DEVELOPMENT OF *E* -MODULE IN ACID BASE MATERIALS *GUIDED INQUIRY LEARNING* BASED ON IMPROVING STUDENTS' LEARNING MOTIVATION

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Abstract. *The purpose of this study (1) to determine the validity of the chemistry e-module based on Guided Inquiry Learning (2) to determine the increase in student learning motivation after using the chemistry e-module based on Guided Inquiry Learning. Data were obtained from observation, interviews and distribution of motivation questionnaires. The development model used was 4-D, but only the define, design and development stages were implemented. The subjects of the e-module trial were 26 students of class XI MA Almuhtadi. This study used quantitative descriptive analysis and also inferential analysis. The conclusions in this study (1) the validity of the developed e-module obtained an average score presentation of 88.53% with very valid criteria, which means that the e-module is suitable for use in the learning process and (2) the acid-base e-module based on Guided Inquiry Learning that was developed can increase student learning motivation.*

Keywords: *e-module, acids-bases, guided inquiry learning, student motivation.*

INTRODUCTION

Education is a service provided by educators through educational units. In this case, the government can provide quality services and assistance to help children develop their potential well [1] . Therefore, it is hoped that through the education process, scientists, innovators, and even many people who care about the environment and are able to develop it to help improve human civilization will be born. Especially at the high school level and equivalent, students receive science subjects, one of which is chemistry.

Most students consider chemistry to be a complicated and boring subject. As a result, chemistry is one of the subjects that students dislike [2] . Some of the difficulties faced by students in learning chemistry are because students do not know what they are learning, struggle to make connections between ideas and need to apply their knowledge of language, logic, and mathematics [2] .

Chemistry learning currently requires more diverse learning resources , not only using worksheets and lecture methods that are often considered boring by students, especially at MA Almuhtadi. As in the results of pre-research observations in class Therefore, researchers in this study used electronic media technology, namely by using *e-* modules. E-modules are one form of digital learning which was originally a printed module, this is a digital transformation in the world of education. Digital transformation in the world of education helps improve the learning experience for students and teachers, as well as others involved in the learning process. [3] .

The learning model also influences the learning motivation of MA Almuhtadi students, there are 97% of students who have low motivation and 3% of students who have moderate motivation, so that the right learning model and media are needed to encourage students to enjoy the lesson, grow and improve

student learning activities, and make lessons easier for students to understand, one way is to use *the Guided Inquiry Learning model* . The *Guided Inquiry learning model* is a learning model that is made on the basis of conceptual learning and connecting several concepts in the subject matter, the teacher plays an active role in determining the problem and determining the stages of its completion and guiding students to find patterns in the problem and providing reinforcement when students have been able to understand the concept that has been taught by the educator [4] .

METHOD

The method used in this study is Research and Development (R&D), In this study, researchers took 26 students of class XI MIPA as test subjects. This research procedure applies a 4-D development model, but only 3 are used, namely define, design, and development to produce the development of acid-base E-modules based on guided inquiry learning and to increase student learning motivation.

Development Stage

Define Stage

Struggle to make connections between ideas and need to apply their knowledge of language, logic, and mathematics.

Early-late analysis

In the results of observations and interviews with chemistry teachers of MA Almuhtadi, problems were found in the chemistry learning process, namely difficulties in chemistry materials, especially acids and bases, due to a lack of understanding of the concept of acids and bases, because they never apply the theory in everyday life, often making mistakes in understanding the questions. Both in the material on determining pH and POH, they cannot distinguish between acid and base compounds. Students experience boredom in the learning process with the learning model used by teachers in the form of lectures and media that are only in the form of worksheets.

Student Analysis

Struggle to make connections between ideas and need to apply their knowledge of language, logic, and mathematics. (1) Students' habits in using and operating *smartphones* almost every day are done on social media, watching videos and playing *games* . (2) Students who were the subjects of the study were class XI with an average age of 16-17 years. Children in this age group are at the formal operational stage or can already think abstractly and can solve problems.

Material Analysis

The activities carried out in this step are to identify, detail, and systematically organize the main material that will be studied by students. Based on the Regulation of the Minister of Education and Culture Number 28 of 2021, an analysis of acid-base material was obtained in accordance with the achievements of phase F chemistry learning and learning objectives.

Design Phase

At this stage, *e*- module-1 is produced. The results are as follows.

Media Selection

The selection of media is adjusted to the results of the material analysis that has been carried out and adjusted to the characteristics of the students. The learning media selected in this study is an *e*- module.

Format selection

The selection of the format is intended to design or compile *e* -module content that is adjusted to the learning materials and the Independent Curriculum. The *selected e-module development format contains text, symbols, and images. The final format of the e* -module is *a professional flip pdf* and is published in HTML format.

Initial design

There are some initial designs as an initial display in *the form of a storyboard.*

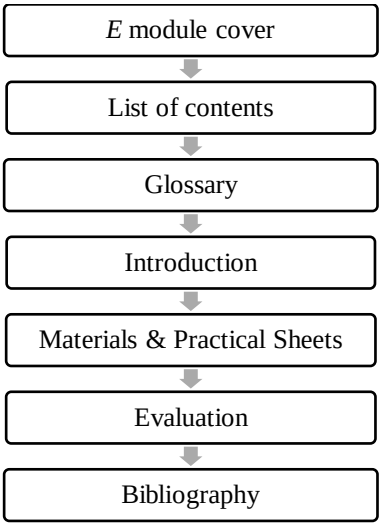


Figure 1 Storyboard for preparing e-modules

***Development* Stage**

At this stage, the final form of the e-module is produced after going through revisions based on input from experts and trial data. The steps taken at this stage are as follows.

Expert review

At this stage, experts are asked to review or provide suggestions for the media that has been completed at the design stage (e-module - 1). The reviewers are also validators of *e*- module-2. As for the expert reviewers are three lecturers of chemistry education at Billfath University with expertise in Chemistry Education. Furthermore, suggestions from the reviewers are used as material. considerations for making revisions. After *e*- module-1 is revised, *e*- module-2 is obtained and validation is carried out .

Expert validation

Expert validation was conducted to determine the feasibility of e-module-2, whether the media was valid or not valid for use in the trial. The validation conducted by the validator includes 2 (two) assessment aspects, namely (1) e-module validation: At this stage the validator validates the developed *e- module including software display* , illustrative presentation, layout, media interactivity, language and readability. (2) e-module material validation: At this stage the validator validates the material in the developed *e*- module where the aspects assessed are the suitability of learning outcomes, learning objectives, material sequence, acid-base concepts, and practice questions.

Trials

At this stage, the developer conducted a trial on class XI-MIPA at MA Almuhtadi Sendangagung to determine the level of student motivation after learning using the acid-base e-module based on Guided Inquiry on e-module-2.

Data Analysis Techniques

The data obtained from the questionnaire were analyzed using descriptive and inferential quantitative techniques. Quantitative analysis techniques were used to calculate the percentage of media feasibility, inferential analysis was used to see the increase in student motivation. This data analysis technique was carried out to find out the level of validity of the e-module in terms of material experts, media, and from increasing student learning motivation.

Validation Results Analysis

The formula used to calculate the percentage of questionnaire scores is as follows.

$$P = \frac{\sum x}{n} \text{ x } 100\%$$

Information : P = Percentage of average score
$\sum x$= Average score sum
n= maximum total score

The percentage of scores obtained is used to determine the validity of the e-module according to the criteria in Table 1.

Table 1 Validity Criteria Percentage

Average Score Percentage	Validity Criteria
85-100	Very valid
70-84	Legitimate
55-69	Quite valid
50-54	Invalid
<50	Invalid

[5]

If the validation results show a percentage below 54%, then the e-module must be revised to be better according to the validator's suggestions.

Analysis of Learning Motivation Questionnaire Results

This analysis technique was carried out to determine the increase in learning motivation after using *the Guided Inquiry - based e-module* by analyzing the student learning motivation questionnaire.

The formula used to analyze the student motivation questionnaire is as follows.

$$P = \frac{\sum x}{n} \times 100\%$$

Information : P = Percentage of average score
$\sum x$= Average score sum
n= maximum total score

The percentage of scores obtained is used to determine students' learning motivation according to the criteria in table 2.

Table 2 Motivation Criteria

Average Score Percentage	Motivation Criteria
81% - 100%	Very high
61% - 80%	Tall
40% - 60%	Low
21% - 40%	Enough
0% - 20%	Not enough

(Komarudin, 2010)

After that, a paired t-test was used to evaluate the hypothesis that students' motivation to study had increased. (for data that is normally distributed) or the Wilcoxon test (for data that is not normally distributed). Because there are two matched groups in the study's sample, the Wilcoxon or matched T test is used. Doing a normalcy test is the first step before choosing the test to be utilized. Since there are ≤ 50 responders, the Shapiro-Wilk test is used for the normality test. The following are the procedures for examining the data from the motivation questionnaire: (1) Normality test: SPSS 25 is utilized to conduct this test, and a 0.05 error rate was used for this investigation. Using the paired t-test if the data is normally distributed, and the Wilcoxon test if it is not, hypothesis testing is used to determine whether or not there is an increase in student learning motivation following instruction using e-modules. If the pretest and posttest significance values are greater than 0.05, the data is considered normally distributed; otherwise, it is not. According to the criteria in this hypothesis test, the hypothesis is rejected if the significance value is greater than 0.05 and accepted if it is less than 0.05. The implementation of e-modules based on guided inquiry learning can boost student learning motivation, according to the sound study premise.

RESULTS AND DISCUSSION

Results of the Development of Acid Base E-Modules Based on *Guided Inquiry Learning*

The results of the development of *the acid-base e-module based on Guided Inquiry Learning* are as follows.

Cover

The e-module cover is designed to contain the identity which includes the title, education level, and class.

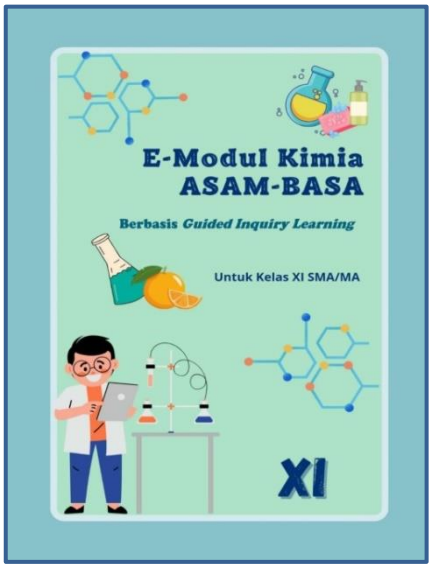


Figure 2 Cover of *e* -module

List of contents

e-modules contain organized pages of chapters, sections, and images to make it easier for readers and writers to find pages.

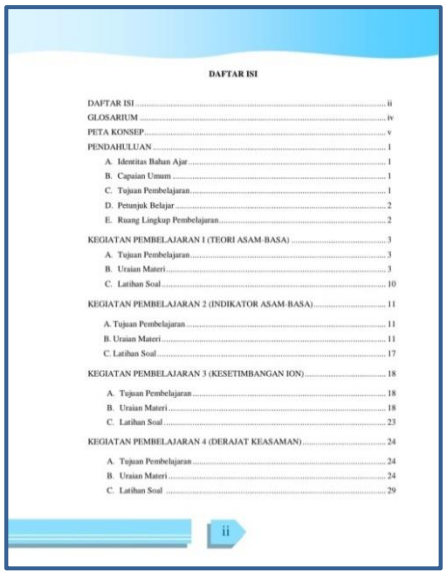


Figure 3 Table of contents *of e* -module

Glossary

This glossary consists of a list of important words or terms compiled to define terms in acid-base chemistry.

Figure 4 Glossary *E-module*

Concept maps

A concept map consists of diagrams that depict the relationships between acid-base concepts that will be discussed in the lesson.

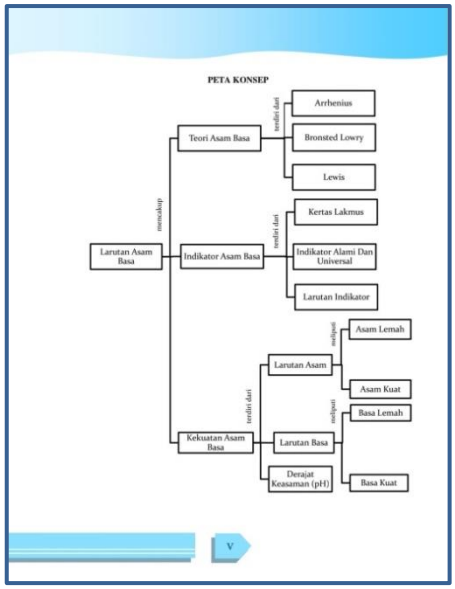


Figure 5. Acid-base concept map

Introduction

The introduction contains the learning identity (courses, materials, number of credits and learning targets), learning achievements in phase F, learning objectives, learning instructions and scope of learning.

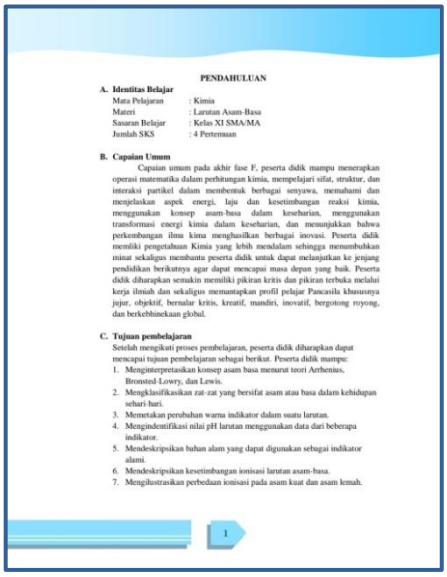
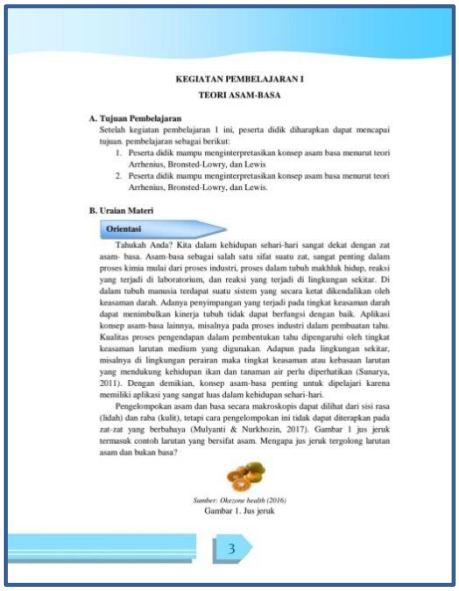


Figure 6 Introduction *to e* -module

Material Contents

The material contained in *the e-* module contains a description of the material based on *the syntax of Guided Inquiry Learning* (orientation, problem formulation, hypothesis formulation, data collection and at the end

there is a conclusion). Equipped with exploration questions and also practice questions in each learning activity.



KEGIATAN PEMBELAJARAN I

TEORI ASAM-BASA

A. Tujuan Pembelajaran

Setelah kegiatan pembelajaran 1 ini, peserta didik diharapkan dapat mencapai tujuan pembelajaran sebagai berikut:

1. Peserta didik mampu menginterpretasikan konsep asam basa menurut teori Arrhenius, Bronsted-Lowry, dan Lewis
2. Peserta didik mampu menginterpretasikan konsep asam basa menurut teori Arrhenius, Bronsted-Lowry, dan Lewis.

B. Uraian Materi

Orientasi

Tahukah Anda? Kita dalam kehidupan sehari-hari sangat dekat dengan zat asam- basa. Asam-basa sebagai salah satu sifat suatu zat, sangat penting dalam proses kimia mulai dari proses industri, proses dalam tubuh makhluk hidup, reaksi yang terjadi di laboratorium, dan reaksi yang terjadi di lingkungan sekitar. Di dalam tubuh manusia terdapat suatu sistem yang secara ketat dikendalikan oleh keasaman darah. Adanya penyimpangan yang terjadi pada tingkat keasaman darah dapat menimbulkan kinerja tubuh tidak dapat berfungsi dengan baik. Aplikasi konsep asam-basa lainnya, misalnya pada proses industri dalam pembuatan tahu. Kualitas proses pengendapan dalam pembentukan tahu dipengaruhi oleh tingkat keasaman larutan medium yang digunakan. Adapun pada lingkungan sekitar, misalnya di lingkungan perairan maka tingkat keasaman atau kebasaan larutan yang mendukung kehidupan ikan dan tanaman air perlu diperhatikan (Sunarya, 2011). Dengan demikian, konsep asam-basa penting untuk dipelajari karena memiliki aplikasi yang sangat luas dalam kehidupan sehari-hari.

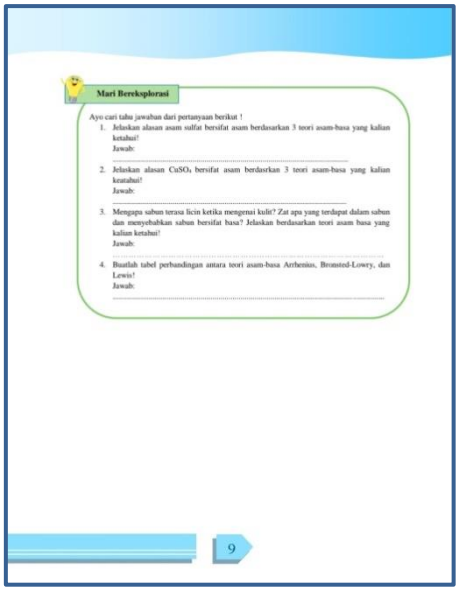
Pengelompokan asam dan basa secara makroskopis dapat dilihat dari sisi rasa (lidah) dan raba (kulit), tetapi cara pengelompokan ini tidak dapat diterapkan pada zat-zat yang berbahaya (Mulyanti & Nurkhozin, 2017). Gambar 1 jus jeruk termasuk contoh larutan yang bersifat asam. Mengapa jus jeruk tergolong larutan asam dan bukan basa?

Sumber: Okezone health (2016)

Gambar 1. Jus jeruk

3

Figure 7 Acid base theory learning activities



Mari Bereksplorasi

Ayo cari tahu jawaban dari pertanyaan berikut !

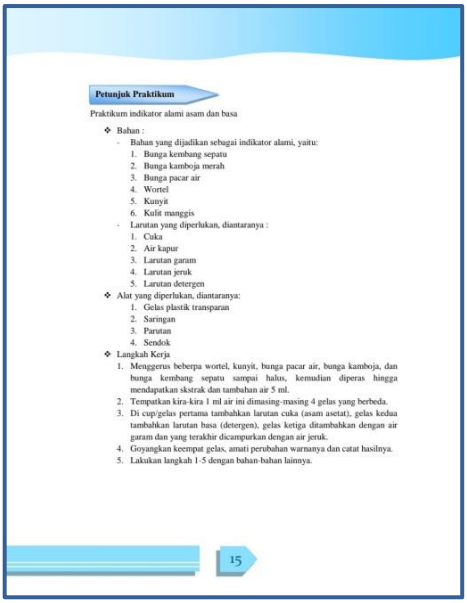
1. Jelaskan alasan asam sulfat bersifat asam berdasarkan 3 teori asam-basa yang kalian ketahui!
   Jawab:
2. Jelaskan alasan $CuSO_4$ bersifat asam berdasarkan 3 teori asam-basa yang kalian ketahui!
   Jawab:
3. Mengapa sabun terasa licin ketika mengenai kulit? Zat apa yang terdapat dalam sabun dan menyebabkan sabun bersifat basa? Jelaskan berdasarkan teori asam basa yang kalian ketahui!
   Jawab:
4. Buatlah tabel perbandingan antara teori asam-basa Arrhenius, Bronsted-Lowry, dan Lewis!
   Jawab:

9

Figure 8 Let's Explore

Practicum

The lab sheet is a guideline used by students in carrying out acid-base lab activities which is equipped with an observation table.



Petunjuk Praktikum

Praktikum indikator alami asam dan basa

- Bahan :
  - Bahan yang dijadikan sebagai indikator alami, yaitu:
    1. Bunga kembang sepatu
    2. Bunga kamboja merah
    3. Bunga pacar air
    4. Wortel
    5. Kunyit
    6. Kulit manggis
  - Larutan yang diperlukan, diantaranya :
    1. Cuka
    2. Air kapur
    3. Larutan garam
    4. Larutan jeruk
    5. Larutan detergen
- Alat yang diperlukan, diantaranya:
  1. Gelas plastik transparan
  2. Saringan
  3. Parutan
  4. Sendok
- Langkah Kerja
  1. Menggerus beberpa wortel, kunyit, bunga pacar air, bunga kamboja, dan bunga kembang sepatu sampai halus, kemudian diperas hingga mendapatkan sikstrak dan tambahan air 5 ml.
  2. Tempatkan kira-kira 1 ml air ini dimasing-masing 4 gelas yang berbeda.
  3. Di cup/gelas pertama tambahkan larutan cuka (asam asetat), gelas kedua tambahkan larutan basa (detergen), gelas ketiga ditambahkan dengan air garam dan yang terakhir dicampurkan dengan air jeruk.
  4. Goyangkan keempat gelas, amati perubahan warnanya dan catat hasilnya.
  5. Lakukan langkah 1-5 dengan bahan-bahan lainnya.

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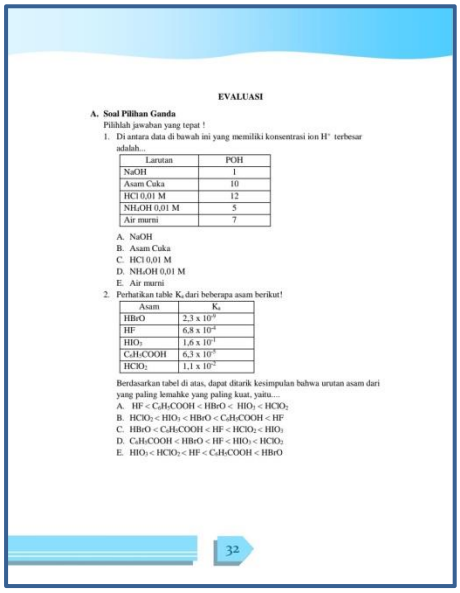
Figure 9 Layout of the Practical Sheet

Evaluation

Evaluation is used to determine the extent to which a learning activity has been achieved by students.



EVALUASI

A. Soal Pilihan Ganda

Pilihlah jawaban yang tepat !

1. Di antara data di bawah ini yang memiliki konsentrasi ion H^+ terbesar adalah...

Larutan	POH
NaOH	1
Asam Cuka	10
HCl 0,01 M	12
NH_4OH 0,01 M	5
Air murni	7

A. NaOH
B. Asam Cuka
C. HCl 0,01 M
D. NH_4OH 0,01 M
E. Air murni

2. Perhatikan table K_a dari beberapa asam berikut!

Asam	K_a
HBrO	$2,3 \times 10^{-9}$
HF	$6,8 \times 10^{-4}$
HIO_3	$1,6 \times 10^{-1}$
C_6H_5COOH	$6,3 \times 10^{-5}$
$HClO_2$	$1,1 \times 10^{-2}$

Berdasarkan tabel di atas, dapat ditarik kesimpulan bahwa urutan asam dari yang paling lemahke yang paling kuat, yaitu...

A. $HF < C_6H_5COOH < HBrO < HIO_3 < HClO_2$
B. $HClO_2 < HIO_3 < HBrO < C_6H_5COOH < HF$
C. $HBrO < C_6H_5COOH < HF < HClO_2 < HIO_3$
D. $C_6H_5COOH < HBrO < HF < HIO_3 < HClO_2$
E. $HIO_3 < HClO_2 < HF < C_6H_5COOH < HBrO$

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Figure 10. Evaluation *Layout*

Validation Results and Discussion (Media and Materials)

Media Validation

Media validation was conducted by expert validators, where aspects assessed included the appearance of the e-module, presentation of illustrations (pictures) of the e-module, language and readability. The validation results were used as a basis for

determining the feasibility of the media. The results of the media validation are presented in Table 3.

Table 3 Media Validation Results

NO	Rated aspect	Average Score	% Per Aspect	Criteria
1	Electronic module display	3.63	90.62	Very valid
2	E-module illustration presentation	3.33	83.33	Legitimate
3	Language and readability	3.66	91.66	Very valid
% Average Score			88.53	Very valid

Based on Table 3, the aspects that obtained the highest scores were language and readability with a percentage of 91.66% and obtained an average score percentage of 88.53% with very valid criteria.

Material Validation

Validation of the material was carried out by expert validators, where the aspects assessed were suitability with the learning achievements of phase F, learning objectives, material sequence, acid-base concepts, practice questions and evaluations. The results of the material validation are presented in Table 4.

Table 4 Material Validation Results

No	Rated aspect	Average Score	% Per Aspect	Criteria
1	General Achievements of Phase F	4.00	100	Very valid
2	Learning objectives	4.00	100	Very valid
3	Material Order	4.00	100	Very valid
4	Acid base concept	3.41	85.41	Very valid
5	Practice questions and evaluation	3.77	94.44	Very valid
% Average Score			95.97	Very valid

Based on Table 4, the aspect that obtained the highest score was the suitability of general achievements, learning objectives and sequence of materials with a percentage of 100% and obtained an average score percentage of 95.97% with very valid criteria.

Trials

The trial phase was conducted to obtain data on whether or not there was an increase in students' learning motivation. To determine whether or not there was an increase in students' learning motivation using *the Guided Inquiry Learning-based e-module*, a motivation questionnaire was used which was given before and after being taught using the e-module. Before testing the hypothesis of whether or not there was an increase, a normality test was first conducted. The results of the normality test can be seen in Table 5 below:

Tabel 5 *Shapiro-Wilk* Normality Test

	Shapiro Wilk		
	Statistics	*df*	*Sig.*
Pretest	0.956	26	0.318
Posttest	0.943	26	0.162

As can be seen from Table 5, the data is normally distributed since both the pretest and posttest significance values are more than 0.05. To ascertain whether or not there is an increase in student learning motivation following instruction using the e-module, the hypothesis will next be tested. A paired two-sample test, or paired t-test, is used in hypothesis testing. The data is regularly

distributed, hence the Paired t-test is used. Table 6 below displays the findings of the Paited t-test:

Table 6 *Paired t-test* output

	t	df	Sig(2-tailed
Pretest-Posttest	-2.882	25	0.008

H0 is rejected and H1 is accepted based on Table 6 of the paired t-test above, which shows that there is a significant increase in learning motivation using the acid-base e-module based on Guided Inquiry before receiving treatment (pretest) and after receiving treatment (posttest).

This is also reinforced by research by Awwaliyah et al., that from the questionnaire data on student learning motivation before and after using the chemistry e-module, there was an increase from 69.93% to 85.03% with an effective category [7] . Based on research conducted by Handayani et al., the level of student learning motivation after using the e-module on acid-base chemistry material based on Problem Based Learning was 60.40% and increased after using the e-module to 80.09% with a very high category. [8] .

This is also in accordance with the research results of Oksa and Soenarto that before using the chemistry e-module, the average student learning motivation was 74.82% with a low category, while after using the chemistry e-module, the average student learning motivation was 85.03% with a high category [9] .

CONCLUSION AND SUGGESTIONS

Conclusion

The following conclusions can be drawn from the analysis and discussion results: (1) The developed e-module's validation results showed an average score percentage of 88.53% with very valid criteria, and the material's validation showed an average score of 95.97%, indicating that the e-module is very valid for use in learning. (2) The acid-base e-module based on Guided Inquiry Learning that was developed can increase student learning motivation.

Suggestion

In relation to the weaknesses of the e-module, the researcher provides suggestions to readers who wish to develop similar e-modules to perfect or add parts of the acid-base material that are not yet listed, animations and illustrations (adding illustrations and animations that are in accordance with the concept with clear resolution).

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