Vol.10 (1), 2021, 49-62 DOI: 10.23960/jppk.v.10.i1.April 2021. 06
Jurnal Pendidikan dan Pembelajaran Kimia
e-ISSN: 2714-9595| p-ISSN 2302-1772
http://jurnal.fkip.unila.ac.id/index.php/JPK/index

Acid Base Module with SETS Approach to Train Students' Critical Thinking Skill

Anis Mualifah dan *Rusmini

Jurusan Kimia FMIPA., Universitas Negeri Surabaya
Jl. Ketintang Wiyata No.62, Surabaya, East Java 60231.

*Corresponding e-mail: ***rusmini@unesa.ac.id***

Received: April 01st, 2021 *Accepted:* April 23th, 2021 *Online Published:* April 24th, 2021

Abstract: Acid-Base Module with SETS Approach to Train Student Critical Thinking Skills. This study aimed to develop an acid-base module with a SETS approach to train students' critical thinking skills. The study used Borg & Gall Research and Development (R&D) method until the limited trial stage. The limited trial was carried out on 12 students of class XI at SMAN 1 Dongko Trenggalek. Then, the developed module was tested for its feasibility based on 3 aspects, namely validity, practicality, and effectiveness. The module's validity data was obtained from the results of the assessment from two chemistry lecturers and one chemistry teacher. The module obtained validity percentages of 84.1% for content, 84.17% for presentation, and 83.33% for language with a valid category. The module's practicality were obtained from the student response questionnaire results, where the practicality percentage of the module was 98.81% with a very practical category. The module's effectiveness was known from the students' critical thinking skills improvement based on the pretest and posttest scores and obtained an n-gain score average of 0.79 with high category. It is supported by the Wilcoxon test results, which obtained Asymp.Sig <0.05 (0.002 <0.05), so that Ha is accepted. So, it can be concluded that the acid-base module with the SETS approach can train students' critical thinking skills.

Keywords: SETS approach, critical thinking, module, acid-base

Abstrak: Modul Asam Basa dengan Pendekatan SETS untuk Melatihkan Keterampilan Berpkir Kritis Peserta Didik. *Tujuan dari penelitian ini adalah untuk mengembangkan modul asam basa dengan pendekatan SETS untuk melatihkan keterampilan berpikir kritis peserta didik. Penelitian ini menggunakan metode Research and Development (R&D) Borg & Gall sampai pada tahap uji coba terbatas. Uji coba modul dilakukan kepada 12 peserta didik kelas XI di SMAN 1 Dongko Trenggalek. Modul yang dikembangkan diuji kelayakannya ditinjau dari 3 aspek yaitu kevalidan, kepraktisan dan keefektifan. Kevalidan modul didapatkan dari hasil penilaian dari dua orang dosen kimia dan satu orang guru kimia. Modul mendapatkan persesntase kevalidan sebesar 84,1% untuk isi, 84,17% untuk penyajian dan 83,33% untuk kebahasaan dengan kategori sangat valid. Kepraktisan modul ditinjau dari hasil angket respon peserta didik, dimana diperoleh persentase kepraktisan modul sebesar 98,81% dengan kategori sangat praktis. Keefektifan modul diketahui dari adanya peningkatan keterampilan berpikir kritis peserta didik berdasarkan nilai pretest dan posttest dengan rata-rata skor n-gain yang diperoleh sebesar 0,79 dengan kategori tinggi. Hal tersebut didukung dengan hasil uji Wilcoxon didapatkan Asymp.Sig < 0,05 (0,002<0,05), sehingga Ha diterima. Jadi dapat disimpulkan bahwa modul asam basa dengan pendekatan SETS dapat melatihkan keterampian berpikir kritis peserta didi****K.****

Kata kunci: pendekatan SETS, berpikir kritis, modul, asam basa.

▪ INTRODUCTION

As we know, the world has entered the 21st-century, marked by changes in the entire areas of our life such as technology, transportation, economy, communication, information, etc., which are very fast and unpredictable (Redhana, 2019). Siswanto (2020), states that in this situation, humans are required to be tough people who are able to face everyday life challenges in this century, the way is to master the skills needed in this century. Based on the identification that the National Education Association has carried out, it is stated that the skills that must be owned by peoples in this century are called "The 4Cs skills" which include critical thinking, creativity, communication, and collaboration (NEA, 2012). "The 4Cs skills" are important because they are needed in solving scientific problems in everyday life (Eliyawati et al., 2020).

Education is an important factor in preparing human resources. Quality education is expected to form qualified and tough human resources so that they can compete globally in this era (Sari et al., 2019). However, the quality of education in Indonesia, especially in science, is still low (Pandela et al., 2019). Based on the Program for International Student Assessment (PISA) analysis in terms of science education in 2018, Indonesia is ranked 71 out of 79 participating countries (OECD, 2019). Students' low ability in Indonesia, especially in science education, can affect the quality of Indonesia's human resources if it is not addressed as soon as possible. Therefore, all parties involved must do their best to advance education in Indonesia.

The Regulation of National Ministry of Education Number 64 of 2013 about the Standard of Contents states that chemistry is one of the parts of natural science learning in Senior High School (SMA/MA). Chemistry is defined as the study of matter and its changes and the energy that accompanies these changes (Chang, 2010). In the context of mastery of 21st-century skills, chemistry learning is expected not only about the knowledge and skills transfer to students, but also develop thinking skills and attitude skills. More than that, after studying chemistry at school, it is expected that students can apply the competencies they have acquired as daily behavior in interacting with society, the environment and the use of technology (Kemendikbud, 2016).

The Regulation of National Ministry of Education & Culture Number. 37 of 2018, stated that one of the chemistry learning materials in SMA/MA class XI is acid-base. Learning chemistry on acid-base materials tends to lead to understanding the chemical concepts and their calculations. Chemistry, especially on acid-base material, is a difficult, abstract, and complex subject, which requires high reasoning skills and a maximum effort to understand (Cardellini, 2012). It requires teachers to present active learning, where in the learning process students are actively involved. However, the fact is that in chemistry learning, students are not actively involved and are only emphasize and apply it in everyday life (Maimunah, 2017; Suyanti, 2010). As a result, learning becomes meaningless, and students will easily forget the learning material because of the students' low understanding. In addition, students' thinking skills, which are very important to have in this century, have become untrained.

Among the several thinking skills that students must master in this century, critical thinking skills are one of those that must be mastered (Mutakinati et al., 2018). Critical thinking skills are very important skills to have because, with these skills, students will have problem solving skills that exist in everyday life, not only problems that exist in class during learning (BSNP, 2007; Eliyawati et al., 2020; Haseli & Rezali, 2013). According to King, Goodson, L., and Rohani (2010) explained that critical thinking skills are skills of analyzing, assessing, evaluating, reconstructing, making decisions that lead

to rational and logical actions. Critical thinking is a complex discussion process and involves a variety of behavior and skills. Critical thinking skills include several behavior tendencies such as curiosity, open-mindedness and others (Hasrudin et al., 2015). There are six indicators of critical thinking skills, namely: (a) interpretation, (b) analysis, (c) inference, (d) evaluation, (e) explanation, and (f) self-regulation (Facione, 2011). Based on previous research results, it was found that the critical thinking skills of high school students especially on acid-base material are mostly still low (Susilawati et al., 2020; Yessi et al., 2019).

Critical thinking skills can be trained through integrating and applying existing concepts to students' daily lives (Mulyani, Rudibyani, and Efkar, 2018). Critical thinking skills can be trained through innovative learning activities that paying attention to developments in science, environment, technology, and their relationship with contextual problems (Sari et al., 2019). The SETS approach is a learning approach that can train students' critical thinking skills (Poedjiadi, 2005). According to Aikenhead (1994), the purpose of learning with SETS approach is to make it easier for students to understand science, make science learning more fun, and improve their creative and critical thinking skills. Based on the result of the previous study, it can be seen that the learning process using of the SETS approach is able to train students' critical thinking skills (Amanda et al., 2018; Maimunah, 2017)

Basically, the SETS approach is integrated learning where the students will be able to see something with an integrated manner with four aspect, including science, environment, technology and society, so that students able to gain a deep understanding of the knowledge being studied (Minarti et al., 2012). The SETS approach learning is done by providing real and simple problems or phenomena in students' daily lives, which are then linked to the concept of science and its relationship with environmental, technology and society aspects (Yulistiana, 2015). Thus, students' critical thinking skills can be trained by connecting and then applying knowledge with technology beneficial to the environment and society (Hairida & Hadi, 2017).

The existence of learning materials has a significant role in supporting the learning process, namely by bridging and combining students' experiences and knowledge (Toharudin et al., 2011). With quality learning materials, it can facilitate teachers and students to simplify the learning process, in this case, chemistry (Direktorat Pembinaan SMA, 2008). According to Daryanto & Dwicahyono, (2014), there are four types of learning materials, namely visual learning materials, audio learning materials, audiovisual learning materials, and interactive multimedia learning materials. Learning materials included in the types of visual learning materials are modules, handouts, worksheets, etc. Module is a form of the learning material that can assist and facilitate the learning process. Modules are arranged comprehensively and systematically, containing a bunch of planned and designed learning experiences to help students master specific learning goals (Daryanto, 2013). According to the Ministry of Education (2008), module is a book written for students so that students can learn independently, whether there is assistance from the teacher or not. The content contained in a module usually consists of instructions, competencies to be achieved, learning objectives, student activity sheets, student worksheets, evaluation sheets, and answer keys (Prastowo, 2013). The characteristics of the module include: (1) self-instruction, (2) self-contained, (3) independent, (4) adaptive, (5) friendly (Daryanto, 2013).

▪ METHOD

This study includes development research where the method used was the Borg and Gall Research & Development (R&D). This model has ten stages as shown in Figure 1 below

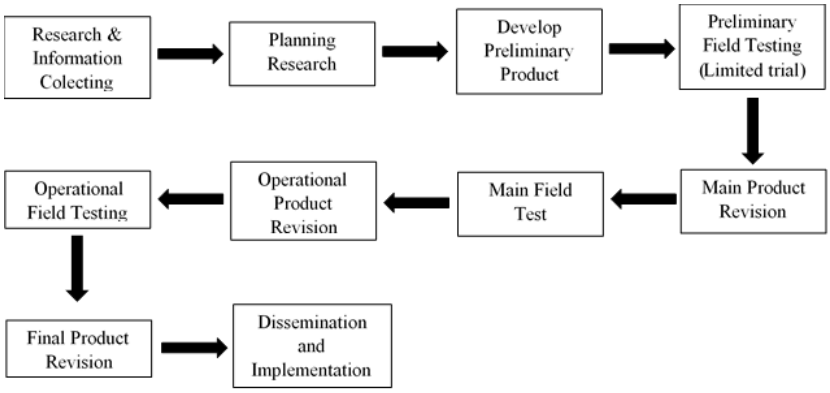

Figure 1. The stages on the Borg and Gall R&D

This research was only conducted until the fourth stage, namely limited trials (Ni'mah et al., 2017). The limited trial was carried out on 12 students at SMAN 1 Dongko. The feasibility of the developed product described based on the validity, practicality and effectiveness. Module validity was assessed from the assessment of 3 validators result, practicality was assessed from the student response questionnaire result, while effectiveness was assessed from the students' critical thinking skills test result.

The research instruments used were the review sheets, validation sheets, response questionnaire sheets, and critical thinking skills test sheets. This study's data sources were obtained from comments or suggestions and assessments from chemistry lecturers and teachers, students' responses, and critical thinking skills test scores. The method of the data collection used was the questionnaire method and the test method. The questionnaire method used included review, validation, and response questionnaires, then the test methods used included pretest and posttest.

The module review sheet was used to get comments or suggestions from the chemistry lecturer, which are used to improve the module's quality. Module validation sheet was used to obtain module validity data. It was filled in by three validators, including two chemistry lecturers and one chemistry teacher. The validators provide an assessment using a Likert scale in Table 1 as the basis for the assessment.

Table 1. Likert Scale

Scale	Category
5	Very good
4	Good
3	Normal
2	Bad
1	Very bad

(Riduwan, 2015).

Then the data obtained was calculated using the following formula:

$$\text{Validity (\%)} = \frac{\sum obtained\ score}{\sum criteria\ score} \text{ x } 100\%$$

Description:
Criteria score = maximum score for each aspect x number of aspects number of validator

The validity percentage obtained from the calculation was interpreted using the table 2, namely the table of score interpretation criteria so that the validity criteria of the module developed can be identified.

Table 2. Interpretation of Module Validity Scores

Percentage (%)	Category
0%-20%	Not valid
21%-40%	Less valid
41%-60%	Enough valid
61%-80%	Valid
81%-100%	Very valid

(Riduwan, 2015).

The module was stated to be valid if the validity percentage reached a percentage of ≥61% in the valid category or the very valid category.

The student response questionnaire sheet was used to obtain module practicality data. Determination of student response questionnaire data was based on the Table 3 bellow, namely the Guttman scale.

Table 3. Guttman Scale

Question	Answer	Score
Positive	Yes	1
	No	0
Negative	Yes	0
	No	1

Then the data obtained was calculated using the following formula to get the percentage of responses:

$$\text{Percentage (\%)} = \frac{\sum obtained\ score}{maximal\ score} \text{ x } 100\%$$

The percentage of response data was interpreted using the table 4 so that the practically criteria of the module developed can be identified.

Table 4. Interpretation of questionnaire responses percentage

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

(Riduwan, 2015).

The module was stated to be practical if the percentage reached a of ≥61% with the practical category or the very practical category.

The critical thinking skills test sheet consists of 2, namely the pretest and posttest. This test sheet was used to determine the developed module's effectiveness based on the

improvement of students' critical thinking skills. This improvement determined by using the n-gain score, which is calculated using the formula:

$$\text{n-gain} = \frac{posttest\ score - pretest\ score}{maximum\ score - pretest\ score}$$

The n-gain score obtained is interpreted using Table 5 below:

Table 5. Interpretation of the n-gain score

n-gain score	Category
g < 0,3	Low
0,3≤g≤0,7	Medium
g>0,7	High

(Hake, 1999).

The module was stated to be effective if each student reached an n-gain score of ≥ 0.3 with the medium or high category (Hake, 1999).

The critical thinking skills test result data were statistically analyzed using SPSS. Data normalized to determine whether the data were normally distributed or not using the Shapiro-Wilk test. The decision-making basis based on the Sig value in SPSS is:

If Sig <0.05, the data is not normally distributed

If Sig> 0.05, the data is normally distributed (Ghozali, 2016)

Then proceed with hypothesis testing, namely the Wilcoxon Test (Wilcoxon Sign Rank Test), to determine the influence of giving modules with SETS approach to improving students' critical thinking skills (Hartono, 2008). The criteria used to reject or accept a hypothesis based on the Asymp Sig value in SPSS are:

If Asymp. Sig <α then Ha is accepted

If Asymp. Sig> α then Ha is rejected (Ghozali, 2016)

Description:

H_0 = there is no effect of improving critical thinking skills after the learning implementation using the developed modules

Ha = there is an effect of improving critical thinking skills after the learning implementation using the developed modules

▪ RESULT AND DISCUSSION

This study, entitled "Acid-Base Module with SETS Approach to Train Students' Critical Thinking Skill" has the aim to obtain learning material products in the form of feasible modules and can train students' critical thinking skills. In this study, there are four stages include: 1) Research and information collecting, 2) Planning, 3) Product Development and 4) Limited Trial.

Research and Information Collecting

This is the very important stage in this research because, at this stage, the needs needed by teachers and students can be identified (Kurniawan & Hidayah, 2020). At this stage, literature study and analysis of students' potential problems and acid-base material were carried out (Suwandayani et al., 2016). Based on the literature study and identification that has been done, it can be seen that there are many students who experience a difficulty to understand the acid-base material. They are not encouraged to understand the material deeply but only memorize the material. Based on data collection

and literature study, information was obtained if the critical thinking skills of students, especially in high school level, are still low (Susilawati et al., 2020; Yessi et al., 2019), and the SETS approach was known to be able to train critical thinking skills (Yörük et al., 2010).

Based on the literature study, it can also be seen if the level of use and development of learning modules is still low. Schools mostly only use printed books circulating in the market, power points or some material summaries from teachers where the scope of the material is not comprehensive and looks less attractive (Julia et al., 2016; Ulya et al., 2018). Modules can be chosen as a learning resource alternative to support students learn independently or in groups (Rachmatia et al., 2016).

Planning

Based on the previous stage that has been carried out, then product planning was carried out. At this stage, basic competency adjustments, learning objectives and competency achievement indicators are made based on the 2013 curriculum. The module contains 3 main components, namely 1) Introduction consisting of: cover, introduction, table of contents, basic competencies, learning objectives, teacher instructions, and information about the SETS approach 2) Material explanation consisting of 3 section (acid-base theory, acid-base indicators and acid-base strength & pH) which in each section contains a description of the material and practice questions, 3) Closure consisting of: a summary of material and a bibliography.

Product Development

At this stage, the module was prepared in accordance with the planning that has been done in the previous stage. A chemistry lecturer reviewed the module's initial draft to obtain input and suggestions for module improvement. Furthermore, the suggestions and input that has been given used to improve the modules. After the review process was complete, then the module was validated by 3 validators to obtain module validity data.

Module validity

The module's validity was known from the validation results where 3 validators, namely 2 chemistry lecturers at the State University of Surabaya and 1 chemistry teacher at SMAN 1 Dongko, provided an assessment of the module that has been developed. The research instrument used was the module validity sheet. The assessment was carried out by giving a checkmark (√) on the rating scale used, namely 1-5. The data obtained were processed so that a percentage was obtained and the validity criteria of the module developed were known. The module was stated to be valid if the validity percentage obtained was ≥61% in the valid or very valid category (Riduwan, 2015). The percentage of assessment result given by the three validators can be shown in Table 6 below:

Table 6. Module Validation Results

No	Aspects assessed	Percentage (%)	Category
1	Content criteria	84,1	Very valid
2	Presentation criteria	84,17	Very valid
3	Language criteria	83,33	Very valid

Based on the module validation result of the content criteria validity percentage is 84.1% with a very valid category. The developed module has very valid criteria, which

means that there is suitability between the developed module and the 2013 curriculum, suitability with 4 aspects in the SETS approach, namely science, environment, technology and society and suitability with critical thinking skills that were trained, namely interpretation, analysis and inference. The module's material has been adjusted to content standards and basic competencies that apply in the 2013 curriculum. The module was written by paying attention to the four SETS approach aspect, namely science, environment, technology, and society. Students will have a deep understanding of acid-base material and its benefits and application in everyday life. The SETS approach used in the module can help students improve their critical thinking skills (Yörük et al., 2010). In addition to learning materials, the module also contains practice questions that can help students practice their critical thinking skills on 3 indicators, namely interpretation, analysis and inference. Students can also practice integrating the scientific concepts, in this case, acid-base with other aspects of the SETS by using the SETS chart.

Based on the result in the Table 6, the validity percentage of presentation criteria is 84.17% with very valid criteria. The presentation criteria validity includes the validators assessment of the appropriateness of the module's components presentation such as cover, title, the table of contents, instructions, learning objectives, concept maps, order of material preparation, student activities, summaries and bibliography, suitability of illustrations or images with the acid-base material and the presentation of the module was in an interesting and fun way. In addition, illustrations and images have been presented in accordance with the acid-base material and can make students feel interested and excited when learning using the modules.

Based on Table 6, the language criteria obtain a validity percentage of 83.33% with very valid criteria. It was very valid, indicating that the module developed has used good and correct Indonesian in accordance with the applicable rules, and an be understood easily. The terms and symbols in the module was appropriate, consistent, and can be understood easily.

Therefore, based on the validation result in terms of 3 criteria, namely content, presentation and language, it can be stated that the module was verry valid and suitable for use. These results are in line with previous research conducted by Hasanah & Isnawati, (2019) which states that student worksheets with SETS approach to training critical thinking skills on mushroom material are valid and feasible to use. In addition, it is also in accordance with the research conducted by Putri & Rusmini, (2021) which states that the module with the SETS approach to training critical thinking skills on hydrocarbon and petroleum materials is valid and feasible to use.

Limited Trials

Module that was stated valid was tested on a limited trial against 12 students of class XI who had received acid-base material at SMAN 1 Dongko. The data obtained from this stage is the practicality and effectiveness of the module.

Module practically

The module practicality is known from the student response questionnaire result. Response questionnaires are given to students after a limited trial. The response questionnaire was given in a questionnaire sheet containing 14 positive questions with two clear answer choices, namely "Yes" or "No". The data obtained were processed to obtain the percentage and practicality criteria from the developed module. Module stated

to be practical if it reach a practical percentage of ≥61% with practical or very practical category (Riduwan, 2015).

The average percentage of responses obtained was 98.81% with the very practical category. It shows that the module developed is very practical for use in chemistry learning. In this case, users find it easier to understand acid-base material in-depth and more enjoyable. The material presentation was clear, and the language used was easy to understand. The module's presentation was attractive so that users find learning to be more fun and less boring. In addition, the practice questions in the module can help users practice their critical thinking skills with the SETS approach help.

Module Effectiveness

The module effectiveness is known from the critical thinking skills test result. In this study there were three critical thinking skills indicators that were tested included interpretation, analysis and inference. Interpretation is the ability to understand and interpret various kinds of events, experiences, situations, data, rules and procedures. Categorization and explaining meaning is included in the sub-skills of interpretation. Analysis is the ability to identify actual relationships between statements, questions, or concepts to express knowledge, experience, beliefs, judgments, considerations, information, and opinions. The analysis sub skill includes ideas identification, arguments detection and arguments analysis. Meanwhile, the inference is the identification ability of the components needed to make rational conclusions, formulate hypotheses, relevant information consideration and know the consequences. Inference sub-skills are question evidence, suspect alternatives then conclude (Facione, 2011).

The critical thinking skills test consisted of 2 stages, namely the pretest and posttest. The module's effectiveness can be determined by students' critical thinking skills improvement from the pretest and posttest. Pretest was given to students before they learn by using modules to determine students' initial critical thinking skills. Posttest was given to students after they learn using modules to find out the improvement in students' critical thinking skills. The question sheets of pretest and posttest contain 10 essay questions The test result was analyzed using the n-gain score formula. The n-gain score for each student is shown in the Table 7 bellow.

Table 7. Critical Thinking Skills Test Result

No	Name	Pretest	Posttest	n-gain	Category
1	ALDF	56	85	0,66	Medium
2	AAL	55	89	0,75	High
3	APM	53	88	0,74	High
4	ERW	17,5	76	0,71	High
5	FU	58,5	90	0,76	High
6	IAA	23	80	0,74	High
7	NPA	12,5	80	0,77	High
8	NS	57,5	100	1	High
9	RN	56	85,7	0,67	Medium
10	RPM	53,5	98	0,96	High
11	RAW	53	91	0,81	High
12	WLN	20	90	0,87	High
Average				**0,79**	**High**

Based on Table 7 above, information is obtained that 10 students obtained an n-gain score of >0.7 with high category, and 2 students obtained an n-gain score of 0.3≤g≤0.7 with a medium category so that the n-gain score average obtained was 0.79 in the high category. These results indicate that after using the module there was an improvement in students' critical thinking skills.

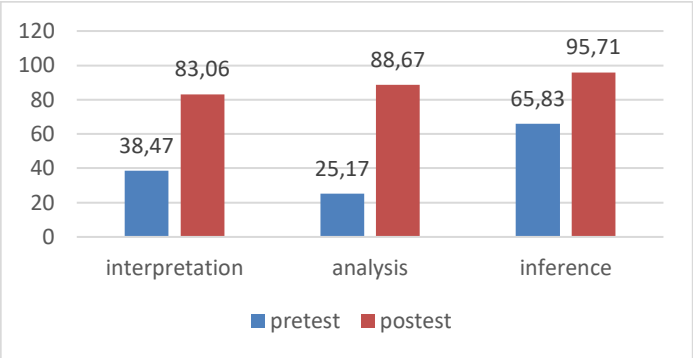

Figure 2. Graph of Increasing Critical Thinking Skills for Each Indicator

Figure 2 contains a graph showing critical thinking skills of the students in three indicators trained from the score of the pretest and posttest. Based on Figure 2, it can be seen if after using the acid-base module with SETS approach, students have increased their critical thinking skills for three indicators trained. This increase shows that the critical thinking skills of the students can be improved by the use of the SETS approach. It is in accordance with the previous research from Putri, W. R., Supardi, Z. I., & Sudibyo (2020), which states that learning with the SETS vision can improve the critical thinking skills of the students.

Based on the analysis results above, it is known if the use of the acid-base module with the SETS approach affects improving the critical thinking skills of the students. It was reinforced by the result of statistical analysis using SPSS 23 based on a hypothesis test. The normality test was carried out before starting the hypothesis test. This normality test aimed to determine the distribution of the data, whether the data was normally distributed or not (Ghozali, 2016). In this study, the chosen test of normality was the Shapiro-Wilk test because the number of data in this study were less than 50, and the Shapiro-Wilk test had higher normality consistency than other normality tests (Oktaviani & Notobroto, 2014; Razali & Wah, 2011). The normality test of the pretest and the posttest data result is shown in Table 8 below.

Table 8. Shapiro-Wilk Test Results

	Statistic	df	Sig.
Pretest	.731	12	.002
Posttest	.960	12	.788

The data in table 8 shows that the Sig. for the pretest data was <0.05, so it was not normally distributed, while the Sig. for the posttest data was >0.05, so it was normally distributed (Ghozali, 2016). Because there was not normally distributed data, namely the pretest data, so the statistical analysis was continued by using the Wilcoxon test which is a non-parametric test (Hartono, 2008). The result of the Wilcoxon test is in table 9 below.

Table 9. Wilcoxon Test Results

	Posttest-Pretest
Z	-3.059[b]
Asymp.Sig. (2-tailed)	.002

Based on table 9 the Asymp.Sig value is 0.002, meaning that the Asymp.Sig value is <0.05. So, it can be concluded that Ha is accepted, which means that there is an influence, namely an improvement in the critical thinking skills of the students after the learning implementation using the acid-base modules with the SETS approach.

The improvement in students' critical thinking skills caused by the learning process using the SETS approach involves several subcritical thinking skills such as identification, analysis, assessment, concluding and observing facts on acid-base material (Hairida & Hadi, 2017). Through the SETS approach, students are encouraged to think critically and deeply about the relationship between acid-base (science) with the use of technology related to acid-base compounds, the impact on the environment and society, and think about how to overcome the negative impacts caused by acid-base on the environment and society (Nugraha & Binadja, 2013). Thus, students' critical thinking skills become trained, and students gain a deeper understanding of acid-base material. So based on the description above, it can be stated that the acid-base module with the SETS approach can train students' critical thinking skills

▪ CONCLUSION

Based on the results obtained and the discussions that have been carried out, it can be concluded that the acid-base module with the SETS approach is stated very feasibly. The module gets a percentage of validity of 84.1% for content, 84.17% for presentation and 83.33% for a language where all three categories are very valid. The module's practicality was known from the student response questionnaire results and gets a practicality percentage of 98.81% with the very practical category. The module's effectiveness was known from the improvement of students' critical thinking skills, with n-gain score average obtained was 0.79 in the high category. It was reinforced by the statistical analysis using the Wilcoxon test and obtained Asymp. Sig <0.05 (0.002 <0.05), so that Ha is accepted. There was an improvement in students' critical thinking after the learning process using the acid-base modules with the SETS approach.

▪ REFERENCES

Aikenhead, G. S. (1994). What is STS science teaching? In: Solomon, J. and Aikenhead, G.S. Ed.,. *STS Education In-Ternational Perspectives on Reform.* New York: Teachers College Press.

Amanda, S., Muharrami, L. K., Rosidi, I., & Ahied, M. (2018). Peningkatan Kemampuan Berpikir Kritis Siswa pada Pembelajaran IPA Menggunakan Model Pembelajaran Berbasis Masalah yang Berbasis SETS. *Journal of Natural Science Education Research*, *1*(1), 57–64.

BSNP. (2007). *Kurikulum Tingkat Satuan Pendidikan*. Jakarta: BSNP.

Cardellini, L. (2012). Chemistry: Why the Subject is Difficult? / Química: ¿Por qué la disciplina es difícil? *Educación Química*, 1–6.

Chang, R. (2010). *Chemistry* (10th ed.). New York: McGraw-Hill Companies, Inc.

Daryanto. (2013). *Menyusun Modul Bahan Ajar Untuk Persiapan Guru Dalam Mengajar*. Yogyakarta: Gava Media.

Daryanto, & Dwicahyono, A. (2014). *Pengembangan Perangkat Pembelajaran*. Yogyakarta: Gava Media.

Depdiknas. (2008). *Penulisan Modul*. Jakarta: Depdiknas.

Direktorat Pembinaan SMA. (2008). *Panduan Pengembangan Bahan Ajar*. Jakarta: Kementerian Pendidikan Nasional Direktorat Jenderal Manajemen Pendidikan Dasar dan Menengah.

Eliyawati, Sanjaya, Y., & Ramdani, A. S. (2020). Implementation of Project Oriented Problem-Based Learning (POPBL) Model Integrated with STEM to Enhance Junior High School Students' Science Concept Mastery. *Jurnal Pena Sains*, *7*(2). 120-129.

Facione, P. a. (2011). *Critical Thinking : What It Is and Why It Counts*. Hermosa Beach: Measured Reasons LLC.

Ghozali, I. (2016). *Aplikasi Analisis Multivariate dengan Program IBM SPSS 23* (8th ed.). Semarang: BPFE Universitas Diponegoro.

Hairida, & Hadi, L. (2017). Improving Student's Critical Thinking Skills Through SETS Vision Learning. *Unnes Science Education Journal*, *6*(2), 1571–1576.

Hake, R. R. (1999). *Analyzing Change/gain Scores*. Woodland Hills : Dept of Physics, Indiana University.

Hartono. (2008). *Statistika untuk Penelitian*. Yogyakarta: Pustaka Pelajar.

Hasanah, U., & Isnawati. (2019). Validity of Salingtemas Based-Worksheet on Fungi Topic to Influence Critical Thinking Skill. *BioEdu*, *8*(3), 20–25.

Haseli, Z., & Rezali, F. (2013). The Effect o Teaching Critical Thinking on Eductional Achievement and Test Anxiety Among Junior High School Student in Savech. *European Online Journal of Natural and Social Science*, *2*(2), 168–175.

Hasrudin, Nasution, M. Y., & Rezeqi, S. (2015). Application of contextual learning to improve critical thinking ability of students in biology teaching and learning strategies class. *International Journal of Learning, Teaching and Educational Research*, *11*(3), 109–116.

Julia, D., Rosilawati, I., & Efkar, T. (2016). Pengembangan Modul berbasis Multipel Representasi pada Materi Garam dan Hidrolisis. *Jurnal Pendidikan Dan Pembelajaran Kimia*, *5*(3), 65–76.

Kemendikbud. (2016). *Silabus Mata Pelajaran Kimia untuk SMA/MA*. Jakarta: Kemendikbud.

King, F. J., Goodson, L., M. S., & Rohani, F. (2010). *Assessment & Evaluation Educational Services Program: Higher-Order Thinking Skills*. Washington D.C.: Educational Services Program.

Kurniawan, A. B., & Hidayah, R. (2020). Validitas Permainan Zuper Abase Berbasis Android Sebagai Media Pembelajaran Asam Basa. *Jurnal Pendidikan Dan Pembelajaran Kimia*, *9*(1), 63–70. https://doi.org/10.23960/jppk.v9.i1.202006

Maimunah. (2017). The Use of Science Environment Technology and Society (SETS) Learning Model for Enhancing The Critical Thinking Skills and Scientific Attitudes. *Jurnal Penelitian Dan Pembelajaran IPA*, *3*(1), 65–73.

Minarti, I. B., Susilowati, S. M. E., & Indriyanti, D. R. (2012). Perangkat Pembelajaran Ipa Terpadu Bervisi SETS Berbasis Edutainment Pada Tema Pencernaan. *Journal of Innovative Science Education*, *1*(2), 105–111.

Mulyani, S. D., Rudibyani, R. B., & Efkar, T. (2018). Efektivitas LKS Berbasis Multipel Representasi dalam Meningkatkan Kemampuan Berpikir Kritis. *Jurnal Pendidikan Dan Pembelajaran Kimia*, *7*(2), 1–12.

Mutakinati, L., Anwari, I., & Yoshisuke, K. (2018). Analysis of students' critical thinking

skill of middle school through stem education project-based learning. *Jurnal Pendidikan IPA Indonesia*, *7*(1), 54–65. https://doi.org/10.15294/jpii.v7i1.10495

NEA. (2012). *A-Guide-to-Four-Cs*. Washington D.C.: National Education Association.

Ni'mah, M., Hidayah, R., Aprianto, & Hidayati, N. (2017). Kepraktisan dan keefektifan LKPD berbasis problem based learning untuk melatihkan kemampuan literasi sains pada materi asam basa. *Jurnal Pendidikan Kimia*, *9*(3), 347–351.

Nugraha, D. A., & Binadja, A. (2013). Pengembangan Bahan Ajar Reaksi Redoks Bervisi Sets, Berorientasi Konstruktivistik. *Journal of Innovative Science Education*, *2*(1).

OECD. (2019). *PISA 2018 Results Combined Executive Summaries*. PISA-OECD Publishing.

Oktaviani, M. A., & Notobroto, H. B. (2014). Perbandingan tingkat konsistensi normalitas distribusi metode Kolmogorov-Smirnov, Lilliefors, Shapiro-Wilk, dan Skewness-Kurtosis. *Jurnal Biometrika Dan Kependudukan*, *3*(2), 127–135.

Pandela, Y. S., Sunyono, & Rudibyani, R. B. (2019). Pengaruh Isu Sosio-Saintifk dalam Meningkatkan Kemampuan Berpikir Kritis pada Materi Larutan Elektrolit dan Non-Elektrolit. *Jurnal Pendidikan Dan Pembelajaran Kimia*, *8*(2). 296-307.

Poedjiadi, A. (2005). *Sains, Teknologi, and Masyarakat (STM)*. Bandung: PT Remaja Rosdakarya.

Prastowo, A. (2013). *Panduan Kreatif Membuat Bahan Ajar Inovatif*. Yogyakarta: Diva Press.

Putri, W. R., Supardi, Z. I., & Sudibyo, E. (2020). the Effectiveness of Learning Devices Through the Stem Approaches To Train Students ' Critical. *Jurnal Education and Development*, *8*(2), 281–284.

Putri, D. K., & Rusmini. (2021). Hydrocarbon and Petroleum with SETS Approach Module to Train Students' Critical Thinking Skills. *Indonesian Journal of Science and Mathematics Education*, *4*(1), 12–24. https://doi.org/10.24042/ijsme.v4i1.7839

Rachmatia, E., Aunurrahman, & Usman, A. (2016). Pengembangan Modul Pembelajaran Kimia untuk Kecakapan Membangun dan Menggunakan Konsep Redoks dan Hidrokarbon Kelas X SMAN 3 Sungai Kakap. *Journal Of Prospective Learning*, *1*(2), 20–31.

Razali, N. M., & Wah, Y. B. (2011). Power Comparision of Shapiro-Wilk, Kolmogorov_Smirnov, Lilliefors, and Anderson-Darling tests. *Journal of Statistical Modeling and Analytics*, *2*(1), 21–33.

Redhana, I. W. (2019). Mengembangkan Keterampilan Abad Ke-21 dalam Pembelajaran Kimia. *Jurnal Inovasi Pendidikan Kimia*, *13*(1), 2239–2253.

Riduwan. (2015). *Skala Pengukuran Variabel-Variabel Penelitian*. Bandung: Alfabeta.

Sari, R. M. N., Suryaningsih, S., & Yunita, L. (2019). The Correlation of Guided Inquiry Model with SETS Approach on Students' Critical Thinking Skills. *Edusains*, *10*(2), 341–348. https://doi.org/10.15408/es.v10i2.10268

Siswanto. (2020). *Mempersiapkan Society 5.0 melalui Pembelajaran Fisika*. SNPF (Seminar Nasional Pendidikan Fisika), Univeristas PGRI Madiun, 31 July 2019, Madiun

Susilawati, E., Agustinasari, Samsudin, A., & Siahaan, P. (2020). Analisis Ketreampilan Berpikir Kritis Siswa SMA. *Jurnal Pendidikan Fisika Dan Teknologi*, *6*(1), 11–16.

Suwandayani, B. I., Akbar, S., & Hanurawan, F. (2016). Model Pembelajaran Pendidikan Karakter Kelas I di SD Negeri Kauman I Kota Malang. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *1*(10), 1981–1986.

Suyanti, D. R. (2010). *Strategi Pembelajaran Kimia*. Yogyakarta: Graha Ilmu.

Toharudin, U., Hendrawati, S., & Rustaman, A. (2011). *Membangun Literasi Sains Peserta Didik*. Bandung: Humaniora.

Ulya, H., Rudibyani, R. B., & Efkar, T. (2018). Pengembangan Modul Kimia Berbasis Problem Solving Pada Materi Asam Basa Arrhenius. *Jurnal Pendidikan Dan Pembelajaran Kimia*, *7*(1), 129–141.

Yessi, M., Sudyana, I. N., & Fatah, A. H. (2019). Pembelajaran Asam Basa Menggunakan LKS Berbasis Learning Cycle 7E untuk Meningkatkan Penguasaan Konsep dan Keterampilan Berpikir Kritis Siswa SMA. *Quantum: Jurnal Inovasi Pendidikan Sains*, *10*(1), 27–37. https://doi.org/10.20527/quantum.v10i1.5687

Yörük, N., Morgil, I., & Seçken, N. (2010). The Effects of Sience, Technology, Society, Environment (STSE) Interactions on Teaching Chemistry. *Natural Science*, *02*(12), 1417–1424. https://doi.org/10.4236/ns.2010.212173

Yulistiana, Y. (2015). Penelitian Pembelajaran Berbasis SETS (Science, Environment, Technology, And Society) dalam Pendidikan Sains. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, *5*(1), 76–82. https://doi.org/10.30998/formatif.v5i1.169