J. Pijar MIPA, Vol. 17 No.3, May 2022: 276-284 ISSN 1907-1744 (Print)
DOI: 10.29303/jpm.v17i3.3452 ISSN 2460-1500 (Online)

DEVELOPMENT OF STUDENT WORKSHEETS WITH CONTEXTUAL TEACHING AND LEARNING (CTL) APPROACH TO TRAIN CRITICAL THINKING SKILLS RESPONSIBILITY OF STUDENTS ON THERMOCHEMICAL MATERIALS

Sitti Kholifah Amartyah and Rusmini*
Chemistry Education Study Program, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya, Surabaya, Indonesia
*Email: rusmini@unesa.ac.id

Received: March 23, 2022. Acceped: April 30, 2022. Published: May 10, 2022

Abstract: This study aims to produce and describe the feasibility of Student Worksheet with a Contextual Teaching and Learning (CTL) approach in training critical thinking skills and responsibility in thermochemical material. This study uses a Research and Development (R&D) type which refers to the ADDIE (Analysis, Design, Development, Implementation, Evaluation). The research sample was 24 students of class XI IPA MA Nurut Taqwa Grujugan Cermee Bondowoso. The results showed that: 1) Validity analysis obtained an average percentage of 87% with very valid criteria; 2) Practical analysis based on the percentage of response questionnaires and student activity observations of 88% and 98% with very practical criteria; 3) Analysis of effectiveness based on pretest-posttest data: a) Normality test of cognitive knowledge and critical thinking skills 0,999 and 0,920 normally distributed; b) Paired Sample t-Test 0,048 and 0,003 showed an increase in learning outcomes; c) The N-Gain test of cognitive knowledge and critical thinking skills scored 93% and 79% showed an increase in learning outcomes and attitude of responsibility obtained a score of 87% with very good criteria. So it can be concluded that the development of Student Worksheet with a Contextual Teaching and Learning (CTL) approach is categorized as feasible with very valid, practical and effective criteria. The development of Student Worksheet as a teaching material to improve students' critical thinking skills, become an alternative choice for learning to make learning more meaningful, accompanied by the attitude of students who are full of responsibility, which is an important thing to do.

Keywords: *Student Worksheet, CTL, Critical Thinking, Responsibility, Thermochemistry*

INTRODUCTION

Chemistry is a branch of science that is based on facts, thoughts, and research results. Judging from the characteristics of the material, chemistry is a subject that is included in the difficult category because it is theoretical, computational, and practical. Meanwhile, what is considered difficult is understanding concepts and calculations [1-2]. Among the chemistry material in class XI SMA is thermochemistry, which discusses the measurement and interpretation of heat changes that accompany chemical reactions, changes in state, and the formation of solutions [3]. The material contains concepts and calculations that require understanding in solving problems by thinking critically. Critical thinking is a thinking process to make conclusions that can be accounted for based on the data obtained, have imagination armed with skills and sensitivity, find the truth, clarify, conclude and present it [4-6].

Thermochemistry is important to learn because the next chemical concepts will be difficult to understand if the ability to analyze and solve problems from the material cannot be mastered properly. Efforts that can be made are by applying learning innovations and teaching materials innovations. The types of teaching materials that can be used to improve students' critical thinking skills are Student Worksheet (LKPD) with a Contextual Teaching and Learning (CTL) approach [7].

CTL is a comprehensive system and consists of interrelated parts. CTL is a learning concept that relates the material being taught with examples of everyday life, learning that emphasizes the knowledge process (learning based on constructivism) and aims to train critical thinking skills and be skilled in processing knowledge so that students do not just memorize but need to with understanding [8-10]. Contextual Teaching and Learning (CTL) has 7 components, namely constructivism, inquiry, questioning, the concept of a learning community, modeling, reflection, and authentic assessment [11].

Based on Muliaman's research, which compared the differences in learning outcomes in the application of CTL and Guided Inquiry on the subject of Atomic Structure, it was concluded that there was an increase in learning outcomes of 77.56% and 56.40%, respectively. This shows that the application of the CTL approach is more influential in improving student learning outcomes [12-13]. Learning with the CTL approach based on the research of Fitriah, U.N. concluded that the Student Worksheet oriented to the CTL approach on the material solubility and solubility product can train students' critical thinking skills with an increase of 0.8 in the high category [14]. This shows that the CTL approach can be used in the learning process to practice critical thinking skills and improve learning outcomes.

The use of the Student Worksheet with a CTL approach as a guide for conducting experiments can develop the character of responsibility. Being

responsible is an important factor in the learning process because it can make students serious about learning. The sense of responsibility that students have requires the intervention and guidance of the teacher. Responsibility is one of the pillars of character that can be built through education and its implementation in every aspect of life [15-16].

Based on the researcher's interview with the chemistry teacher of class XI IPA MA Nurut Taqwa Grujugan Cermee Bondowoso, information was obtained that critical thinking skills had been trained but students lacked curiosity so student learning outcomes were less than optimal. The teaching materials used are worksheets which include summaries of several materials, practice questions, and experiments. However, the Student Worksheet does not use attractive designs or pictures and rarely relates the material to everyday life, and has not been developed based on a learning model that is under the material. In addition, the ongoing learning process is still dominated by the teacher explaining the material, then giving questions. The alternative solution is given by the researcher in the development of teaching materials that are adapted to the Contextual Teaching and Learning (CTL) approach. The teaching materials developed are in the form of a Student Worksheet, but they are different from those used by teachers. The Student Worksheet developed is integrated with the CTL stage so that it can train critical thinking skills. Student Worksheet is also combined with the aspect of responsibility. If students have good responsibilities, then they have the awareness to learn better so that learning achievement will increase [17]. In Yeni Setyowati's research, it is stated that the increase in student responsibility for learning is able to increase student learning achievement in mathematics. The value of the learning responsibility regression coefficient obtained is 0.791 with positive parameters [18].

Based on the description above, the researcher is interested in bringing up the title "Development of student worksheets with Contextual Teaching and Learning (CTL) Approaches to Practice Critical Thinking Skills for Students' Responsibility in Thermochemical Materials." which aims to generate and describe the feasibility of student worksheets from the aspects of 1) the validity of developing student worksheets; 2) practical use of student worksheets; and 3) the effectiveness of the application of student worksheets.

RESEARCH METHODS

Before the research, a pre-study was conducted by conducting interviews with the MA chemistry teacher Nurut Taqwa Grujugan Ceermee Bondowoso and filling out questionnaires by students.

This research uses the type of research development or Research and Development (R&D) which refers to the ADDIE model which consists of the Analysis, Design, Development, Implementation, and Evaluation stages. [19-20].

The following are the details of the stages and instruments used at each stage of the research:

1) **Analysis**
   The analysis stage is a stage of gathering information that can be used as material for making products. The resulting product is an educational Student Worksheet learning resource. This information collection is in the form of needs analysis and analysis of learning materials with data collection techniques in the form of interviews and filling out questionnaires.
2) **Design**
   The design stage is carried out to make it easier for researchers to design the Student Worksheet to be made. The design phase includes data collection, curriculum analysis, determining Student Worksheet titles, compiling a map of Student Worksheet needs related to the CTL component, critical thinking skills adapted to thermochemical material, and indicators of responsibility attitudes that support the implementation of the CTL component and critical thinking skills.
3) **Development**
   Application development is the stage of realizing what has been made in the design stage into a product, namely Student Worksheet. Before the implementation of the experiment, three chemists were validated. The validators in this study were two chemistry lecturers at the State University of Surabaya and one teacher at MA Nurut Taqwa. Student Worksheet that has been declared to have met the criteria for good will be used and tested on students of class XI IPA MA Nurut Taqwa Grujugan Cermee Bondowoso.
4) **Implementation**
   Implementation is carried out in a limited manner at the designated school as the place of application of the research.
5) **Evaluation**
   Evaluation is carried out to provide feedback to product users so that revisions are made according to the results of the evaluation or needs that have not been met by the product.

This research was only carried out until the development stage. This research focuses on thermochemistry, system, and environment sub-chapters, exothermic and endothermic reactions, types of enthalpy changes, and calculation of enthalpy changes using calorimetry. The research, which was conducted at MA Nurut Taqwa Grujugan Ceermee Bondowoso, was conducted in February in the even semester of the 2021/2022 academic year. The number of samples was 24 students of class XI IPA which were divided into 4 groups in each session. The research instruments used were 1) validation sheets; 2) student response questionnaire;

3) the student activity observation sheet; 4) question sheets for pretest and posttest of cognitive knowledge; 5) question sheets pretest and posttest critical thinking skills; 6) responsibility questionnaire sheet.

The data analysis carried out in this study include:

1) Validity Analysis

The validity of the Student Worksheet developed was assessed by several validators, namely validators who are experts in the preparation of the Student Worksheet.

$$\text{Persentage} = \frac{\text{score earned}}{\text{max score}} \text{ x } 100\%$$

The percentage obtained is then converted into a qualitative value with the validity criteria in table 1 [21].

Table 1. Validity Criteria

Percentage (%)	Criteria
0.00-20	Invalid
20.1-40	Less Valid
40.1-60	Quite Valid
60.1-80	Valid
80.1-100	Very Valid

2) Practical Analysis

The practicality of using the Student Worksheet is obtained from the results of activity observations and student response questionnaires which are converted into percentages. The results of the data used were obtained through filling out activity observation sheets and student response questionnaires using the Guttman scale in table 2 [14].

Table 2. Guttman Scale Criteria

Mark	Criteria
Not	0
Yes	1

In calculating the average score of student activity observations and responses, the following equation is used [22]:

$$\bar{x}=\frac{\sum x_i}{n}$$

Information:

$\bar{x}$ = average score
$\sum x_i$ = score obtained
n = number of statements

The average score obtained is then converted into a qualitative value with the criteria in table 3 [22].

Table 3. Practical Criteria

Percentage (%)	Criteria
0.00-20	Not Practical
20.1-40	Less Practical
40.1-60	Practical enough
60.1-80	Practical
80.1-100	Very Practical

3) Effectiveness Analysis

The effectiveness of the implementation of the Student Worksheet is obtained by using analytical techniques from data measuring learning outcomes through pretest-posttest cognitive knowledge, critical thinking skills, and attitude of responsibility. Measurement of student learning outcomes was analyzed quantitatively through normality test, paired sample t-test, and N-Gain test.

The following is an analysis of the measurement of learning outcomes through pretest and posttest.

a) Normality test

A normality test is used to determine whether the data is normal or not normally distributed. The data tested were in the form of pretest and posttest scores. The basis for decision-making for the normality test can be seen from the sig value. Contained in the One-Sample Shapiro-Wilk Test table. The test criteria used are:

a) If the value of sig > 0.05 then H_0 is accepted and H_1 is rejected, which means that the data is normally distributed.
b) If the value of sig < 0.05 then H_0 is rejected and H_1 is accepted, which means that the data is not normally distributed [23].

b) Paired Test Sample t-Test

Paired Sample t-Test was used to test the hypothesis about an increase in students' cognitive knowledge and critical thinking skills. The hypothesis used is as follows:

a) H_0: there is no increase in students' cognitive knowledge and critical thinking skills.
b) H_1: there is an increase in students' cognitive knowledge and critical thinking skills.

The criteria for decision making whether there is an increase in results, namely [23]:

a) If sig 0.05 then H_0 is rejected and H_1 is accepted, which means that there is an increase in students' cognitive knowledge and critical thinking skills.
b) If sig 0.05 then H_0 is accepted and H_1 is rejected, which means that there is no increase in students' cognitive knowledge and critical thinking skills.

a) N-Gain Test

The N-Gain test was conducted to determine the increase in the ability of cognitive knowledge and critical thinking skills of students. The following equation is used:

$$\text{N} - \text{Gain} = \frac{\text{posttest score} - \text{pretest score}}{\text{max score} - \text{pretest score}}$$

The N-Gain scores were then averaged and converted into the N-Gain score criteria in Tables 4 and 5 [24].

Table 4. Criteria for N-Gain Score

Mark	Category
G 0.7	Tall
0.3 G > 7	Currently
G < 0.3	Low

Table 5. Criteria for N-Gain Score

Percentage (%)	Criteria
<40	Ineffective
41-55	Less effective
56-75	Effective enough
>76	Effective

The effectiveness of the Student Worksheet is also analyzed through the measurement of the results of the responsible attitude data obtained by the equation:

$$\text{Persentage} = \frac{\text{score earned}}{\max \text{score}} \text{x } 100\%$$

The percentage gain is converted into a qualitative value with the criteria in table 6 [22].

Table 6. Criteria for Student Responsibility Questionnaire Value

Percentage (%)	Criteria
0-19,99	Very bad
20-39.99	Not good
40-59.99	Pretty good
60-79.99	Well
80-100	Very good

The Student Worksheet developed is declared effective if the pretest-posttest analysis of cognitive knowledge and critical thinking skills has a significance value of > 0.05 on the normality test; has a significance value of 0.05 in the paired sample t-Test; has an N-Gain score >76%, and get the percentage of responsibility attitude >80% with very good category.

RESULTS AND DISCUSSION

The product resulting from this research is a Student Worksheet with a Contextual Teaching and Learning (CTL) approach to train students' critical thinking skills on thermochemical material. The following is an explanation of the results of research using the Research and Development (R&D) model of ADDIE [19-20].

1) Analysis

The analysis carried out is needs analysis and learning material analysis. First, a needs analysis was conducted by conducting interviews with chemistry teachers and observing through filling out questionnaires by students to obtain information about the conditions and facts of learning chemistry at MA Nurut Taqwa class XI IPA. The information obtained is used to analyze the problems that arise in the learning process. After conducting interviews and observations, it was found that in learning chemistry in class XI IPA MA Nurut Taqwa several problems could be described, including: (1) the teaching materials used could not maximize student learning outcomes, (2) the involvement of students in chemistry is still low so that students tend to be passive, (3) the lack of curiosity of students about chemistry so that the ability to think critically is still low, (4) the method used by the teacher is still dominated by conventional or teacher-centered methods. (5) the ability of reasoning, critical thinking, and responsibility of students is still relatively low. These problems serve as the basis for determining the required Student Worksheet so that its implementation is precise and efficient.

Second, analysis of learning materials. It was obtained information that in thermochemical material, students had difficulty in understanding the concept of thermochemistry, especially in distinguishing exothermic and endothermic reactions as well as calculating the determination of enthalpy changes. The concept is under basic competence 3.4 explains the concept of the enthalpy change of a reaction at constant pressure in a thermochemical equation, and 4.4 concludes the results of the thermochemical experimental data analysis at constant pressure. Based on the KD, learning objectives can be formulated under the applicable curriculum in schools.

2) Design

The Student Worksheet developed using the CTL approach is focused on training critical thinking skills combined with the responsibility aspect. This Student Worksheet contains 7 components of CTL, indicators of critical thinking, and responsibility. The components of CTL are as follows: 1) constructivism, which relates the material learned to real life to train students to associate knowledge with its application [25]. This component emphasizes the selection of phenomena and questions based on examples from everyday life; 2) inquiry, is a core part which comes from finding yourself, not just the result of remembering. [26]. Learners are trained to find their knowledge by being asked questions based on the phenomena presented; 3) questioning, asking is a strategy that is used actively by students to analyze and explore ideas; 4) the concept of a learning community, suggest that learning outcomes are obtained from discussions with other students, with the hope that there will be an exchange of ideas between students; 5) Modeling, discuss ideas that are thought of, demonstrate how the teacher wants his students to learn [27]. The work on the calculation questions begins with this process in

which students are then asked to explore their knowledge on other questions; 6) reflection asking students what things they just got after learning about thermochemical material by asking questions that can be concluded; and 7) authentic assessment, is an assessment procedure in contextual learning [25].

3) Development

This stage is the process of realizing what has been made in the design stage. At this stage, the calculation or input of the data obtained from the student response questionnaires, the results of the pretest-posttest cognitive knowledge and critical thinking skills of students as well as a questionnaire of students' responsibility attitudes are carried out.

Validity Analysis

The learning tools that have been designed are then validated and revised based on the input of three chemists (two chemistry lecturers at the State University of Surabaya and one chemistry teacher at MA Nurut Taqwa). This expert validator provides an assessment of the correctness of the content, language, presentation, and graphic aspects of the Student Worksheet developed by the researcher. The highest score is 5 and the lowest score is 1. The total score obtained is then averaged. This average score is converted to a percentage value.

The recapitulation of the results of the Student Worksheet validation with the CTL Responsibility approach is presented in Figure 1.

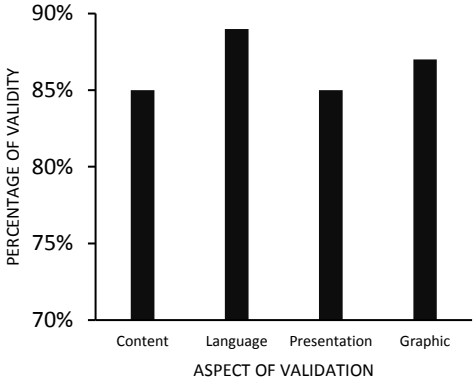

Figure 1. Results of Validation of Student Worksheet Development

The results of this expert validity test show very valid results with a final score of 88%, which means that the Student Worksheet developed can be categorized as very valid to be used as a learning resource because it obtains a percentage of validity achievement of >80%. The validation aspect used in this study was also carried out by Hakim, AH [28] by obtaining a percentage of the validity of the developed worksheets of 81% with very valid criteria.

Practical Analysis

The practicality of using Student Worksheet is obtained from the results of activity observations and student response questionnaires. Assessment of student activity observations is carried out at each meeting. The results of student observations are obtained in Figure 2.

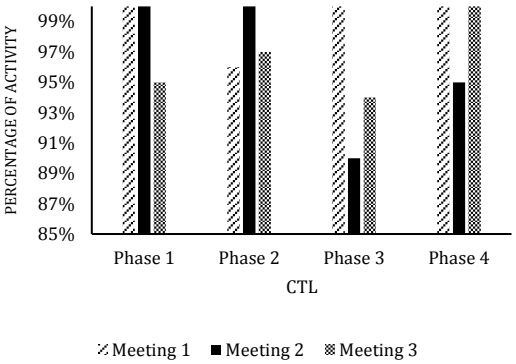

Figure 2. Results of Observation of Student Activities

The student activities shown in Figure 2 show that learning using the Student Worksheet with a CTL approach which has 4 phases and is carried out for 3 meetings has an average score of 97% in the practical category. This means that the activities of students when learning takes place are carried out well. The CTL phase at each meeting has activities that consist of a CTL component. Phase 1 includes a questioning component (questioning); phases 2 and 3 include finding, components of the learning community, constructing (inquiry, learning community, constructivism); Phase 4 includes reflection and authentic assessment (reflection, authentic assessment). Research conducted by Nurfidayanti, H. [28] stated that the practicality of Student Worksheet can be known by observing the activities of students, namely obtaining 90.2% of the results of observing student activities in the very practical category.

The student's response to the developed Student Worksheet aims to determine the ease of use of the Student Worksheet with a CTL responsibility approach. The results of student responses are presented in Figure 3.

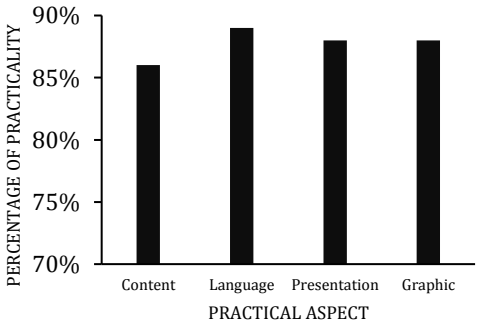

Figure 3. Results of Student Response

Figure 3 shows the response of students to the Student Worksheet is high with an average score of 88%.

The percentage results from activity observation data and student response questionnaires have met the very practical category to use with an average percentage of 97% and 88%, respectively. This shows that the use of the Student Worksheet which is applied with the CTL responsibility approach is very practical for students to use in thermochemical material because it obtains a percentage of practicality achievement of >80%.

The practicality of using instructional media can be known through student response questionnaires as research conducted by Ihsan, MS [29] which obtained a response result of 80.4% with a very practical category.

Effectiveness Analysis

The effectiveness test can be known by analyzing the data obtained from the pretest and posttest scores of questions of cognitive knowledge and critical thinking skills. The data were tested for normality and then tested using the Sample Paired t-Test and tested using the N-Gain test to determine the improvement of students' learning abilities.

Cognitive Knowledge

The results of the cognitive knowledge normality test are presented in table 7.

Table 7. Normality Test of Learners' Cognitive Knowledge

One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		24
Normal Parameters [a,b]	mean	.0000000
	Std. Deviation	2.38095564
Most Extreme Differences	Absolute	.191
	Positive	.142
	negative	-.191
Kolmogorov-Smirnov Z		.381
asymp. Sig. (2-tailed)		.999

Based on table 8 the significance value obtained is 0.999. This means that the data is normally distributed > 0.05. Then the data was tested using the Paired Sample t-Test which aims to determine the difference in the pretest and posttest scores. The 2-tailed significance value obtained from table 8 is 0.048 which indicates that there is an increase in cognitive knowledge because it has a 2-tailed significance value <0.05.

Table 8. Paired Sample t-Test Cognitive Knowledge

Cognitive Knowledge	Average Value		Paired Sample t-Test
	Pretest	Posttest	
C1	19	20	0.048
C2	6	21	0.048
C3	8	20	0.048
C4	3	12	0.048

The test of the effectiveness of the implementation of the developed Student Worksheet got a cognitive knowledge N-Gain score of 0.93 which means that students' cognitive knowledge on thermochemical material is included in the high category. If it is converted into percentage form, it is 93% classified as effective criteria which can be seen in table 9.

Table 9. Cognitive Knowledge N-Gain Test Results

Cognitive Knowledge	N-Gain	Criteria
C1	1.00	Effective
C2	1.00	Effective
C3	1.00	Effective
C4	0.71	Effective Enough
Average	0.93	Effective

Critical Thinking Skills

There are 4 indicators of critical thinking skills used in this study, namely 1) providing simple explanations: focusing questions, 2) setting strategies and tactics: determining an action, 3) building basic skills: observing and considering observation reports, 4) providing explanations further: identify assumptions, 5) provide conclusions to make and determine the results of conclusions [30].

The normality test on the data from the pretest and posttest critical thinking skills is presented in table 10.

The significance value obtained from table 10 is 0.920. This indicates that the data is normally distributed > 0.05. Then the data was tested using Paired Sample t-Test which aims to determine the difference in pretest and posttest scores listed in Table 11. The 2-tailed significance value obtained from the Paired Sample t-Test test on each indicator is 0.003. This shows that there is an increase in critical thinking skills because it has a 2-tailed significance value <0.05.

The effectiveness test of the implementation of the developed Student Worksheet got an N-Gain score for critical thinking skills of 0.79. This means that students' critical thinking skills are included in the high criteria. After that, it was converted into percentage form and 79% was

categorized as effective. The results of the N-Gain test of cognitive knowledge and critical thinking skills can be seen in table 12.

Table 10. Normality Test of Students' Critical Thinking Skills

One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		5
Normal Parameters [a,b]	mean	.0000000
	Std. Deviation	7.71333333
Most Extreme Differences	Absolute	.247
	Positive	.159
	negative	-.247
Kolmogorov-Smirnov Z		.552
asymp. Sig. (2-tailed)		.920

Table 11. Paired Sample t-Test Critical Thinking Skills

Indicator	Average Value		Paired Sample t-Test
	Pretest	Posttest	
Give a simple explanation	3.1	5	0.003
Set strategy and tactics	2.1	4.7	0.003
Building basic skills	0.5	4.5	0.003
Provide further explanation	0.5	3.9	0.003
Giving conclusion	0.5	2.4	0.003

Table 12. N-Gain Test Results for Critical Thinking Skills

Indicator	N-Gain	Kriteria
Give a simple explanation	1.00	Effective
Set strategy and tactics	0.90	Effective
Building basic skills	0.89	Effective
Provide further explanation	0.76	Effective
Giving conclusion	0.42	Effective Enough
Average	0.79	Effective

Learning with CTL can improve student learning outcomes as in Simangunsong, N.S.D's research [31] which obtained an average N-Gain score of 72% with effective criteria.

Fitriah, U.N. [14] said that after being given a CTL-oriented Student Worksheet, it could improve students' critical thinking skills by increasing the N-Gain score of 80% in the very high category. In developing the intellectual potential of students, CTL learning can be used to improve critical thinking [26]. Critical thinking components which include interpretation, analysis, and inference can help students find concepts in learning activities that include practicum and teach the CTL approach in the form of inquiry and ask questions at the interpretation stage; inquiry, community learning, and reflection at the analysis stage; and inquiry and constructivism at the inference stage [14].

Responsibility

The data from the responsibility attitude questionnaire aims to determine the responsibility score of students. The indicators used can be seen in table 13 which is also used by Ulfa, D. [32] who obtained the result of responsibility of 74.5%.

Table 13. Responsibility Attitude Indicators

No	Indicator
1	Can explain the reason for the study he did
2	Do your own work with pleasure
3	Have a strong interest to pursue in learning
4	Having a sense of responsibility is closely related to achievement in school

The results obtained from the responsibility attitude questionnaire can be seen in Figure 4.

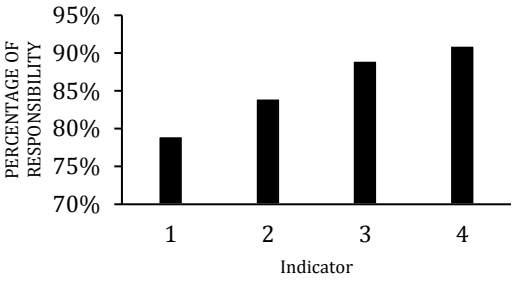

Figure 4. Results of the Responsibility Attitude Questionnaire

Based on Figure 4, it can be seen that the students of class XI IPA MA Nurut Taqwa have a very good attitude of responsibility with an average score of 87% because they get an achievement percentage of >80%.

The development of Student Worksheet as teaching material to improve students' critical thinking skills become an alternative choice for learning to make learning more meaningful, accompanied by the attitude of students who are full of responsibility, which is an important thing to do.

CONCLUSION

The conclusion from the research that has been done is that the Student Worksheet Contextual Teaching and Learning (CTL) approach to train students' critical thinking skills on thermochemical

material is feasible to use. Student Worksheet received an assessment by the validator 87% with a very valid category. Student Worksheet obtained the results of activities and student responses of 88% in the very practical category. Learning outcomes in practicing cognitive knowledge and critical thinking skills which are marked by an increase in pretest and posttest scores on the N-Gain test obtained a cognitive ability score 93% and a critical thinking skill score of 79% with an effective category.

ACKNOWLEGMENTS

We would like to express our gratitude to Dijten Belmawa Kemenristekdikti who has provided the Bidikmisi scholarship and the Principal of MA Nurut Taqwa who gave the research permit.

REFERENCES

[1] Majid, A. (2011). Perencanaan pembelajaran mengembangkan kompetensi guru. Bandung: PT Remaja Rosdakarya.

[2] Muawiyah, D., Yamtinah, S., & Indriyanti, N. Y. (2018, September). Higher education 4.0: assessment on environmental chemistry course in blended learning design. In *Journal of Physics: Conference Series* (Vol. 1097, No. 1, p. 012058). IOP Publishing.

[3] Keenan, C. W., Kleinfelter, D. C., & Wood, J. H. (1984). Kimia untuk universitas.

[4] Ennis, R. H. (1987). Critical thinking and the curriculum. *Thinking skills instruction: Concepts and techniques*, 40-48.

[5] Sulistyowarni, P. A. D., Prahani, B. K., Supardi, Z. A. I., & Jatmiko, B. (2019, February). The effectiveness of OR-IPA teaching model to improve students' critical thinking skills on senior high school physics subject. In *Journal of Physics: Conference Series* (Vol. 1157, No. 3, p. 032011). IOP Publishing.

[6] Cañas, A. J., Reiska, P., & Mollits, A. (2017). Developing higher-order thinking skills with concept mapping: A case of pedagogic frailty. *Knowledge Management & E-Learning: An International Journal*, *9*(3), 348-365.

[7] Prastowo, A. (2011). Panduan kreatif membuat bahan ajar inovatif.

[8] Shanti, W. N., Sholihah, D. A., & Abdullah, A. A. (2018). Meningkatkan kemampuan berpikir kritis melalui ctl. *Jurnal Pembelajaran Matematika*, *5*(1).

[9] Hosnan, M. (2014). Pendekatan saintifik dan kontekstual dalam pembelajaran abad 21: Kunci sukses implementasi kurikulum 2013.

[10] Suryani, N. (2016). Pengembangan media pembelajaran sejarah berbasis it. *Jurnal Sejarah dan Budaya*, *10*(2), 186-196.

[11] Negeri, Q. G. S., & Tengah, C. K. J. (2017). Upaya Peningkatan Prestasi Belajar Siswa Kelas VII C SMP Negeri 1 Cawas, Klaten Melalui Metode CTL Pada Materi Konsep Organisasi Kehidupan Tahun Pelajaran 2016/2017. *Teknis*, *12*(1).

[12] Sugiharti, G., & Muliaman, A. (2016). Perbandingan Hasil Belajar Siswa yang Diajar Dengan Menggunakan Model Contextual Teaching And Learning dan Guided Inquiry pada Pokok Bahasan Struktur Atom. *Jurnal Pendidikan Kimia*, *8*(1), 5-11.

[13] Fitriah, U. N. (2017). LKPD Berorientasi Pendekatan Contextual Teaching and Learning Untuk Melatihkan Keterampilan Berpikir Kritis Pada Materi Kelarutan Dan Hasil Kali Kelarutan. *UNESA Journal of Chemical Education*, *6*(2).

[14] Pertiwi, W. J., Solfarina, S., & Langitasari, I. (2021). Pengembangan Lembar Kerja Peserta Didik (LKPD) Berbasis Etnosains Pada Konsep Larutan Elektrolit dan Nonelektrolit. *Jurnal Inovasi Pendidikan Kimia*, *15*(1), 2717-2730

[15] Parandika, R. W., Muhtarom, M., & Sutrisno, S. (2019). Analisis Karakter Disiplin dan Tanggung Jawab Siswa pada Proses Pembelajaran Matematika Kelas XI SMK Palebon Semarang. *Imajiner: Jurnal Matematika dan Pendidikan Matematika*, *1*(6), 364-372.

[16] Indriani, A. D. N. (2014). Upaya Meningkatkan Tanggung Jawab dan Prestasi Belajar Ips Melalui Metode Outdoor Study Siswa Kelas Iv Sekolah Dasar Negeri 1 Sidabowa (Doctoral dissertation, UNIVERSITAS MUHAMMADIYAH PURWOKERTO).

[17] Setyowati, Y. (2012). *Pengaruh Motivasi Dan Tanggung Jawab Belajar Siswa Terhadap Prestasi Belajar Matematika (Pada Siswa Kelas VIII SMP Negeri 3 Sragen Tahun Ajaran 2011/2012)* (Doctoral dissertation, Universitas Muhammadiyah Surakarta).

[18] Sugiyono, D. (2013). Metode penelitian pendidikan pendekatan kuantitatif, kualitatif dan R&D.

[19] Dick, W., Carey, L., & Carey, J. O. (2013). A model for the systematic design of instruction. *Instructional Design: International Perspectives: Theory, Research, and Models*, *1*, 361-370.

[20] Sudiana, N. (1989). *Dasar-dasar proses belajar mengajar*. PT Sinar Baru Algensindo.

[21] Riduwan, M. B. A. (2007). Skala pengukuran variabel-variabel penelitian. *Alf. Bandung*.

[22] Arikunto, S. (2013). Prosedur penelitian suatu pendekatan praktik.

[23] Fatimah, F. M., & Anggrisia, N. F. (2019). The effectiveness of 7e learning model to improve scientific literacy. *Advances in Social Science, Education and Humanities Research*, *277*, 18-22.

[24] Trianto, M. P. (2009). Mendesain model pembelajaran inovatif-progresif. *Jakarta: Kencana*.

[25] Johnson, E. B. (2002). *Contextual teaching and learning: What it is and why it's here to stay*. Corwin Press.
[26] Nugraheny, D. C. (2018). Penerapan lembar kerja peserta didik (LKPD) berbasis life skills untuk meningkatkan keterampilan proses dan sikap ilmiah. *Visipena*, *9*(1), 94-114.
[27] Hakim, A. R., Hairunisa, H., Makasih, M., & Haris, A. (2020). Pengembangan LKS Berbasis Contextual Teaching and Learning (CTL) Pada Pembelajaran IPA di SDN Sakuru. *Jurnal Pendidikan MIPA*, *10*(2), 94-101.
[28] Nurfidayanti, H. N., & Yonata, B. (2022). Development of student worksheets based on guided inquiries to train students science process skills on reaction rate materials. *Jurnal Pijar Mipa*, *17*(1), 8-15.
[29] Ihsan, M. S., Ramdani, A., & Hadisaputra, S. (2019). Pengembangan E-Learning pada pembelajaran kimia untuk meningkatkan kemampuan berpikir kritis peserta didik. *Jurnal Pijar Mipa*, *14*(2), 84-87.
[30] Ennis, R. (1997). Incorporating critical thinking in the curriculum: An introduction to some basic issues. *Inquiry: Critical Thinking across the disciplines*, *16*(3), 1-9.
[31] Simangunsong, N. S. D. (2012). Pengaruh model pembelajaran contextual teaching and learning (CTL) terhadap hasil belajar kimia pada pokok bahasan sistem koloid kelas xi sma methodist lubuk pakam TA. 2011/2012 (Doctoral dissertation, UNIMED).
[32] Ulfa, D. (2014). Meningkatkan Tanggung Jawab Belajar dengan Layanan Konseling Individual Berbasis Self Management Pada Siswa Kelas XI di SMK Negeri 1 Pemalang Tahun Pelajaran 2013/2014. *Semarang: Fakultas Pendidikan Universitas Negeri Semarang*.