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Discovery Learning Based E-Modul Development On the Acid Base Tiration Material for Class XI Senior High School

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Abstract —The 2013 curriculum requires students to be active, productive and innovative during the learning process at school so that to achieve these goals it is carried out using a scientific approach. The scientific approach requires a learning model in its development. The learning model used in this research is discovery learning. This study aims to develop an acid-base titration e-module based on discovery learning. The development model used is the plomp model which has 3 development stages, namely preliminary research, development or prototyping phase and assessment phase. This research is limited to the level of validity and practicality of the developed e-module. The instrument used in this research is a validity and practicality of the questionnaire. The subject of this study were 3 UNP chemistry lecturers, 3 chemistry teachers and 18 students of class XI at SMAN 14 Padang. The data obtained from the validity test were analyzed using Aikens V and practicality was analyzed using descriptive statistics. The average content validity analysis result obtained is 0,82 with a valid category, the average construct validity data analysis result obtained is 0,85 with a valid category and the average media validity data analysis result is 0,94 with valid categories. The average result of the practicality data analysis by the teacher is 84% wtih a very high practicality category. The average result of practicality data analysis by students in the small group test is 86% with a very high practicality category and the average data analysis result in the field test is 88% with a very high practicality category. For further researchers, they can test the effectiveness of this discovery learning based acid-base titration e-module.

Keywords—E-Module, Validity, Practicality,Discovery Learning,Acid-Base Titration.

I. INTRODUCTION

The 2013 curriculum requires student to be active, productive and innovative so that to achieve this goals it must be carried out using scientific approach. The scientific approach is a process carried out in learning where this approach is made so that students are active in determining concepts, laws and principles. This requires stages, namely observing, formulating problems, collecting data, and drawing conclusion (Hosnan, 2014).

Chemistry is a science that discusses of substances and how these substances react with other substances (Chang, 2005). Chemistry subjects have the aim of applying the chemical concepts learned in solving problem found in everyday life (Kemendikbud, 2017). Acid-base titration is one of the main subjects in chemistry subjects. Acid base titration material contains knowledge with factual, conceptual and procedural dimensions.

Acid-base titration material contains theoretical concepts and experiments where students find it difficult in this material. It is based on a questionnaire that has been distributed to students in two schools, namely SMA Negeri 7 Padang and SMA Negeri 1 Lubuk Alung. Information obtained that as many as 53,5% of students have difficulty in understanding acid-base titration material. Based on the result of interview with teachers at SMA Negeri 7 Padang and SMA Negeri 1 Lubuk Alung, information was obtained that students were not fully independent in finding their own concepts in acid-base titration material, with researchers want to develop teaching materials that were in accordance with the discovery learning model to facilitate students in

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the teaching and learning process. The discovery learning model will make students active by being directed to find a material concept through learning they undergo. There is already a discovery learning model that has been developed in the form of a module. Modules are printed teaching materials with the aim that students can learn independently without being directed and guided by teachers in achieving learning goals (Depdiknas, 2008).

Technological developments in the world of education that are increasingly rapidly encouraging many innovations in the variation of learning process, especially in the combination of print technology with computer technology. Technology plays a role in student so that students are more interested in teaching materials that use image displays, interactive learning videos and interesting materials. This influence gave rise to the idea to develop the module into an electronic module which contains material, evaluation questions and practicum videos so that it can attract the attention of students in the teaching and learning process using this electronic module.

E-modules are learning media that are used independently which are made in digital form where the purpose of this e-module is to realize the learning competencies to be achieved and make students more active and interactive through applications that have been designed (Rahmi, 2018). Based on a questionnaire that was given to students at SMA Negeri 7 Padang and SMA Negeri 1 Lubuk Alung, the teaching materials used in these two schools were not interesting enough in acid-base titration material. These two schools also need e-modules to make learning more interesting and as an effort to help students understand the material to be studied. Some materials in chemistry can be understood more effectively if you do a practicum/experiment. During the covid-19 pandemic, several schools implemented online and offline learning systems which made it difficult to carry out practicums.

This is in accordance with interviews conducted with teachers at SMA Negeri 7 Padang and SMA Negeri 1 Lubuk Alung. The result of interviews provide information that the lack of time needed to be able to carry out practicum at school, so it is difficult to adjust to the delivery of the material. The explanation above is the reason why the researcher wants too develop an e-module based on discovery learning by using a demonstration video of practicum. Setiadi & Zainul's research (2019) reports that the acid-base e-module using the discovery learning model is able to help students in the learning process. In this acid-base e-module there are media and questions from the material where a valid and practical e-module is produced. In addition, there are several studies that have been tested for validity and practicality, namely research from Artha et al (2018), research from Yerimadesi et al (2017), and research from Asmiyunda et al (2018). Based on these problem, an e-module teaching material was develop with the title "Development of Discovery Learning Based E-Module on Acid-Base Titration Materials for Class XI SMA".

II. METHODS

The type of research used is research and development (R&D), which is a type of research by applying the plomp model. Researchers use R&D research because researchers want to develop and produce e-modules based on discovery learning on acid-base titration material for class XI SMA. The plomp model has 3 stages, namely the preliminary research stage, the development or prototyping phase, and the assessment phase (Plomp, 2013). This research was conducted only to test the validity and practicality test. The subjects involved in this study were 3 UNP chemistry lecturers, 3 UNP engineering lecturers, 3 chemistry teachers and 18 class XI students at SMAN 14 Padang.

The initial investigation stage is carried out with the investigation and analysis needed in developing an acid-base titration e-module for SMA. These stages include : (a) Needs analysis is carried out by looking at the picture that occurs in the field regarding the problem experienced by students during the learning process at school; (b) context/curriculum analysis aims to determine indicators of competency achievement and learning objectives that have been adapted to competencies in the 2013 curriculum; (c) the development of the conceptual framework is carried out after the discovery of the problem and literature study has been carried out; (d) Literature review is conducted to find references related to research conducted through books, journals or sources obtained from the internet.

The development or prototyping phase, activities at this stage include : (a) Prototype I is carried out by designing an acid-base titration e-module using a discovery learning model; (b) prototype II was conducted formative evaluation, namely self-test on the resulting prototype I. Self-test is carried out using a checklist system on the components contained in the e-module; (c) prototype III was carried out in a formative manner, namely a one-to-one evaluation with students and assessment from experts (expert review). Prototype III aims to obtain the level of validity of prototype II. The evaluation results of prototype III were revised using one-to-one trials and expert assessments so that a valid prototype III was produced; (d) prototype IV conducted a small

group test on prototype III produce for students. The final step is to analyze the questionnaire filled out by students and make revisions to produce a prototype IV. Prototype IV, which has been valid and practical, then evaluated (semi-summatively) through a field test.

In the assessment phase, a field test is carried out to obtain the level of practicality of the prototype IV obtained. The instrument used is a validity and practicality questionnaire. The practicality test was carried out by giving questionnaires to teachers and students of SMA Negeri 14 Padang. The validity data obtained were analyzed using Aiken (1985) where at the end of the processing a V value was obtained which is called the validator agreement index. The formula used is,

$$V = \frac{\sum s}{[n(c-1)]} \quad (1)$$

$$s = r - Io \quad (2)$$

Information :

V= validator agreement index

r = validtator choice category score

n = number of validators

Io = the lowest value of the validity assessment

c = the highest number of validity assessments

The practicality test used a questionnaire instrument which was analyzed using descriptive statistics.

$$P = f/n \times 100\%$$

Information :

P = product practicality

f = total value obtained from the questionnaire

N= maximum value in the questionnaire

Practicality categories can be seen in Table 1.

Table 1. Practicality categories

Score	Category
80% < x ≤ 100%	Very practical
60% < x ≤ 80%	Practical
40% < x ≤ 60%	Quite practical
20% < x ≤ 40%	Less practical
0% < x ≤ 20%	impractical

III. Result And Discussion

3.1. Preliminary Research

3.1.1 Need Analysis

A needs analysis was conducted to see a picture that occured in the field regarding the problems experienced by students

during the learning process through interviews ith chemistry teachers at SMAN 7 Padang and SMAN 1 Lubuk Alung. The following information was obtained : (1) students were still not active in learning process; (2) there are still students who have difficulty understanding acid-base titration material in theory and practice; (3) the absence of teaching materials for acid-base titration based on discovery learning using animation and video.

3.1.2 Context/Curriculum Analysis

The context/curriculum analysis aims to formulate indicators of competency achievement and learning objectives. Basic competence in acid-base titration material can be seen in Table 2.

Table 2. Basic Competencies and Competency Achievement Indicators

Basic Competencies	Indicators of Competence Achievement
3.13 Analyzed the data from various types of acid-base titration	3.13.1 Explaining the meaning of acid-base titration 3.13.2 Determine the concentration from the results of the experimental data analysis of various types of acid-base titration 3.13.3 Analyze the acid-base titration curve
4.13 Concludes the result of the analysis of the acid-base titration experimental data	4. 13.1 Conclude the results of the analysis of the acid-base titration experiment data

3.1.3 Conceptual Framework Development

At this stage the identification and preparation of the basic concepts in the development of the e-module of acid-base titration material is carried out.

3.1.4 Literature Review

In the liteature review, the sources used in developing e-modules on acid-base titration materials are guidelines from the Ministry of Education and culture in 2017 which explain the meaning of e-modules and the advantages of e-modules. The reference in developing the discovery learning model is using Hosnan's book. Reference in developing acid-base titration materials using books by Raymond Chang, Syukri, Brady and Unggul Sudarmo.

3.2. Prototyping Stage

3.2.1. Prototype I

Prototype I produces an e-module based on discovery learning on acid-base titration material. The components of the e-module are adapted to the Ministry of Education and Culture (2017) namely : cover, study guide, concept map, activity sheet, student worksheet, evaluation sheet, answer key and glossary. This e-module was created using the microsoft word 2010 application, kinemaster, flipbook PDF professional and power point 2010.

3.2.2. Prototype II

The resulting prototype I was then evaluated by self evaluation, from the results that have been evaluated using self evaluation, it was found that the prototype I produced was in accordance with the components of the e-module at the Ministry of Education and Culture (2017) namely : cover, table of contents, glossary, basic competencies, IPK, learning objectives, instructions for use, activity sheets, exercises, evaluations, answer keys and bibliography.

3.2.3. Prototype III

3.2.3.1. Expert Review

The revised prototype II was validated by 6 material expert validators (3 chemistry lecturers at FMIPA UNP and 3 chemistry teachers) and 3 media expert validators. The validity tests that have been carried out are content validity, construct validity and media validity. The results of data processing can be seen in figure 1.

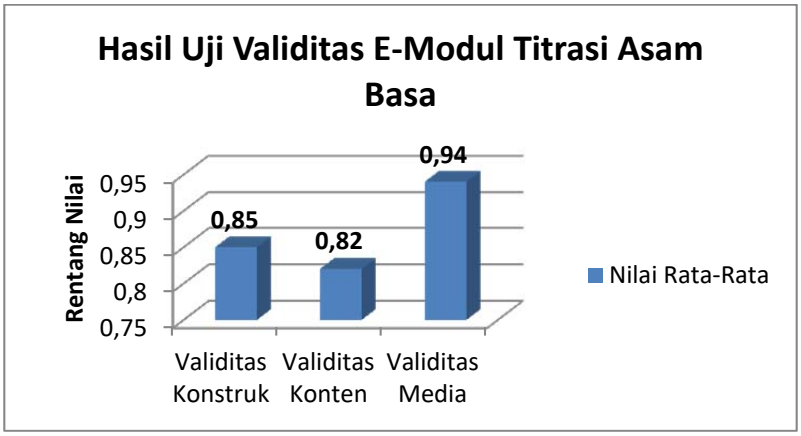

Fig 1. Validity Data Processing Result by Validator

Content validity consists of two aspect, namely : (a) aspect of the suitability of the e-module content with discovery learning syntax with a validity value of 0,82; (b) the truth aspect of the content of the e-module on the content of chemistry with a validity value of 0,81. The construct validity contains several assessment components, namely : (a) the content component with the validation results obtained that average value of Aikens V is 0,84 with a valid category. Based on the Aikens V value obtained, it shows that the discovery learning based of acid-base titration e-module that was developed is in accordance with 3.13 and 4.13 for the 2013 revised 2018 curriculum. Which is in the e-module with KI, KD and student; (b) the linguistic component obtained an average Aikens V value of 0,86 with a valid category. This is in accordance with the Ministry of Education and Culture (2017) the language used in e-modules is communicative, interactive and semi-formal so that it is easily understood by students; (c) the presentation component, the average value of Aikens V is 0,85 with a valid category. This indicates that the presentation of the acid-base titration e-module has been systematically arranged based on the components of the e-module in accordance with the e-module preparation guidelines from the Ministry of Education and Culture (2017); (d) the graphical component, the average value of Aikens V is 0,84 with a valid category.

The validity of the media includes several aspects, namely : (a) the display aspect, the Aikens V average value for the e-module display aspect is 0,95 with a high validity category; (b) the programming aspect obtained an average Aikens V value of 0,93 with a high validity category. This shows that the e-module is easy to use, the symbols/icons on the e-module are easy to understand (Lisa Rosanna et al., 2021); (c) the aspect of utilization, the average value of Aikens V is 0,94 with a high validity category.

3.2.3.2. One to One Evaluation

One to one evaluation is done by selecting 3 students based on their ability level, that is high, medium and low. Students are asked to fill out a questionnaire. Based on the results of the analysis carried out, it can be seen that the prototype II produced is attractive in terms of cover. The color design and appearance of the e-module make students interested in reading it and the presentation of the material and the exercises are also understood by students. The use of language in the e-module is also easily understood by students. Pictures, videos and tables in e-module can help students understand and discover concepts.

3.2.4. Prototype IV

The prototype III has been produced is evaluated using the small group test to obtain the practical value of the developed acid-base titration e-module. The small group test was conducted on 6 students with different ability levels, that is high, medium and

low. The results of the small group test can be seen in figure 2.

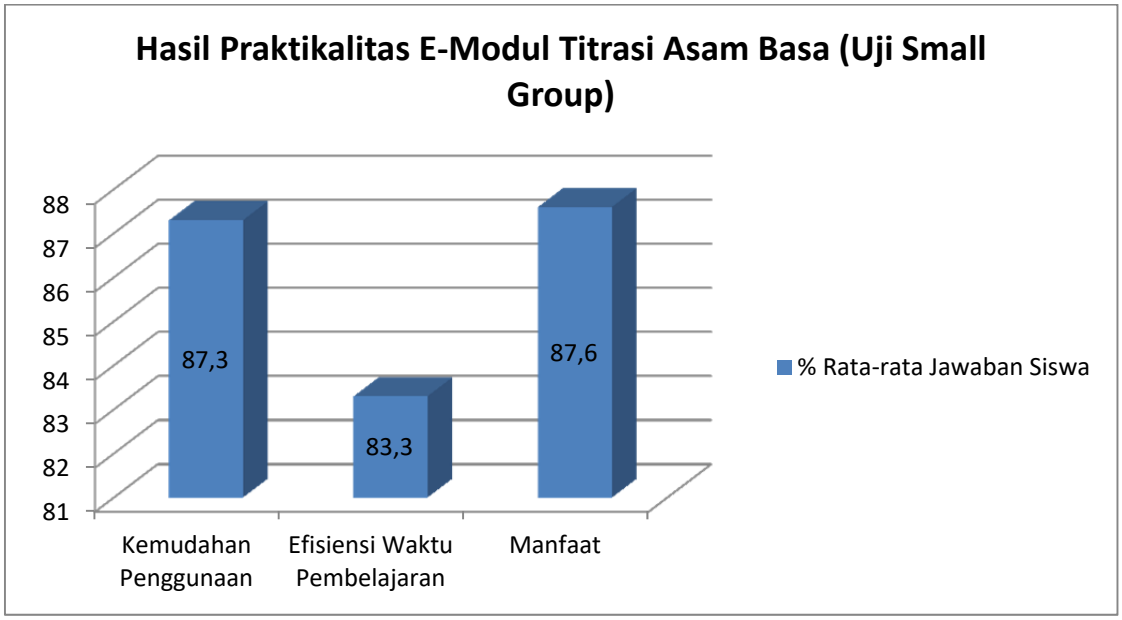

Fig 2. Results of Practical Data Analysis (Small Group Test) by Student

3.2.5. Assessment Phase

At this stage, a field test is conducted by teachers and students to determine the level of practicality of the acid-base titration e-module. The results of the teacher and student field tests can be seen in figures 3 and 4 below.

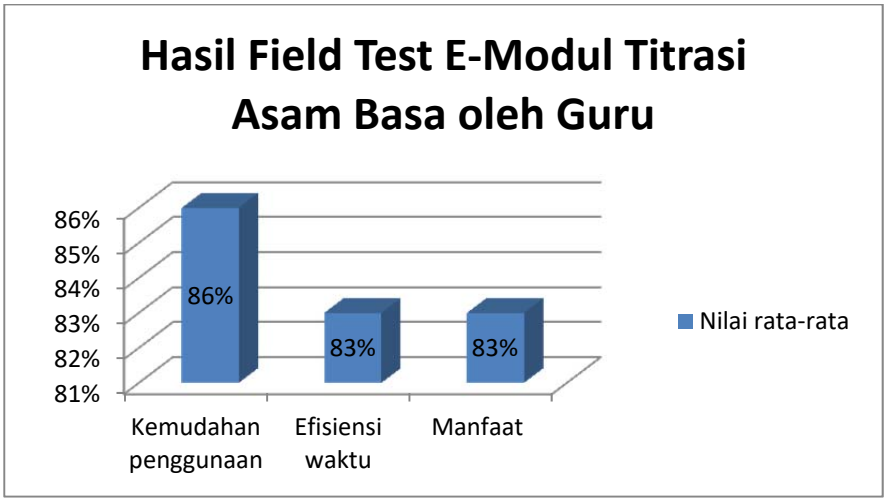

Fig 3. Results of Practical Data Analysis (Field Test) by the Teacher

From the aspect of ease of use, an average value of 86% is obtained with a very high category for the level of practicality. This shows that the e-module developed contains clear and simple material, the models and questions contained in the e-module are easy to understand, and the e-module has a practical size and is easy to use (user friendly) (Kemendikbud, 2017). From the aspect of learning time efficiency, e-module has an average percentage of 83% with a very high category for practicality. Through the help of e-modules, students can learn at their own pace and can make learning time more efficient (Adhim & Jatmiko, 2015). From the aspect of benefits, e-module has an average percentage of 83% with a very high category for its level of practicality. E-

modules that use discovery learning models can help students to be active in learning and be able to find their own concepts through the questions contained in the e-module.

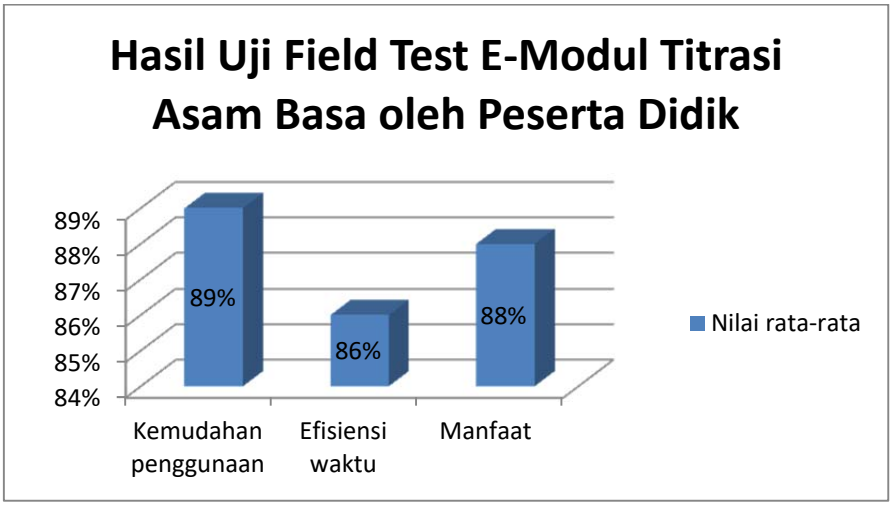

Fig 4. Results of Practical Data Analysis (Field Test) by Students

The average practicality result obtained is 88% with the practicality value category is very high. In terms of ease of use, this acid-base titration e-module has a practical value of 89% with a very high practicality category. This indicates that the acid-base titration e-module is easily understood by students according to the practicality questionnaire filled out by students during the field test. In the aspect of learning time efficiency, the practicality value is 86% with a very high practicality category. This is illustrated by students answer which state that students can learn at their own pace. The benefit aspect obtained a practicality value of 88% with a very high practicality category. E-modules are able to help students solve difficulties in learning (Yerimadesi, 2014).

IV. Conclusion

The discovery learning based acid-base titration e-module was developed using the plomp development model. The e-module on discovery learning based acid-base titration material for class XI SMA that was developed is valid and practical.

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Reference

[1] Adhim, A. Y., & Jatmiko, B. (2015). Penerapan Model Pembelajaran Guided Discovery Dengan Kegiatan Laboratorium Untuk Meningkatkan Hasil Belajar Siswa Kelas X Sma Pada Materi Suhu Dan Kalor. *Jurnal Inovasi Pendidikan Fisika (JIPF)*, *4*(3), 77–82.

[2] Aiken, L. R. (1985). Three Coefficients for Analyzing the Reliability, and Validity of Ratings. *Educational and Psychological Measurement*, *45*, *131–14*.

[3] Artha, K. S. W., Agustini, K., & Sugihartini, N. (2018). Pengaruh E-Modul Berbasis Discovery Learning pada Mata Pelajaran Siswa Kelas X SMKN 3 Singaraja. *Jurnal Nasional Pendidikan Teknik Informatika*, *7*(2), 141.

[4] Asmiyunda, A., Guspatni, G., & Azra, F. (2018). Pengembangan E-Modul Kesetimbangan Kimia Berbasis Pendekatan Saintifik untuk Kelas XI SMA/ MA. *Jurnal Eksakta Pendidikan (Jep)*, *2*(2), 155. https://doi.org/10.24036/jep/vol2-iss2/202

[5] Chang, R. (2005). Kimia Dasar Konsep-Konsep Inti Edisi Ketiga Jilid 2. Erlangga.

[6] Depdiknas. (2008). Panduan Pengembangan Bahan Ajar. *Depdiknas Jakarta*, 1–13. http://file.upi.edu/Direktori/FIP/JUR._KURIKULUM_DAN_TEK._PENDIDIKAN/194601291981012-PERMASIH/PENGEMBANGAN_BAHAN_AJAR.pdf

[7] Hosnan, M. (2014). Pendekatan Saintifik dan Kontekstual dalam Pembelajaran Abad 21 (R. Sikumbang (ed.)). Ghalia Indonesia.

[8] Kemendikbud. (2017). Panduan Praktis Penyusunan E-Modul. Kemdikbud.

[9] Lisa Rosanna, D., Yerimadesi, Andromeda, & Oktavia, B. (2021). Validity and Practicality of Salt Hydrolysis E-Module Based on Guided Discovery Learning for SMA/MA Students. *International Journal of Innovative Science and Research Technology*, *6*(5), 1196–1201. www.ijisrt.com

[10] Plomp. (2013). Educational Design Research Educational Design Research. *Netherlands Institute for Curriculum Development: SLO*, 1–206. http://www.eric.ed.gov/ERICWebPortal/recordDetail?accno=EJ815766

[11] Purwanto, N. (2006). Prinsip-Prinsip dan Teknik Evaluasi Pengajaran. Remaja Rosdakarya.

[12] Putra, K. W. B., Wirawan, I. M. A., & Pradnyana, G. A. (2017). Pengembangan E-Modul Berbasis Model Pembelajaran Discovery Learning Pada Mata Pelajaran "Sistem Komputer" Untuk Siswa Kelas X Multimedia Smk Negeri 3 Singaraja. *Jurnal Pendidikan Teknologi Dan Kejuruan*, *14*(1), 40–49. https://doi.org/10.23887/jptk.v14i1.9880

[13] Rahmi, L. (2018). JURNAL TA'DIB, Vol 21 (2), 2018, (Juli -Desember). 21(2), 105–111.

[14] Setiadi, Trihanto; Zainul, R. (2019). Pengembangan e-modul asam basa berbasis discovery learning untuk kelas XI SMA/MA. *INA-Rxiv Papers*.

[15] Yerimadesi. (2014). Pengembangan Model Guided Discovery Learning (GDL) untuk Meningkatkan Keterampilan Berpikir Kritis Siswa Pada Pembelajaran Kimia di SMA. In *Presiden Republik Indonesia*.

[16] Yerimadesi, Y., Putra, A., & Ririanti, R. (2017). Efektivitas Penggunaan Modul Larutan Penyangga Berbasis Dicovery Learning Terhadap Hasil Belajar Sisa Kelas XI Mia SMAN 7 Padang. Jurnal Eksakta Pendidikan (Jep), 1(1), 17. https://doi.org/10.24036/jep/vol1-iss1/29.