives the impression of calmness that wants to be built [18].

Figure 2. Desain sampul E-Worksheet

The structure of E-LAPD preparation in this study is the title/cover, subject identity, preface, instructions for use, learning objectives, material, the syntax of the inquiry learning model, and questions [17]. The syntax of the inquiry learning model includes (1) Phase 1: Getting attention and explaining the inquiry process, (2) Phase 2: Presenting inquiry problems or inappropriate events, (3) Phase 3: Asking students to formulate hypotheses to explain problems or events, (4) Phase 4: Encouraging students to collect data to test hypotheses, (5) Phase 5: Formulating explanations or conclusions, and (6) Phase 6: Reflecting on problematic situations and the thought process used to investigate [20]. This E-Worksheet can be done directly by students using gadgets. The phases of guided inquiry are related to the indicators of critical thinking skills [14].

Table 9. Linkage of Guided Inquiry Phase with Critical Thinking Skills Indicators

Guided Inquiry Phase	Indikator Keterampilan Berpikir Kritis
Phase 1	Interpretation
Phase 2	Interpretation
Phase 3	Interpretation
Phase 4	Analysis and Evaluation
Phase 5	Inference
Phase 6	Explanation

After phase 6 of the guided inquiry learning model, there are critical thinking skills practice questions and a questionnaire on self-regulation, which are essential skills of thinking indicators.

Furthermore, the validation and practical results are achieved during the product development stages.

Product Validation Results

The validity of the e-worksheet is obtained through analysis of the results of the validation sheet based on content and construct validity conducted by two Surabaya State University chemistry education lecturers and one Ta'miriyah Surabaya high school chemistry teacher. E-worksheet is declared valid if a minimum mode score of 4 is obtained.

The feasibility of guided inquiry-oriented e-worksheet content includes content suitability, suitability with guided inquiry components, and suitability to train critical thinking skills. Meanwhile, the construct feasibility of a guided inquiry-oriented e-worksheet includes presentation and language criteria.

Table 10. Results of Content Feasibility E-Worksheet Validation

Assessment Components	Mode	Criteria
Content suitability	5	Very valid
Compliance with guided inquiry components	5	Very valid
Appropriateness of practicing critical thinking skills	4	Valid

Table 11. Results of E-Worksheet Validation for Constructability

Assessment Components	Mode	Criteria
Presentation criteria	5	Very valid
Language criteria	5	Very valid

From tables 9 and 10, the validation results obtained scores 4 and 5 with valid and very valid categories so that it can be concluded that E-worksheet oriented guided inquiry using live worksheet is feasible to use to train students' critical thinking skills on electrolyte and non-electrolyte solution materials.

Product Practicality Results

After validation testing and improvements that provide results, namely valid e-worksheet products, the next step is to carry out product practicality testing. The practicality of e-worksheet-oriented guided inquiry is reviewed from the results of the response questionnaire sheet distributed to 28 students, supported by student activity sheets and learning implementation observed by observers. Response questionnaire sheets were distributed to students after implementing limited product trials at Ta'miriyah Surabaya High School. E-worksheets are said to be practical for use as learning media if the percentage of achievement is ≥ 61% [16].

Table 12. Response Questionnaire Results

Assessment Components	Percentage	Criteria
Knowing the ease of using E-worksheet	92.86 - 100%	Very practical
Knowing the usefulness of E-worksheet on learning outcomes	100%	Very practical
Knowing the helpfulness of E-worksheet on critical thinking skills	96.43 - 100%	Very practical

The activity of students was observed by 3 observers, namely 3 chemistry students of Surabaya State University, using the instrument of the student activity sheet. The learner activity observation sheet is used to observe learner activities in the classroom related to learner responses to E-worksheet, and the learning model is used from the observer's point of view.

Table 13. Results of Observation of Student Activity

Aspect/Phase	Meeting 1	Meeting 2
Introduction	3.8 (very good)	3.8 (very good)
Phase 1	3.6 (very good)	3.8 (very good)
Phase 2	3.6 (very good)	3.8 (very good)
Phase 3	3.67 (very good)	3.6 (very good)
Phase 4	3.8 (very good)	3.93 (very good)
Phase 5	3.8 (very good)	3.9 (very good)
Phase 6	3.8 (very good)	3.8 (very good)
Closing	4 (very good)	4 (very good)

In the implementation of learning, this study used the guided inquiry model, which was observed by 2 observers, namely 2 chemistry students from Surabaya State University, using the instrument of the implementation observation sheet. The implementation observation sheet is used to assess the teacher's ability to manage learning in the classroom and ensure that the learning process runs according to all syntax contained in the guided inquiry-based teaching module.

Table 14. Learning Implementation Observation Results

Aspect/Phase	Meeting 1	Meeting 2
Introduction	3.83 (very good)	3.67 (very good)
Phase 1	3.75 (very good)	4 (very good)
Phase 2	4 (very good)	4 (very good)
Phase 3	3.67 (very good)	4 (very good)
Phase 4	3.63 (very good)	3.63 (very good)
Phase 5	3.75 (very good)	4 (very good)
Phase 6	3.67 (very good)	3.67 (very good)
Closing	4 (very good)	4 (very good)

From Table 11, it can be concluded that the results of the student response questionnaire are declared practical because the percentage of achievement of all components

of the response questionnaire sheet ≥ 61%, namely obtaining a percentage between 92.86 - 100% and supported by tables 12 and 13 regarding the results of observations of student activity and learning implementation with an overall score of 3.1 - 4 with very good criteria. These results are also supported by research from Yuzan and Jahro (2022). The development of guided inquiry-based e-worksheets obtained a student response, whose results were 83.08%, with exciting criteria [13]. However, Yuzan and Jahro's research did not examine all indicators of critical thinking skills, namely, indicators of self-regulation. This study reviewed all indicators of critical thinking according to Facione.

Conclusion

Pengembangan e-worksheet inquiry-oriented. The development of guided inquiry-oriented E-worksheet using live worksheets on electrolyte and non-electrolyte solution materials to train students' critical thinking skills using the Research and Development (R&D) research type using the Borg and Gall method modified by Sukmadinata has been successfully developed and obtained feasible results in terms of validity and practicality. The results of E-worksheet validation get modes 4 and 5 so that it is included in the valid and very valid categories. The practical results of the learner response questionnaire are 92.86 - 100%, so it is said to be very practical, which is also supported by the observation sheet of learner activity and learning implementation.

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