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Development of an E-Worksheet on Acid-Base Material with the *Sorogan-Bandongan* Learning Model to Train Students Attitude of Responsibility

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Abstract: The *Sorogan-Bandongan* learning model is a traditional approach that is effective in training learners' responsibility through a series of learning activities, including reading and working on handouts, diagnostic tests, independent practice based on test results, reinforcement of concepts by the teacher, and self-reflection. This model emphasizes both individual (*Sorogan*) and collective (*Bandongan*) approaches, so that students are not only responsible for tasks they complete independently but also participate in collaborative discussion and evaluation processes. The purpose of this study is to describe the feasibility of the E-Worksheet on acid-base material using the *Sorogan-Bandongan* learning model to cultivate students' sense of responsibility. The feasibility of the E-Worksheet is assessed based on validity, practicality, and effectiveness. The method used in this study is Research and Development (R&D) with Thiagarajan's 4D development model, limited to the Develop stage. In this study, a limited pilot test was conducted in May 2025 with 20 high school students from SMA Negeri 19 Surabaya who had already studied acid-base material. Based on the results of the research conducted, it was found that the validity of the E-Worksheet was deemed valid based on the scores obtained from the validation sheet. The overall results of student activities from meeting 1 to meeting 3 showed an increase and obtained a percentage of ≥ 61%, indicating that the E-Worksheet on acid-base material is practical. The effectiveness of the E-Worksheet was assessed based on the increase in the observation sheet scores for students' sense of responsibility in each session. The n-gain results for students' sense of responsibility were categorized as high. Based on these results, it can be concluded that the E-Worksheet on acid-base material using the *Sorogan-Bandongan* learning model to cultivate students' sense of responsibility is suitable for use.

Keywords: Acid-Base; E-Worksheet; Responsibility; *Sorogan-Bandongan*.

Introduction

Chemistry is a natural science that specifically studies the composition, structure, properties, material changes, and energy that accompany its changes. The field studied in chemistry is much broader, not just numbers, but also understanding the concept of cognitive knowledge. Chemistry contains concepts that are complex and abstract; therefore, it requires a strong understanding. Understanding the concept of abstract chemistry explains the concept of real chemistry [1]. This abstract concept requires learners to be able to relate theory to real phenomena, so a strong understanding becomes very important in the process of learning chemistry. Chemistry, as part of science, must be learned through three main stages, namely knowing or understanding science, understanding science, and practising science in technology [2].

One of the innovations that utilize technological developments in the realm of education is a variety of learning media and new learning models [3]. The development of digital learning media is one of the innovations in improving the effectiveness of the teaching and learning process, one of which is through Learner Worksheets in electronic form (E-Worksheet). E-Worksheet is teaching material in the form of digital books that can facilitate learning activities that can be accessed through computers, notebooks, and smartphones [4]. An e-worksheet can be developed through Flipbook Software. Flipbook is an interactive electronic learning media that can combine text, animation, images, audio, and video to increase the attractiveness and interest of students' learning [5]. Thus, the Flipbook-based E-Worksheet not only facilitates access to material but is also able to overcome the challenges of abstract chemistry learning by increasing student engagement and learning motivation.

The *Sorogan-Bandongan* learning model is a traditional approach that is effective in training learners' responsibility through a series of learning activities, including reading and working on handouts, diagnostic tests, independent practice based on test results, reinforcement of concepts by the teacher, and self-reflection. This model prioritizes individual (*Sorogan*) and collective (*Bandongan*) approaches, so that learners are not only responsible for the tasks they do independently, but are also involved in the discussion and evaluation process together. Recent research shows that this model can significantly improve students' learning outcomes, such as in acid-base chemistry, where the n-gain value reached the medium category (0.60), and posttest results exceeded the Minimum Completion Criteria [6]. In addition, this model also accommodates various learning styles of students, so that it can improve concept mastery effectively [7].

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On Friday, April 19, 2024, an interview was conducted with a chemistry teacher at one of the public high schools in Surabaya. Based on the results of the interview, it is known that acid-base is classified as a material that is quite difficult for middle to lower ability students. The difficulty for students in this material is in the calculation of pH. This is supported by the results of diagnostic tests on acid-base material, which is 52.9. It is also known that the school has never used worksheets in electronic form. In addition, the attitude of responsibility of students also still needs to be improved because there are actions of students who do not collect assignments on time, collect assignments after being given a second warning by the teacher, and collect assignments waiting for friends first, and some students still ignore when the teacher explains in class. A sense of responsibility owned by students can bring motivation and interest in learning to students and foster the initiative to participate in every activity in school [8].

By combining E-Worksheet learning media and the *Sorogan-Bandongan* learning model on acid-base material, which not only aims to improve understanding of concepts but is also specifically directed to train students' responsibility attitudes, which contain the implementation of tasks that can support students to understand concepts, it is hoped that the teaching and learning process will be more proactive and can train students' responsibility attitudes.

The E-Worksheet development format includes various important components such as cover, preface, table of contents, concept map, learning outcomes, learning objectives, instructions for use, handouts, diagnostic tests, reading materials, practice questions, summary column, notes column, and self-assessment table. The developed E-Worksheet is accompanied by picture illustrations. The existence of picture illustrations included in the E-Worksheet greatly helps students in understanding the material visually and contextually, thus facilitating the learning process, especially for abstract concepts. Interactive E-Worksheet equipped with animated videos improves the understanding of chemical concepts thoroughly, with a percentage of presentation validity reaching 89% [9]. Therefore, a complete and interactive E-Worksheet format not only facilitates students in learning independently but also becomes an effective solution in overcoming the obstacles of abstract and complex chemistry learning. In addition, E-Worksheet has advantages over printed worksheets, namely storage space efficiency, easy access through various digital devices, and environmental friendliness because it does not use paper.

Based on the findings in a private Christian school in Jakarta, students in grade XI IPA have not fully demonstrated readiness to learn before learning, which is one of the main indicators of responsibility [10]. In addition, there are still cases of students not submitting assignments on time, forgetting to submit assignments, and doing assignments not according to instructions [11]. A similar phenomenon was found in class X IPA in one of the Christian high schools in Jember, 7 out of 22 students did not do physics assignments because they forgot [12]. An attitude of responsibility in learning includes the ability to submit tasks according to instructions and to present one's own work [13].

Based on this background, the author was interested in conducting research entitled Development of E-Worksheet on Acid-Base Material with the *Sorogan-Bandongan* Learning Model to Train Students' Attitude of Responsibility. The novelty of this research lies in the development of an E-Worksheet on acid-base material using the *Sorogan-Bandongan* learning model, which specifically contains tasks that can train students' responsibility. The purpose of this research is to develop and determine the feasibility of the E-Worksheet on acid-base material based on validation, practicality, and effectiveness.

Research Methods

The type of research used in this study is research and development (R&D). In this study, E-Worksheet learning media development trials were carried out on Acid-Base material by adapting the 4-D model research and development method by Thiagarajan, which includes 4 stages, namely define, design, develop, and disseminate [14]. However, in this study, it is limited only to the development stage.

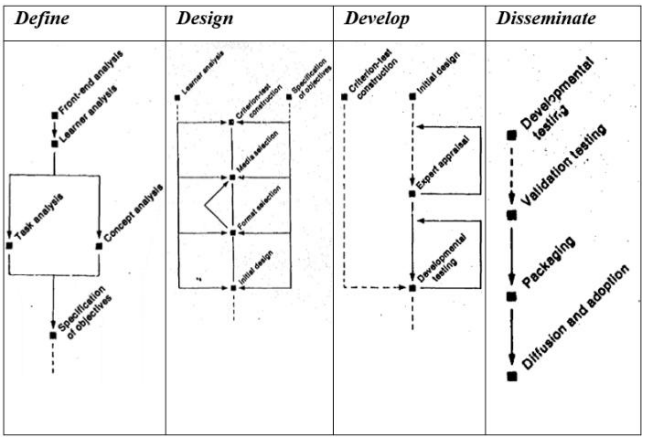


Figure 1. Research and Development Stage

Based on Figure 1, the research procedure can be described as follows. The define stage is a stage that contains activities to analyze and determine the product, learner analysis, which includes learner characteristics related to academic ability, cognitive development, motivation and individual skills. Task analysis, which is related to the main tasks that students will do to be able to achieve the skills expected by researchers, analyzes the concepts to be taught and formulates learning objectives. The design stage is to make an initial research design, including the selection of media that will be used to develop E-Worksheet products. The development stage is the stage to produce a product that is developed, including expert appraisal. At this stage, the learning media developed get suggestions for improvement by the expert, and then are further revised according to expert advice. After being declared valid, developmental testing is carried out, which aims to get direct input in the form of responses, reactions, and comments from students and observers on the learning tools that have been developed.

The research sample amounted to 20 students of class XI SMA Negeri 19 Surabaya. The data collection techniques used were the questionnaire method and the observation method. The next stage is to perform data analysis techniques to test the practicality of the E-Worksheet on acid-base material using a student response questionnaire,

which is analyzed based on the Guttman scale score as follows.

Table 1. Guttman Scale for Learner Response Questionnaire

Activity Implementation	Positive Statement Score	Negative Statement Score
Yes	1	0
No.	0	1

[15]

The data obtained was then analyzed using percentages.

$$\text{Percentage (\%)} = \frac{\text{Number of scores on each aspect}}{\text{Number of respondents}} \text{x } 100\%$$

Supported by the student activity observation sheet, which is analyzed based on the Guttman scale score as follows.

Table 2. Guttman Scale for Observation of Student Activity

Activity Implementation	Score
Yes	1
No	0

[15]

The data obtained was then analyzed using percentages.

$$\text{Percentage (\%)} = \frac{Number\ of\ scores\ on\ each\ aspect}{Number\ of\ respondents} \text{x } 100\%$$

The results of the percentage of student response questionnaires and student activity observation sheets are interpreted into the percentage of practicality criteria as follows.

Table 3. Percentage of Practicality Criteria

Percentage (%)	Criteria
0 – 20	Not Very Practical
21 – 40	Not Practical
41 – 60	Quite Practical
61 – 80	Practical
81 – 100	Very Practical

[15]

Based on Table 3, the E-Worksheet can be declared practical if the percentage of practicality is obtained ≥ 61%.

The data analysis technique used to measure the effectiveness of the E-Worksheet on acid-base material is the observation sheet for the attitude of responsibility of students, which is analyzed based on Likert scale scores as follows.

Table 4. Likert Scale Observation Sheet for Students' Responsibility Attitude

Criteria	Score	
	Negative Statement	Positive Statement
Never	4	1
Rarely	3	2
Often	2	3
Always	1	4

[16]

The increase in learner responsibility was calculated using the n-gain analysis method.

$$< g \geq \frac{\text{Posttest} - \text{Pretest}}{S_{max} - \text{Pretest}}$$

The n-gain score obtained is interpreted based on the following table.

Table 5. N-gain Scoring

N-gain score <g>	Category
$g \geq 0.7$	High
$0.7 > g \geq 0.3$	Medium
$g < 0.3$	Low

[17]

Results and Discussion

The results of E-Worksheet development research on acid-base material with the help of the *Sorogan-Bandongan* learning model aim to describe the feasibility of the E-Worksheet on acid-base material. There are three aspects that qualify the feasibility of a media, namely validity, practicality, and effectiveness [18].

The development of the E-Worksheet in this study used Thiagarajan's 4D development design, which consists of four stages, namely define, design, develop, and disseminate. The development stage in this study was limited to the develop stage through limited trials to determine the applicability of the product.

The first stage is defined. There are five stages that will be carried out at the define stage, namely the first front-end analysis, second learner analysis, third task analysis, fourth concept analysis, and fifth formulation of learning objectives (Specifying instructional objectives). The results of the front-end analysis are the curriculum used and the problems faced by one of the schools in Surabaya. Based on the results of the interview, the school is still using the independent curriculum, but the learning media used do not fully support the applied curriculum because it is still in the adaptation stage, one of which has never used a worksheet in electronic form. In addition, chemistry lessons, especially acid-base material, are considered to be quite difficult material, especially for students with middle to lower abilities. Therefore, there is a need for electronic learning resources that can be accessed by students from anywhere and at any time. The results of the analysis of students show that the attitude of responsibility of students is still relatively low. The attitude of students who show low responsibility during learning is still playing alone while learning, being late in completing homework, and ignoring the teacher's explanation. Low attitude of student responsibility contributes significantly to the decline in the effectiveness of the learning process, especially in the context of independent learning, which is increasingly needed in the digital era [19]. In addition, chemistry learning outcomes, especially in acid-base material, are still relatively low. This is in line with the findings of which show that chemical materials with a high level of abstraction, such as acid-base, require learning media that can accommodate various learning styles and increase students' active involvement [20].

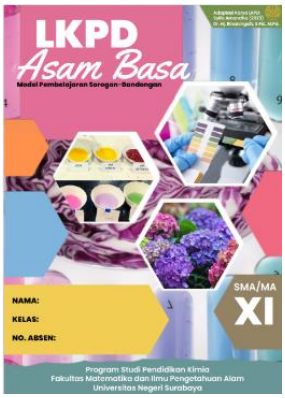
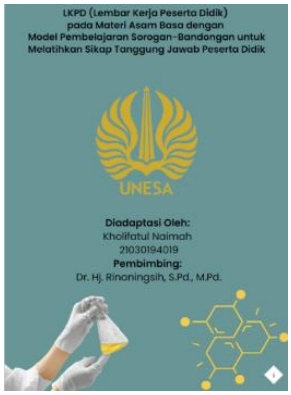
Based on these characteristics, it is necessary to develop learning media that not only focus on cognitive aspects, but also on developing students' attitudes and characters, especially attitudes of responsibility. One relevant solution is the development of electronic learning media, such as E-Worksheet, which has the advantage of

being accessible anytime and from anywhere, thus encouraging students to learn independently and be responsible for their learning process. The use of electronic learning media significantly improves students' attitudes of discipline and responsibility, which in turn has a positive impact on learning outcomes [21]. Thus, the development and utilization of E-Worksheet as learning media is not only an innovative alternative in overcoming the obstacles of abstract chemistry learning, but also as a strategic means in fostering the attitude of responsibility of students, which is very necessary for sustainable learning success. Based on the results of the analysis of the tasks made in the E-Worksheet on acid-base material, the aim is to train the students' attitude of responsibility, which is adjusted to the syntax of the *Sorogan-Bandongan* learning model. Next is the formulation of concepts that will be discussed in the E-Worksheet and the determination of learning objectives based on the curriculum used and learning outcomes.

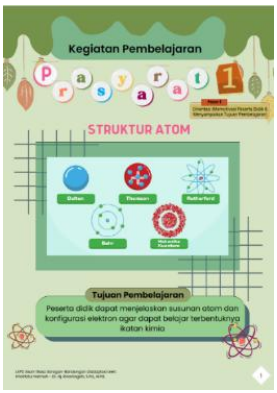
The next stage is design, which involves designing learning media developed in the form of an E-Worksheet. The steps of this stage are the preparation of tests that contain tasks that will be included in the E-Worksheet and related material that will be contained in it, based on the achievements and learning objectives that have been formulated. Based on the learning objectives that have been formulated, the E-Worksheet is divided into 8 different acid-base material subchapters, and there are 2 prerequisite materials that must be completed first before studying the acid-base material. The 2 prerequisite materials are prerequisite E-Worksheet 1: Atomic Structure and prerequisite E-Worksheet 2: Chemical Bonding. 8 different subchapters of acid-base material, namely E-Worksheet 1: Acid-Base in Life, E-Worksheet 2: Acid-Base Theory, E-Worksheet 3: Litmus Paper Indicator, E-Worksheet 4: Universal Indicator Paper and Indicator Solution, E-Worksheet 5: Natural Indicators, E-Worksheet 6: pH of Solutions of Strong Acids and Strong Bases, E-Worksheet 7: pH of Solutions of Weak Acids and Weak Bases, E-Worksheet 8: Acid-Base Practicum. Test preparation can be in the form of practice questions that serve to practice students' concept understanding related to acid-base material. The questions are designed to help students better understand the ideas taught by using real phenomena as examples. This is because the surrounding environment provides a context that is relevant and easy to understand. The environment close to learners can allow them to relate the subject matter to their daily experiences, so that the intrinsic motivation of learners increases [22]. Second, media selection. The platform chosen is Flip PDF Professional, an e-Learning that can be utilized for teaching purposes and Google Form as a place to upload learner answers. A flipbook is an interactive electronic learning media that can combine text, animation, images, audio, and video so that it can increase the attractiveness and interest of learners. Google Form can detect when students collect their answers, so that teachers can monitor whether students have completed the task and know exactly when students collect answers to each question. Therefore, the development of an E-Worksheet on acid-base material using the Flip PDF Professional platform is considered appropriate to improve the attitude of responsibility of students. Third, format selection, in the process of preparing the E-Worksheet, must consider feasibility based on presentation, language, and graphics. This needs to be considered to develop E-Workshops that are interesting and innovative, so that the desire and interest in learning of students can be awakened. The components in the independent curriculum E-Worksheet are title, subject, semester, learning instructions, learning outcomes, learning objectives, and tasks. Fourth, designing E-Worksheet, the stages of E-Worksheet on acid-base material for the *Sorogan-Bandongan* learning model are arranged based on the stages or phases of learning, namely orientation which contains a review of handout assignments that have been done and working on diagnostic tests, determining class settings or mapping students into groups, presenting information which contains brief material to be learned, guiding group work which contains practice questions that must be done during learning with group discussions guided by the group leader and under the supervision of the teacher, providing reinforcement which contains presentation activities of work results between groups and the teacher provides reinforcement of the students' work and invites them to conclude the learning that has been carried out. Furthermore, students are directed to do independent practice questions to strengthen the material that has been understood, and an evaluation, which includes self-assessment during learning, to measure the level of success in mastering the material subchapters studied.

The components of the E-Worksheet on acid-base material to train students' responsibility are shown below.

Table 6. Development Of E-Worksheet

Information	Design
Main Cover of E-Worksheet	
Author's identity	

Cover E- Worksheet prerequisite 1



Cover E- Worksheet prerequisite 2

Cover of E- Worksheet 1

Cover of E- Worksheet 2

Cover of E- Worksheet 3

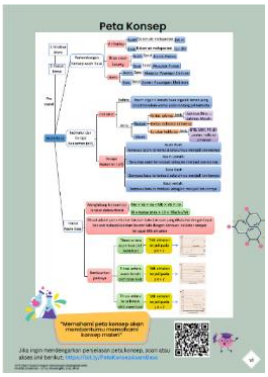
Cover of E- Worksheet 4

Cover of E- Worksheet 5

Cover of E- Worksheet 6

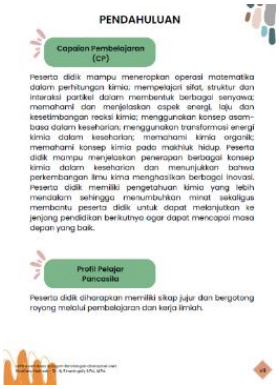
Cover of E- Worksheet 7

Concept maps



Cover of E- Worksheet 8

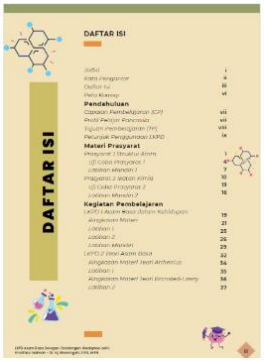
Learning Outcomes and Pancasila Student Profile



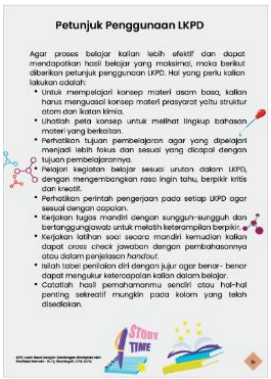
Foreword

Learning objectives

List of contents

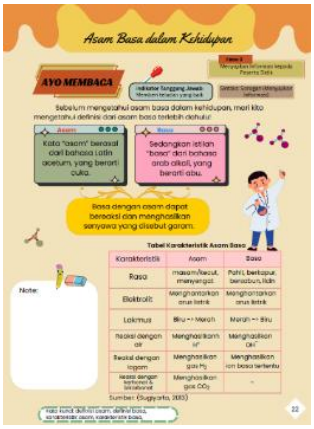


Instructions for use E-Worksheet

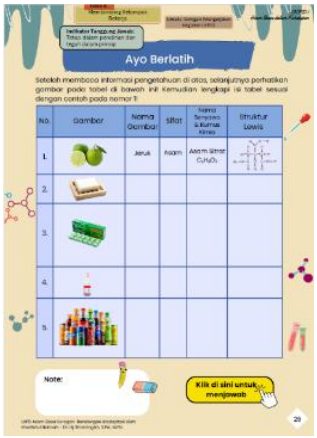


Reviewing handouts, administering diagnostic tests, and organizing students into groups

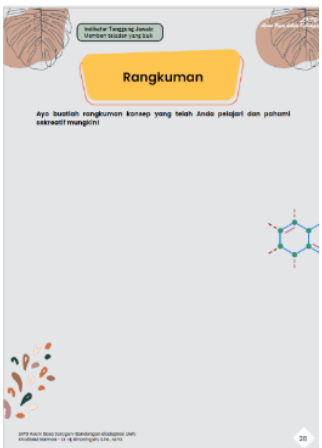
Providing information to students



Guiding work groups

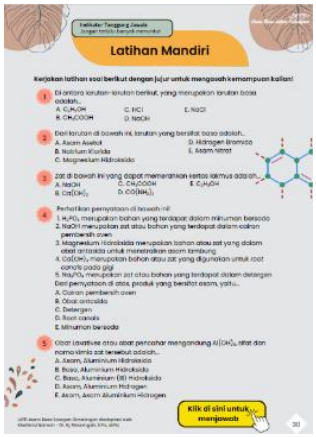


Summary

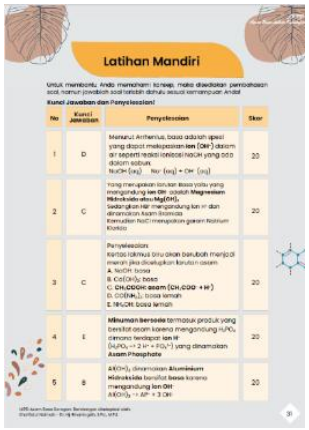


Providing reinforcement to students

Independent Practice



Answer key for independent practice



Evaluation of student learning outcomes

Bibliography

Back *Cover*

To support the source of information and learning of students on E-Worksheet prerequisite 1, there is a video that displays the constituent elements of the atom. The purpose of adding videos is to facilitate the understanding of students related to the atomic structure material. In E-Worksheet prerequisite 2, there is a barcode which, when clicked, displays a video of an example of an ionic bond and an example of a covalent bond, presented in the form of a video, in order to facilitate students' understanding of ionic bonds and covalent bonds. In E-Worksheet 1, there is a link that contains food and beverage ingredients. From the food and beverage ingredients presented, learners can explore materials that are acidic and basic in life. In E-Worksheet 2, there is an audio explanation of each acid-base theory, namely, from Arrhenius, Bronsted-Lowry, and Lewis theories. In E-Worksheet 3, there is a link that displays a video of the effect of acidic and basic solutions on litmus paper. The purpose of adding this video is so that students can actually know the changes in litmus paper against acidic and basic solutions. In E-Worksheet 4, there is a barcode that displays a video of how to use a universal indicator, presented in the form of a video, so that students can observe directly how to use a universal indicator. In E-Worksheet 5, there is a link that contains reading materials on natural materials that can be used as natural acid-base indicators. This link is presented so that students can further explore what natural materials can be used as natural acid-base indicators. In E-Worksheet 6, there is a video that displays how to calculate the pH of strong acids and strong bases, presented in the form of a video, so that students find it easier to understand how to calculate the pH of strong acids and strong bases. In E-Worksheet 7, there is a barcode that displays how to calculate the pH of weak acids and weak bases, presented in the form of a video so that students can more easily understand how to calculate the pH of weak acids and weak bases. In E-Worksheet 8, there is a video that displays an example of a natural indicator experiment. The purpose of adding this video is to provide students with an overview of the practicum that will be carried out.

The E-Worksheet design that integrates interactive multimedia emphasizes the connection of science concepts with technology and social life so that learning is not only theoretical but also applicable and interesting for students. This is supported by research that learning media that combine audio-visual elements can increase learning motivation and cognitive abilities of students [23].

The third stage develops to produce an E-Worksheet with the steps of review, revision of review results, validation, and testing. The review was conducted to obtain expert suggestions/comments on the draft E-Worksheet that had been made as a basis for improvement, if there were errors. The review was conducted by one lecturer from the Chemistry Education study program. The initial E-Worksheet (draft I) that has been revised is called draft II and then validated by validators, namely 1 chemistry teacher and 2 chemistry education lecturers.

In content validation, the suitability of the E-Worksheet with criteria in accordance with learning outcomes and learning objectives gets mode 4, the suitability with the Sorogan-Bandongan learning model gets mode 4, the suitability with responsibility attitude indicators gets mode 4, and the suitability with language gets mode 3. In construct validation based on aspects of chemical characteristics gets mode 3, suitability with the characteristics of students gets mode 3, presentation criteria gets mode 4, and graphic criteria gets mode 4.

Based on the results of validation conducted by 3 validators of the E-Worksheet on acid-base material, it is known that the E-Worksheet is valid for use. The E-Worksheet has gone through comprehensive revisions based on input and suggestions from the three validators, so that the E-Worksheet is declared valid and suitable for use as learning media and can be tested. The E-Worksheet that has been validated is then called draft III.

After going through the validation stage, which showed valid results, the E-Worksheet was then tested in a limited trial on 20 students in class XI at SMA Negeri 19 Surabaya. The limited trial was conducted to determine the practicality and effectiveness of the developed E-Worksheet.

Practicality data is obtained through a learner response questionnaire and observation of learner activities during the use of the E-Worksheet, which directly reflects the ease of use, media attractiveness, and learner involvement in the learning process. The E-Worksheet developed is declared practical if the percentage reaches ≥ 61% [15].

The presentation aspect of E-Worksheet gets an average of 96.25% classified as a very practical category, which shows the presentation of material in E-Worksheet is easy to understand and interesting for students. In the aspect of the content component, E-Worksheet gets an average of 100% classified as a very practical category, which indicates that the material presented is relevant, complete, and according to the learning needs of students, so that it can be

effectively used as a learning resource. In the aspect of responsibility attitude, it gets an average of 91.67% classified as a very practical category. This shows that the E-Worksheet developed can train students' responsibility attitude. In the linguistic aspect, the E-Worksheet received an average of 97.50% classified as very practical, which indicates that the language used in the E-Worksheet is communicative, easy to understand, and in accordance with Indonesian language rules.

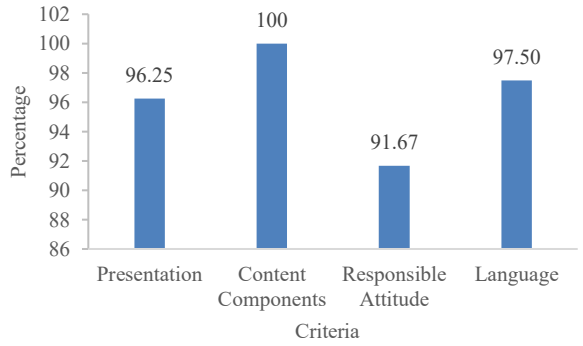


Figure 2. Hasil Angket Respon Peserta Didik

Based on the students' response questionnaire to the E-Worksheet, the average positive response was 95.75% and the average negative response was 4.25% so that the E-Worksheet was in the very practical category and could be used in learning in terms of practicality.

To support the data on student responses, observations of student activities were conducted based on two main criteria. The first criterion was the implementation of learning using the E-Worksheet on acid-base material. Activities under this criterion included students showing interest when viewing the E-Worksheet display, with a percentage of 100% in meeting 1, 100% in meeting 2, and 100% in meeting 3. Students can easily access the barcode or link on the E-Worksheet during Session 1, achieving a 100% rate, Session 2 at 100%, and Session 3 at 100%. Students can read the information contained in the E-Worksheet in session 1 with a percentage of 100%, session 2 with 100%, and session 3 with 100%. Students can operate the E-Worksheet in session 1 with a percentage of 75%, session 2 with 100%, and session 3 with 100%. Students can freely take notes on the material studied in the notes column in Session 1, achieving a 100% score, Session 2, achieving a 100% score, and Session 3, achieving a 100% score. Students can freely summarize the material studied in the summary column in Session 1, achieving a 100% score; in Session 2, achieving a 100% score; and in Session 3, achieving a 100% score. Second, based on the implementation of student responsibility indicators. Activities that meet this criterion include students participating in learning using E-Worksheet acid-base material on time in meeting 1, achieving a percentage of 75%, meeting 2, 100%, meeting 3, 100%. Students can participate in learning activities using the E-Worksheet acid-base material effectively according to the teacher's instructions, achieving a 75% completion rate in Session 1, 100% in Session 2, and 100% in Session 3. Students completed the questions independently without cheating in session 1, achieving a percentage of 50%, session 2 100%, and session 3 100%. Students left the classroom with the teacher's permission first in session 1, achieving a percentage of 75%, session 2 100%, and session 3 100%. Students were able to account for the results of their task discussions in meeting 1, receiving a percentage of 75%, meeting 2 100%, meeting 3 100%. Students completed the teacher's questions as soon as possible, receiving a percentage of 75%, meeting 2 100%, meeting 3 100%. Students actively ask and answer questions in meeting 1, receiving a percentage of 50%, meeting 2, 75%, meeting 3 100%. Students complete assignments on time in meeting 1, receiving a percentage of 75%, meeting 2, 75%, and meeting 3, 100%. Students who participated in the learning process calmly in Session 1 received a percentage of 75%, Session 2 100%, and Session 3 100%.

The overall results of student activities from meetings 1 to 3 showed an increase and obtained a percentage of ≥ 61%, so it can be said that the E-Worksheet on acid-base material is very practical.

Furthermore, the effectiveness of the E-Worksheet on acid-base material is reviewed from the increase in the observation score of the attitude of responsibility of students at each meeting.

Table 7. N-gain Results of Responsibility of Students Meeting 1 to Meeting 2

Name	Meeting 1	Meeting 2	N-gain	Category
NA	61	80	0.49	Medium
FA	75	88	0.52	Medium
MJ	63	88	0.68	Medium
NR	85	87	0.13	Low
SA	77	80	0.13	Low
AA	74	86	0.46	Medium
ED	71	86	0.52	Medium
EZ	80	81	0.05	Low
DR	60	72	0.30	Medium
HR	62	74	0.32	Medium
FE	79	83	0.19	Low
RM	71	85	0.48	Medium
LN	83	87	0.24	Low
JM	61	74	0.33	Medium
SD	79	86	0.33	Medium
MI	79	86	0.33	Medium
RS	75	82	0.28	Low
AF	77	82	0.22	Low
RT	70	83	0.43	Medium
AZ	87	94	0.54	Medium

Based on table 6, there are 13 students who get an n-gain score in the range of 0.7> g ≥ 0.3 which is included in the medium category, indicating that the responsibility of each student in meeting 1 to meeting 2 learning has increased in the medium category and 7 students who get an n-gain score in the range of g < 0.3 with a low category, indicating that the responsibility of each student in meeting 1 to meeting 2 learning has increased in the low category.

Based on Table 7, there is 1 student who gets an n-gain score ≥ 0.7 with a high category, which indicates that the responsibility of students in learning meeting 2 to meeting 3 has increased with a high category. Then, 18 students who got an n-gain score in the range 0.7> g ≥ 0.3 with a moderate category, which indicates that the responsibility of each learner in learning meeting 2 to meeting 3 has increased with a moderate category. Meanwhile, there is 1 student who gets an n-gain score in the

range of g < 0.3 with a low category, which indicates that the responsibility of students in learning from meeting 2 to meeting 3 has increased with a low category.

Table 8. N-gain Results of Students' Responsibility Meeting 2 to Meeting 3

Name	Meeting 2	Meeting 3	N-gain	Category
NA	80	90	0.50	Medium
FA	88	95	0.58	Medium
MJ	88	96	0.67	Medium
NR	87	98	0.85	High
SA	80	93	0.65	Medium
AA	86	93	0.50	Medium
ED	86	95	0.64	Medium
EZ	81	93	0.63	Medium
DR	72	87	0.54	Medium
HR	74	90	0.62	Medium
FE	83	89	0.35	Medium
RM	85	95	0.67	Medium
LN	87	92	0.38	Medium
JM	74	83	0.35	Medium
SD	86	90	0.29	Low
MI	86	91	0.36	Medium
RS	82	92	0.56	Medium
AF	82	92	0.56	Medium
RT	83	93	0.59	Medium
AZ	94	98	0.67	Medium

Table 9. N-gain Results of the Responsibility of Students Meeting 1 to Meeting 3

Name	Meeting 1	Meeting 3	N-gain	Category
NA	61	90	0.74	High
FA	75	95	0.80	High
MJ	63	96	0.89	High
NR	85	98	0.87	High
SA	77	93	0.70	High
AA	74	93	0.73	High
ED	71	95	0.83	High
EZ	80	93	0.65	Medium
DR	60	87	0.68	Medium
HR	62	90	0.74	High
FE	79	89	0.48	Medium
RM	71	95	0.83	High
LN	83	92	0.53	Medium
JM	61	83	0.56	Medium
SD	79	90	0.52	Medium
MI	79	91	0.57	Medium
RS	75	92	0.68	Medium
AF	77	92	0.65	Medium
RT	70	93	0.77	High
AZ	87	98	0.85	High

Based on Table 8, there are 11 students who get an n-gain score ≥ 0.7, including the high category, which indicates that the responsibility of each student in learning meeting 1 to meeting 3 increases with a high category. Meanwhile, 9 students get an n-gain score in the range 0.7> g ≥ 0.3, including the medium category, which indicates that the responsibility of each student in learning from meeting 1 to meeting 3 is an increase in the medium category.

Based on the results of the analysis of the attitude of students' responsibility, the increase in students' responsibility occurred gradually, namely from meeting 1 to meeting 2 and from meeting 2 to meeting 3, the increase in students' responsibility was in the medium category. Meanwhile, the overall increase in the attitude of responsibility of students from meeting 1 to meeting 3 is included in the high category. The use of interactive learning media such as E-Worksheet, combined with active learning models, can significantly increase students' learning motivation and responsibility [24]-[25].

Conclusion

The research results indicate that the E-Worksheet on acid-base material using the *Sorogan-Bandongan* learning model to develop students' sense of responsibility is deemed suitable for use as a learning medium, with validation results categorized as highly valid in four categories. The practicality of the E-Worksheet, as assessed through student response questionnaires, was found to be highly practical at 95.75%, supported by observational data on student activities. The overall activities of students from session 1 to session 3 showed an increase and achieved a percentage of ≥61%, indicating that the E-Worksheet on acid-base material is practical. The effectiveness of the E-Worksheet was assessed based on the increase in scores from the observation sheets of students' sense of responsibility in each session. The n-gain results for students' sense of responsibility were categorized as high.

Author's Contribution

This research was conducted by Kholifatul Naimah, as the main researcher, and Rinaningsih, as the supervisor.

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