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Development of an Acid Base E-Module based on Flip Book Vocational School Industrial Pharmacy Skills Program

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Abstract

The development of e-modules aims to become an effective learning resource for students, especially in studying acid-base material at the vocational school level. This research aims to evaluate the validity and responses of students to e-modules on acid-base material created using the Flip Book application. The research method used is development research with the ADDIE model. Data was analyzed quantitatively descriptively. The object of the trial is limited to practical aspects, namely class XI students in the Industrial Pharmacy skills program. The research results show that the e-module developed using Flip Book has been validated by material experts, media experts, chemistry subject teachers and pharmaceutical expertise programs, and laboratory assistants, with a score of 95.17%, indicating a very good category and suitable for use in learning . The results of the e-module practicality test of 3.58 are included in the very good category.

Keywords: ADDIE, e-Modul Asam Basa, *Flip Book*, SMK**.**

ABSTRAK

Pengembangan e-modul bertujuan untuk menjadi salah satu sumber belajar yang efektif bagi peserta didik, khususnya dalam mempelajari materi asam basa di tingkat SMK. Penelitian ini bertujuan untuk mengevaluasi validitas dan respon siswa terhadap e-modul materi asam-basa yang dibuat menggunakan aplikasi *Flip Book*. Metode penelitian yang digunakan adalah penelitian pengembangan dengan model ADDIE. Data dianalisis secara deskriptif kuantitatif. Objek uji coba terbatas pada aspek kepraktisan yaitu peserta didik kelas XI program keahlian Farmasi Industri. Hasil penelitian menunjukkan bahwa e-modul yang dikembangkan menggunakan *Flip Book* telah divalidasi oleh ahli materi, ahli media, guru mata Pelajaran kimia dan program keahlian farmasi, dan laboran, dengan sebesar 95,17%, menunjukkan kategori yang sangat baik dan layak digunakan dalam pembelajaran. Hasil uji coba kepraktisan e-modul sebesar 3,58 kategori tersebut termasuk dalam kategori sangat baik.

Kata Kunci : ADDIE, e-Modul Asam Basa, *Flip Book*, SMK.

INTRODUCTION

Education has an important role in human life because through education a person can apply the knowledge gained for the benefit of society. Education in the 22nd century is seen as education based on technology because almost all aspects of education are required to use technology. The technology base shows that there are broader, easier, more effective and efficient learning innovations (Syamsuar & Reflianto, 2018). Improving the quality of education is fundamental to creating an independent, creative, innovative and superior generation, capable of facing increasingly complex changes in times. Education in the Era of Society 5.0 demands the birth of superior human resources, a better education system, and requires students to have basic knowledge and reading skills (Handayani & Muliastrini, 2020). The era of society 5.0 requires students to be more critical because they are prepared as more advanced human resources so that they are not defeated by robots (Agustina & Wibawa, 2019).

Reforms in the field of chemistry education are currently being carried out through various studies, both from content and pedagogical aspects, using new standards that are more meaningful, authentic and contextual. As part of the study of science education, chemistry education essentially teaches students so that the material taught is not only limited to knowledge gained, but also becomes knowledge that can be used for human survival (Hovstein & Kesner, 2006). The government has taken various steps to improve and increase the quality of education, one of which is through the implementation of an independent curriculum. Implementing the Merdeka curriculum in schools requires teachers to adopt learning processes in accordance with national education standards. In learning, students acquire basic competencies to achieve core competencies. Conformity to graduation competency standards is measured based on aspects of attitudes, knowledge and skills possessed by students (Mulyasa, 2013).

Vocational High Schools (SMK) are part of the education system that specifically helps students prepare to enter the world of work. Vocational schools are expected to support economic growth around the area where the vocational school is located. Therefore, vocational schools are required to be able to produce graduates who are ready to work to meet the needs of the business or industrial world, so it is necessary to prepare vocational school graduates who are competent in their fields (Siswantari, 2012). One of the vocational skills programs is Industrial Pharmacy. This expertise program aims to provide knowledge and skills in the production of drugs and other pharmaceutical supplies. Students are encouraged to develop, produce and distribute medicines based on scientific aspects related to pharmacy along with an understanding of work safety both for themselves and the safety of the environment (Sari, 2014).

Acids and bases are one of the main materials in chemistry, and one of the materials that is considered difficult by vocational school students. According to Abdullah (2021), students have difficulty understanding acid-base material, namely: Bronsted-Lowry & Lewis theory and S. Arrhenius theory. Furthermore, Musrin & Salila (2010) revealed that the subject of acid-base reactions is one of the essential materials where most of the concepts are abstract. The acid base material for the SMK Industrial Pharmacy skills program is material that is very much needed for the pharmaceutical industry, especially in drug testing. The characteristics of acid-base material consist of three aspects, namely macroscopic, which is material studied in macro form which can be seen from the naked eye, such as using litmus paper to distinguish the acid-base properties of a solution. Microscopic is a chemical phenomenon that is real but cannot be seen with the naked eye, while symbolic is in the form of symbols, names of acid-base compounds in chemistry or calculations such as the pH of acids and bases.

Based on the results of observations at the Yamasi Pharmacy Vocational School, it provides information that this school is the only school with an Industrial Pharmacy skills program on the islands of Sulawesi and Papua. Aspects of the chemistry content provided are less directly related to the subjects of the expertise program. This is due to the lack of chemistry textbooks or teaching materials to support the needs of the expertise program, where the textbooks used are general health textbooks or use pharmaceutical chemistry textbooks whose material content still explains in general terms like textbooks for high school

(SMA). . This is not in accordance with the vocational school curriculum, where different skills programs will require different chemical material (Sari, 2014). Not to mention advances in information technology require teachers to provide other, more innovative learning resources.

Learning modules are teaching materials that are in accordance with the Merdeka curriculum. The results of interviews with chemistry teachers, laboratory assistants and expertise program teachers revealed that there were no teachers who had created teaching materials in the form of electronic modules (e-modules), especially on acid-base material. Difficult concepts require more innovative teaching materials. One solution is to develop a flip book-based e-module. This e-module is designed to allow students to access learning material outside of class if they have difficulty understanding it during learning. To make it easier to use e-modules, an application is needed. The application used in e-module development is flipbook. The research results show that the FlipBook Maker-based E-module is quite effective in strengthening students' character and is also effective in improving learning outcomes (Asmi et al., 2018).

The ADDIE model is a model for developing learning through a systematic approach. The ADDIE development model used is based on the formulation in the FAO book entitled E-learning methodologies according to Ghirardini, B. (2011). ADDIE is an abbreviation that refers to the main processes of the learning system development process, namely: Analysis, Design, Development, Implementation and Evaluation. Development research aimed at producing acid-base e-modules that are valid, practical and effective for use in pharmaceutical chemistry lessons. With the e-module, it is hoped that educators can provide additional explanations and get feedback from students, which can improve their learning outcomes. These teaching materials must be easily accessible and can be used independently by students.

RESEARCH METHODS

This research uses research and development approach. The development research model used is the ADDIE model (Analyze, Design, Develop, Implement, Evaluate). The research subject is the characteristics of the SMK acid base e-module for the Industrial Pharmacy skills program. The data source is the results of validation carried out by 5 experts. First validation by chemical content experts and expertise programs (lecturers and teachers in chemistry subjects and industrial pharmaceutical expertise programs, as well as laboratory assistants). Second validation by learning media experts. Measurements are carried out based on the scores obtained from the assessment of 5 experts on each aspect, namely material, language, graphics, e-module appearance, and suitability of the material and learning process.

The development flow of the ADDIE model (Branch, 2009) can be seen in Figure 1.

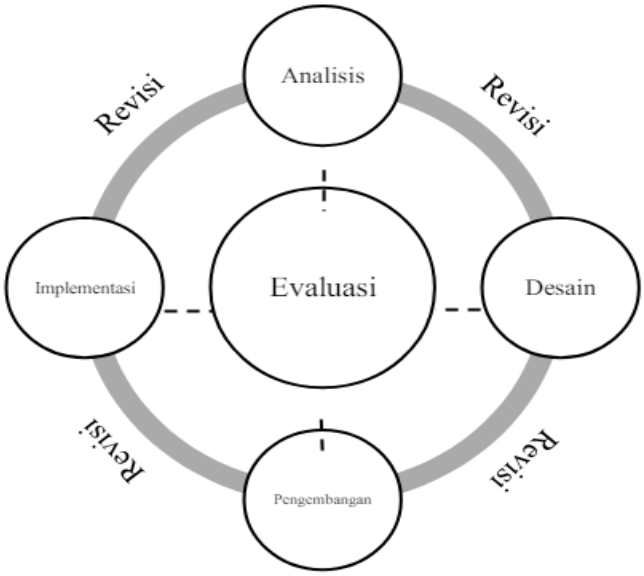


Figure 1. ADDIE Model Steps

The following are the stages of the ADDIE development model carried out:

1. Analysis Stage

This stage is carried out to collect data in making e-module products. The analysis stage process is used to analyze students' needs during learning process activities.

2. Design Stage

This stage is a process of collecting data and designing designs. The explanation of these two stages is: (1) Data collection is carried out to collect material that will be presented in the e-module. (2) Design planning is carried out for the e-module by utilizing the Canva application as product creation software. The design includes the initial page, cover and bibliography.

3. Development Stage

At this stage, product creation sessions, product assessment instruments, validation, revision and product testing are carried out. The description of the four stages is: (1) Product making is a finishing process from the previous stage so that a product can be obtained that meets the researchers' expectations. (2) The product assessment instrument is the stage of creating indicators that will be used to assess e-module products by validators.

1. Determination of the maximum score for each aspect assessed

$$\text{max score} = \text{max weight } X \text{ Total Evaluator}$$
$$= 5 \times 5$$
$$= 25$$

2. Determining the average suitability score for textbooks with BSNP assessment aspects

$$\text{Average percentage} = \frac{\text{total average percentage for each aspect}}{\text{many aspects are assessed}} \times 100\%$$

So the interpretation of the percentage of data obtained is as in Table 1

Table 1. Interpretation of the percentage of data obtained

Score Percentage (%)	Assessment Category
81 – 100	Very well
61 – 80	Good
41 – 60	Enough
21 – 40	Not enough
0 – 20	Very little

4. Implementation Stage

The implementation stage is the testing stage for the e-module product which was created and tested by competent experts in their field. The validation test is carried out with the validator giving a value to the product created and providing suggestions or input on the e-module product based on the Canva application. This research uses an instrument sheet and data analysis is carried out by changing qualitative data into quantitative data.

5. Evaluation Stage

The evaluation stage is the final stage in the ADDIE development model with an evaluation process of the practicality of using e-modules based on the results of product trials in small and large classes using questionnaires. The aim of using students is to find out their responses as well as a basis for knowing the practicality of the e-module that has been developed. This questionnaire consists of 4 answer choices with assessment categories (Mardapi, 2008) in Table 2.

Table 2. Questionnaire Assessment Criteria

Description	Score
Strongly Agree (SS)	4
Agree (S)	3
Disagree (TS)	2
Strongly Disagree (STS)	1

Calculate the total average score for each aspect of the assessment using the formula:

$$average\ score\ \overline{X} = \frac{total\ score\ \ (\sum X)}{number\ of\ students\ (n)}$$

Changing the average score into a qualitative value by converting scores into categories can be seen in Table 3

Table 3 Conversion of scores into categories

No	Score Interval		Qualitative category
1	X ≥ ($\bar{X}$ + 1.SBi)	X ≥ 3	Very well
2	($\bar{X}$ + 1.SBi) > X > $\bar{X}$	3 > X ≥ 2,5	Good
3	$\bar{X}$ > X ≥ ($\bar{X}$ – 1.SBi)	2,5> x ≥ 2	Enough
4	X < ($\bar{X}$ – 1.SBi)	X<2	Not enough

Information:

X = the average number of scores obtained from the research

$\bar{X}$ = average number of ideal scores using the formula:

$\bar{X}$ = (½) . (ideal maximum score + ideal minimum score)

SBi = standard deviation of the ideal score, with a coefficient of 1 (one) using the formula

$\bar{X}$ = ($\frac{1}{6}$). (ideal maximum score – ideal minimum score)

RESULTS AND DISCUSSION

Development of the Acid Base e-Module

The modules developed were prepared with the help of the Canva design website and compiled into flipbook form using the flipbook maker application and published online in html form. The results of this development research are in the form of an e-module based on a flipbook application on Acid-Base material for vocational school students in the Industrial Pharmacy Skills Program. The resulting e-Module consists of several parts including a cover page, preparation page, concept map, glossary, table of contents, introduction containing (e-module identity, KD and indicators, instructions for using the e-module, material description, and learning material), learning activities 1 and 2 contain (learning objectives, material descriptions, summaries, learning video links, practice questions, and answers to practice questions), as well as a bibliography. Before the E-Module was tested, validation was carried out by three experts, namely material experts, learning media, chemistry teachers and pharmacy skills program teachers, as well as chemistry laboratories.

1. *Analysis*

The analysis stage as the first step in the research, data from observations, interviews with laboratory assistants, teachers and students, as well as review of learning implementation documents were used. Analysis is carried out on needs, students, materials and learning objectives. The results of this analysis are the basis for compiling learning resources in the form of flip book-based acid-base e-modules. Content analysis of acid-base material was carried out on several textbooks according to Table 4

Table 4. Textbooks for Content Analysis of Acid-base Material

No	Book title	Publication Year	Author
1	*Chemistry*, Fourth Edition	2003	McMurry, J. & Fay, R.C
2	*General Chemistry*, Seventh edition	2004	Whitten, K. W., Davis, R. E., Peck, M. L
3	*Chemistry Concepts and Applications*	2002	John S. Phillips, Victor S. Strozak, and Cheryl Wistrom

In Table 4, textbooks number 1 and 2 are chemistry textbooks for universities, while book number 3 is a chemistry textbook for high school (SMA). The selection of the three textbooks was based on aspects of novelty, presentation and material needs for vocational school students

Figure 3. Concept and stimulus map

2. *Design*

The design stage aims to design a flip book-based e-module to increase students' productivity insights. The design began with the creation of learning and test tools, as well as the design of flip book-based e-modules. This design includes various parts, starting from the introduction which includes the cover, foreword, table of contents, core competencies, basic competencies, competency achievement indicators, material concept map, material review, prerequisites, to instructions for using e-modules and concept maps. Furthermore, the design includes module content consisting of learning objectives, material descriptions, summaries, evaluation questions, multiple choice questions, and self-assessment. Finally, design a concluding section that includes an evaluation, glossary, and bibliography. Examples of the cover and contents of the e-module can be seen in Figures 2 and 3.

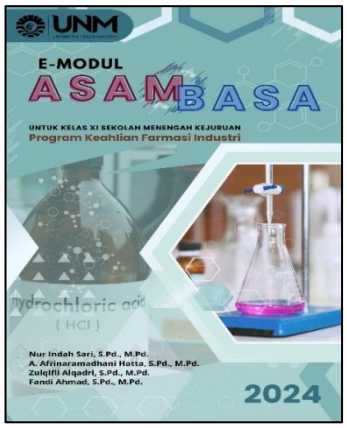
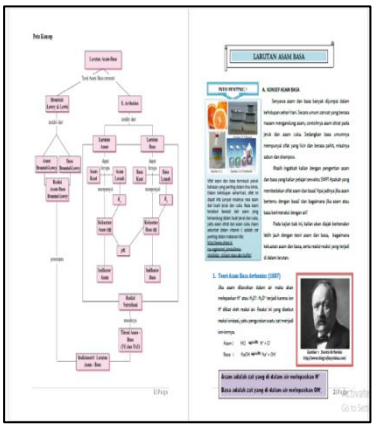


Figure 2. E-Module Cover View



3. *Depelovment*

The development stage aims to produce e-modules that have been improved based on input from experts or practitioners.

Validity Test

The validator assesses several elements in the acid base e-module. They assess the validity of the e-module based on content, presentation, language and graphics. After receiving input from the validators, the e-modules and learning tools were revised and then tested. This assessment process begins by providing materials and assessment sheets to 5 experts.

Table 5. Results of expert assessment of e-modules and learning tools

Validator	Rated aspect						
	Content Eligibility			**Feasibility of presentation**		**Language**	**Graphic**
	Material in E-Module	Substantial truth	Practice questions and assignments	Systematic presentation	Completeness of teaching modules		
Ahli 1	5	5	5	5	5	5	5
Ahli 2	5	5	4	4	5	5	5
Ahli 3	4	4	4	4	5	4	5
Ahli 4	4	4	3	4	5	4	5
Ahli 5	4	5	4	4	5	5	5
Total	22	23	20	21	25	23	25
Average	$\frac{22+23+20}{3} = \mathbf{21,67}$			$\frac{21+25}{2} = \mathbf{23,00}$		**23**	**25**
Max Score	**25**						
Score percentage (%)	**86,68**			**92,00**		**92**	**100**
Average percentage score (100%)	**95,17**						

Source: Microsoft Excel Application Data Processing

Table 6. Description of Expert Assessment Results on E-modules

Instrument	Aspect	Validity Value	Validation Category
Flip Book Based Acid Base E-Module	Content Eligibility	86,68	Very Good
	Feasibility of presentation	92,00	Very Good
	Language Eligibility	92	Very Good
	Graphics	100	Very Good
	Average Total	92,67	Very Good
	Eligibility Percentage (%)	95, 17 %	Very Good

Source: Microsoft Excel Application Data Processing

Activities carried out at this stage include developing e-module content based on suggestions for improvements from experts. The results of expert validation resulted in suggestions for improvements to the acid base e-module, especially in practicum procedures that were adapted to the material needs of the SMK industrial pharmacy skills program in Table 7.

Table 7. Revision of the Acid-Base Chemistry E-module

Before Revision	After Revision
In the work procedure for observing acid-base indicators, it is necessary to add indicators and tools that are in accordance with the industrial pharmaceutical expertise program	Add procedures to suit chemical testing needs for industrial pharmaceuticals
The stimulus is still general. There is no stimulus for the pharmaceutical skills program.	Add some stimuli in the e-module
The form and number of evaluation questions consist of 15 multiple choice numbers and 5 description numbers The time allocation for solving the questions has not been included	The form and number of evaluation questions consist of 20 multiple choice numbers and 2 description numbers added time allocation: 60 minutes.

4. *Implementation*

The results of the revisions that have been carried out after the validation stage in development are referred to as prototype II. The acid-base e-module and other instruments have been assessed as very suitable by the validators for use or implementation. After that, the acid base e-module product was tested on a limited basis to determine the practical aspects of using the e-module using a questionnaire. The trial was limited to a number of students in class XI of the Yamasi Pharmacy Vocational School, face-to-face Industrial Pharmacy skills program. The results of the practicality test for using the acid-base E-module can be seen in Table 8.

Table 8. E-module Practicality Test Results

No	Assessment aspect	Average score for each aspect	Category
1	Presentation of material in modules	3,68	Very Good
2	Integration of material with skills programs	3,33	Very Good
3	Language	3,75	Very Good
4	Expediency	3,69	Very Good
5	Graphics	3,43	Very Good
Overall mean practicality test score		3,58	Very Good

Based on Table 8, the acid base e-module developed is included in the very good category in terms of practicality. This shows that e-modules can be used as a teaching material in chemistry learning at the vocational school level in the industrial pharmacy skills program. This finding is also supported by previous research, such as that conducted by Abdullah, Danial, and Anwar (2021), and Faridah, Yuni, and Sari (2022), which showed that the e-module obtained a high validation score. Thus, it can be concluded that the e-module developed has met the expected validity criteria. During the trial process, the chemistry subject teacher and laboratory assistant served as observers to observe the implementation of learning using the acid-base e-module. After completing the trial, students are asked to provide feedback on the e-module products that have been used as well as an assessment of the learning process. Teacher and student responses were collected face to face.

5. *Evaluation*

During the implementation of the research from the analysis stage to the implementation stage, the author found several things that were weaknesses of this research, namely:

a. At the limited trial stage, teacher activities in managing chemistry learning in the laboratory were not given much attention. Researchers only focused on classroom trials.
b. The development of the acid-base chemistry e-module, which is equipped with integration of industrial pharmaceutical skills program material, requires many observers for student activities.

Recommendation

a. Development focuses on preparing e-modules based on expert validation and practical trials. Testing the effectiveness of using e-modules needs to be applied more widely.
b. The ADDIE development model is a more detailed learning development model, but requires quite a long time, so it can be developed with other models, such as the Rowntree model which consists of 3 stages.

CONCLUSIONS AND SUGGESTIONS

Based on previous research, the flip book-based acid-base e-module development process follows the ADDIE development model, which consists of five stages. The analysis stage involves analyzing needs, students, materials, and learning objectives. The design stage includes preparing learning tools, format design, and creating e-modules. The development stage involves the process of creating and validating the e-module. The implementation phase involves field trials on students of the industrial pharmacy vocational skills program. The evaluation stage includes a review of practical aspects and recommendations. Based on the results of data analysis, the percentage of validity and feasibility of the flip book-based acid-base e-module by experts was 95.17%. The results of the practicality test by students were 3.58 in the very good category. This shows that the e-module is very valid, feasible and practical to use in vocational school chemistry learning.

The suggestion put forward is that teachers apply the e-module in learning acid-base material, students make good use of it, and future researchers can be more innovative in developing learning e-modules. Product trials were carried out through 3 learning meetings, using observation instruments, teacher response questionnaires, student response questionnaires, and learning outcomes tests. In the trial process, two teacher observers observed the implementation of the lesson. After that, teachers and students are asked to provide responses to the e-module and the learning process. The questionnaire was distributed directly.

BIBLIOGRAPHY

Abdullah, A., M. Danial & M. Anwar. (2021). Pengembangan E-Modul Asam Basa Berbasis Problem Based Learning melalui Google Classroom pada Sekolah Menengah Kejuruan (SMK). *Chemistry Education Review*, 5(1), 86-99.

Agustina, D. R., & Wibawa, R. P. (2019). Peran Pendidikan Berbasis Higher Order Thinking Skills (Hots) Pada Tingkat Sekolah Menengah Pertama di Era Society 5.0 Sebagai Penentu Kemajuan Bangsa Indonesia. EQUILIBRIUM: Jurnal Ilmiah Ekonomi Dan Pembelajarannya, 7(2), 137. https://doi.org/10.25273/equilibrium.v7i2.4779.

Asmi, A. R., Dhita Surbakti, A. N., & C., H. (2018). E-Module Development Based Flip Book Maker for Character Building in Pancasila Coursework Sriwijaya University. Jurnal Pendidikan Ilmu Sosial, 27(1), 1. https://doi.org/10.17509/jpis.v27i1.9395.

Branch, R. M. (2009). *Instructional Design: The ADDIE Approach*. University of Georgia. https://doi.org/10.1007/978-0-387-09506-6.

Faridah, U., Yuni, S. R., & Sari, K.D. (20220. Pengembangan E-modul Insteraktif untuk Melatihkan Keterampilan Literasi SAINS Siswa Materi Transpor Membran. *Bioedu*, 11(2), 394-404.

Handayani, N. N. L., & Muliastrini, N. K. E. (2020). Pembelajaran Era Disruptif Menuju Era Society 5.0 (Telaah Perspektif Pendidikan Dasar) Ni. International Seminar Proceeding, 3(2252), 58–66. https://doi.org/https://doi.org/10.33363/sn.v0i0.32

McMurry, J. & Fay, R.C (2003). *Chemistry Fourth Edition*. New York: Pearson.

Mardapi, D (2008). *Teknik Penyusunan Instrumen Tes dan Non Tes*. Yogyakarta: Mitra Cendekia Press

McMurry, J. & Fay, R.C (2003). *Chemistry Fourth Edition*. New York: Pearson.

Mulyasa. (2013). *Pengembangan dan Implementasi Kurikulum 2013*. Bandung: PT Remaja Rosdakarya.

Nindiawati, D., Subandowo, M., & Rusmawati, R. (2021). Pengembangan Bahan Ajar Matematika untuk Siswa Kelas V Sekolah Dasar. *Edcomtech Jurnal Kajian Teknologi Pendidikan*, 6(1), 140–150. https://doi.org/10.17977/um039v6i12021p140

Nurrita, T. (2018). Pengembangan media pembelajaran untuk meningkatkan hasil belajar siswa. *Jurnal misykat*, *3*(1), 171-187. http://dx.doi.org/10.33511/misykat.v3n1.171.

Puspitasari, R., Hamdani, D., & Risdianto, E. (2020). Pengembangan E-Modul Berbasis Hots Berbantuan Flipbook Marker sebagai Bahan Ajar Alternatif Siswa SMA. *Jurnal Kumparan Fisika*, 3(3), 247–254. https://doi.org/10.33369/jkf.3.3.247-254.

Samatowa, Usman. (2006). B*agaimana Membelajarkan IPA di Sekolah Dasar*. Jakarta: Departemen Pendidikan Nasional.

Sari, N.I., (2014). *Konstruksi Buku Ajar Senyawa Organik SMK Program Keahlian Agrobisnis Rumput Laut*. Tesis, Sekolah Pascasarjana, Universitas Pendidikan Indonesia.

Siswantari (2012). Kompetensi Keahlian di SMKN 6 Pertanian Jeneponto Sulawesi Selatan. *Pusat Penelitian Kebijakan, Balitbang Kemdikbud.* 216-227.

Sugiyono. (2013*). Metode Penelitian Kuantitatif, Kualitatif dan R&D*. Bandung: Alfabeta.CV

Syamsuar, & Reflianto. (2018). Pendidikan Dan Tantangan Pembelajaran Berbasis Teknologi Informasi Di Era Revolusi Industi 4.0. Jurnal Ilmiah Teknologi Pendidikan, 6(2). https://doi.org/https://doi.org/10.24036/et.v2i2.101343

Whitten, K. W., Davis, R. E., Peck, M. L., (2004). *General Chemistry, Seventh edition*, US Thomson Brooks/Cole