HYDROGEN
JURNAL KEPENDIDIKAN KIMIA
https://e-journal.undikma.ac.id/index.php/hydrogen/index

February 2024. 12(1)
e-ISSN: 2656-3061
p-ISSN: 2338-6487
pp. 68-74

Development Of Acid-Base Titration Practicum Guide Using Natural Indicators Of Butterfly Pea Flowers

Suci Rahma Hanifa, Ardiansyah*, Neti Afrianis, Heppy Okmarisa
Department of Chemistry Education, Faculty of Education and Teacher Training, State Islamic University of Sultan Syarif Kasim Riau, Jl. HR Soebrantas No. 155, Pekanbaru, Indonesia 28293
* Corresponding Author e-mail: ardiansyahm.pd@uin-suska.ac.id

Article History
Received: 08-02-2024
Revised: 21-02-2024
Published: 29-02-2024

Keywords: acid-base titration; natural indicator; butterfly pea flower

Abstract
Sustainable Development Goals (SDGs) need to be implemented to create environmentally friendly chemistry learning. This can be done in an acid-base titration experiment using natural indicators of butterfly pea flowers. This research aims to produce a practicum guide for acid-base titrations using natural indicators of butterfly pea flowers that are valid and practicum. The research design uses the ADDIE research design, namely Analysis, Design, Development, Implementation, and Evaluation. The research results showed that butterfly pea flowers can be used as a natural indicator for acid-base titrations with color changes from pink (acidic condition) to blue (basic condition). The resulting learning media is a practicum guide which has a validity of 92% (very valid) and a practicality level of 88.75% (very practical). This data was analyzed using qualitative and quantitative analysis. The practicum guide developed is valid and practical to use as a practicum learning media in schools.

How to Cite: Hanifa, S., Ardiansyah, A., Afrianis, N., & Okmarisa, H. (2024). Development of Acid-Base Titration Practicum Guide Using Natural Indicators of Butterfly Pea Flowers. Hydrogen: Jurnal Kependidikan Kimia, 12(1), 68-74. doi:https://doi.org/10.33394/hjkk.v12i1.10813

https://doi.org/10.33394/hjkk.v12i1.10813

INTRODUCTION

Sustainable Development Goals (SDGs) is a program that has been agreed upon by several UN member countries and the government with the aim of making sustainable development an agreement for global development. SDGs are a global initiative to improve people's lives in economic and social aspects and are able to create synergy with the environment (Nurfatimah et al., 2022). One of the goals of the SDGs is to build quality education that does not only focus on providing information to students but also involves interaction between teachers and students, the use of effective learning methods, and the development of skills and deep understanding. SDGs also have a connection with sustainable learning (Safitri et al., 2022).

Sustainable learning is a lifelong learning process that helps individuals to continually improve their knowledge and skills and prepares them to address future development challenges. In this case, sustainable learning plays an important role in ensuring that individuals have the knowledge and skills needed to achieve the SDGs goals, namely quality education. One characteristic of learning that can improve critical and creative thinking is guided inquiry (Putra, 2022) which can be applied in chemistry practicum.

Practicum are very important in studying chemistry. Practicum can give students the opportunity to apply the theories and concepts they acquire in learning chemistry in class to real-life situations. Furthermore, practicum is part of chemistry learning where students can

be directly involved in research activities, experiments, and analysis of experimental data. The aim of the practicum is to increase and strengthen students' understanding of the material they have studied (Baunsele et al., 2020) (Hidayah et al., 2022).

Practicum activities will run well if they are equipped with practicum supporting factors such as the necessary tools and materials as well as a practicum guidance (Ratmini, 2017). Practicum guidance is intended to help and guide students so they can work continuously and purposefully (Wahab et al., 2021). The practicum guide functions to provide clear instructions about the procedures that must be followed in carrying out the practicum (Aini et al., 2023). This includes instructions for using the equipment, correct measurement methods, and safety procedures.

Ardiansyah et al., (2023) recommends that simpler practicums need to be developed that can improve students' critical thinking skills in science learning. In chemistry, simpler practicums can be developed using natural materials. Natural material can be used as natural indicators in acid and base titration materials as a substitute for synthetic or commercial indicators (Agustina et al., 2022). Commercial indicators are expensive and can cause environmental pollution (Abugri et al., 2012). Therefore, the solution is to substitute commercial indicators with natural indicators that are cheaper and more environmentally friendly.

Research on the potential of natural materials as acid-base indicators has been carried out by experts. Kapilraj et al., (2019) stated Bougainvillea glabra, Bauhinia purpurea, and Impatiens balsamina extract have a sharp and clear colour change in acids and bases. (Fitri & Fikroh, 2021) conclude that the butterfly pea flower extract indicator can be used as a substitute for the phellophthalein indicator and the methyl orange indicator. Butterfly pea flower is one of the edible flowers so its use as an acid-base indicator is safer, cheaper and does not pollute the environment (Soedirga et al., 2023). In this paper, researchers want to develop a practicum guidance for acid-base titrations using butterfly pea flower as natural indicator that are safe for students and also environmentally friendly.

A preliminary study in the form of interviews with 2 chemistry teachers at SMAN 10 Pekanbaru regarding the obstacles experienced by students during practicum learning shows that there is still a lack of laboratory facilities in schools, such as the unavailability of complete chemical materials. In this research, the solution obtained was carrying out acid-base titration practice using natural indicators of butterfly pea flowers. By doing this practicum, incomplete materials can be replaced with natural materials that can be used in acid-base titration practicums. Another obstacle is the unavailability of practicum guidance, especially practicum guidance for acid-base titrations using natural indicators. This school only uses material guides from printed chemistry books, so this makes it difficult for students to understand practicum activities. Therefore, the practicum guide for acid-base titration with butterfly pea flower that has been developed can solve this problem.

METHOD

This research is development research that aims to develop a practicum guide for acid-base titration using natural indicators of butterfly pea flowers. The development research model used is the ADDIE model which is commonly used in developing teaching materials (Sugiyono, 2014). The ADDIE stages include Analysis, Design, Development, Implementation, and Evaluation.

Analysis

The analysis was carried out to obtain information about the need for practicum guidance on acid-base titrations with natural indicators desired by teachers and students. The analysis

carried out includes needs analysis, student characteristics, and curriculum. Needs analysis was carried out by interviewing 2 chemistry teachers regarding the analysis of student needs.

Analysis of student characteristics is carried out through a student questionnaire which contains several aspects including students' prior knowledge, interest, understanding, and benefit of the product to be developed. Curriculum analysis was carried out on the 2013 curriculum acid-base titration material.

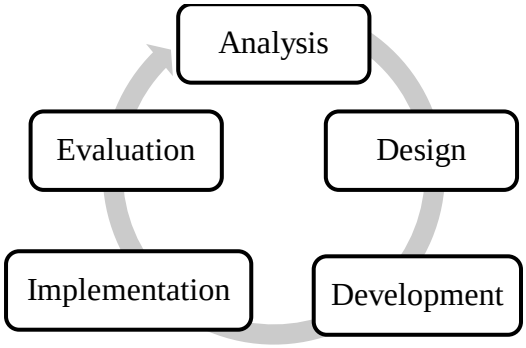


Figure 1. ADDIE model for developing acid base titration practicum guide

Design

The initial stage of this stage is to design and carry out an acid-base practicum using natural indicators of butterfly pea flowers in the laboratory. This aims to obtain changes in the natural indicator color of butterfly pea flowers at a certain pH range. The next stage is to determine the specifications for the practicum guide that will be developed.

Development

At this stage, a validation test of the natural indicator practicum guide of butterfly pea flowers was carried out with experts, namely material experts and media experts. At this stage, a validation test of the natural indicator practicum guide for butterfly pea flowers was carried out with experts, namely material experts and media experts. Next, the practicum guide was revised according to expert advice until a valid practicum guide was obtained.

Implementation

This stage aims to determine the practicality of the butterfly pea flower practicum guide that has been developed. Implementation is carried out in the testing phase, namely small group and large group testing. The small group test was carried out involving 7 people from class XI MIPA in a different class from the research class. The sample was taken using a random sampling technique, which means several students from class XI MIPA were taken at random. This test aims to identify and correct initial errors in the butterfly pea flower practicum guide. Next, a large group test (field test) was carried out. This test was carried out involving all 30 students from class XI MIPA 1. The sample was taken using a cluster random sampling technique, which means taking one class at random from the number of population classes. This aims to determine the results of the practicality test of students' responses to the butterfly pea flower practicum guide.

Evaluation

This evaluation aims to evaluate the final results of the practicum guide and measure the extent to of the practicum objectives have been achieved. In this research, evaluation was carried out 3 times, namely stage 1 evaluation in the form of revision of product design validation through expert validation. Then proceed with stage 2 evaluation, namely revision after carrying out small-scale trials, and finally stage 3 evaluation, namely overall revision

after carrying out large-scale trials. The trials carried out were limited trials, namely only up to the implementation stage.

RESULTS AND DISCUSSION

At the preliminary analysis stage, it was found that the practicum materials at school were incomplete because some chemicals had expired and were not suitable for use. Apart from that, there has never been any practicum acid-base titration using natural indicators and there are no practicum guides for acid-base titration in schools. This situation can be overcome by carrying out practicum experiments on acid-base titrations using natural indicators of butterfly pea flowers. Synthetic acid-base indicators can be replaced with natural indicators of butterfly pea flowers which are more environmentally friendly, economical, and easy to obtain. The school uses the 2013 curriculum with the basic competency in acid-base titration material analyzing result data from various types of acid-base titrations and concluding the results of data analysis of acid-base titration experiments.

At the design stage, the butterfly pea flower indicator color test was first carried out in acidic, and basic conditions on a drop plate and compared with pea flower and Brugmansia arborea flower in a water solvent. This aims to investigate the potential of butterfly pea flowers as an acid-base indicator. Based on the results of the drop plate test, it was found that butterfly pea flowers got good results because there was a clear color change between the acid and the base (left side in Figure 2). Purwono & Mahardiani, (2010) said that color changes can occur through a balance in the molecular and ionic forms of the indicator compound.

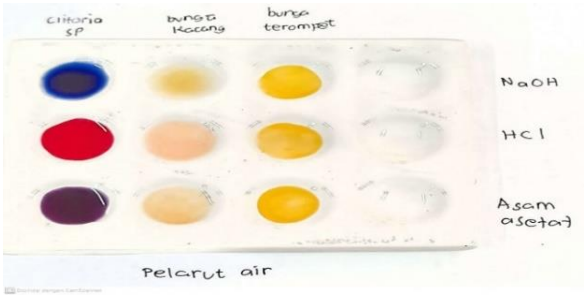
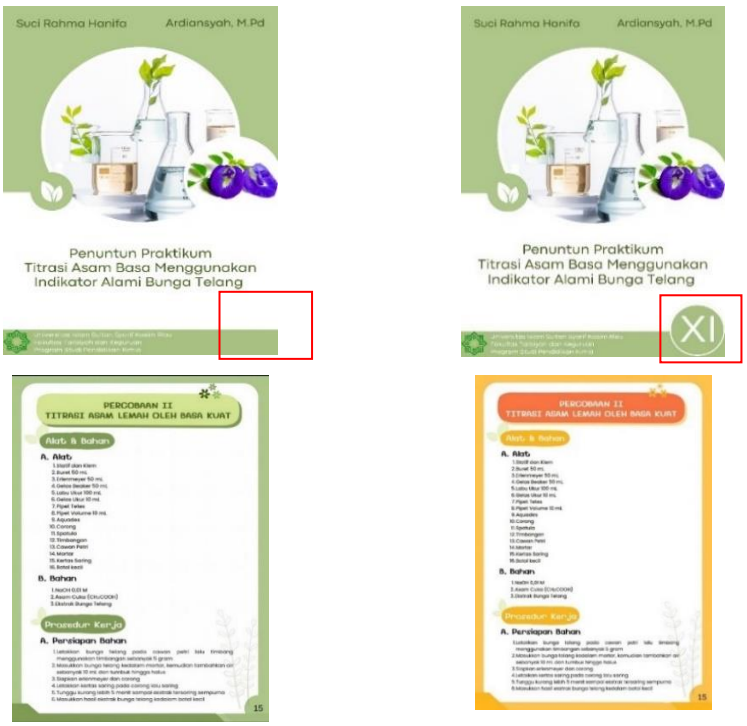


Figure 2. The color of butterfly pea flowers in acidic and basic conditions

Based on the results of acid-base titration experiments using the butterfly pea flower indicator, data was obtained that the butterfly pea flower can be used as a natural indicator of the butterfly pea flower. The results of this experiment, supported by research conducted by (Fitri & Fikroh, 2021) stated that the indicator for butterfly pea flower extract can be used as a substitute indicator phenolphthalein and methyl orange indicator. The color change in butterfly pea flower extract is caused by the presence of anthocyanin compounds whose structure changes back and forth depending on the pH of its environment (Soedirga et al., 2023).

The practicum guide that has been designed is then assessed by expert validators, material, and media experts. The practicum guide that has been designed is then assessed by expert validators, material, and media experts. The design of the practicum guide is revised according to the advice of material and media experts until a valid practicum guide is obtained as shown in Figure 3. Validity tests by material and media experts obtained an average percentage of 97% and 87% with the criteria "very valid". Based on the results of the two validity tests, an average percentage of 92% was obtained, so it can be stated that the practicum guide is "very valid" for use in chemistry practicum learning. The results of this research are supported by previous research conducted by Wahab et al., (2021) which states

that the guided inquiry-based acid-base titration practical guide is very suitable to be used to support practicum learning in the laboratory with a feasibility level of 93,33%.



(a) Before revision (b) After revision

Figure 3. Practicum guide design (a) before and (b) after revision

The implementation stage was carried out by testing student responses and testing the practicality of the practicum guide by chemistry teachers. The results from student responses to the practicum guide developed is given in Table 1. The same results were also obtained from the practicality test of chemistry teachers' responses to the butterfly pea flower practicum guide that was developed with an average percentage of 94,64% (very practical).

Table 1. Results of Student Responses

No	Aspect	Item	Score Obtained	Score Max	Percentage	Category
1	User convenience	1,2,3,4	408	480	85%	Very good
2	User Benefits	5,6,7,8,9	495	600	82,5%	Very good
3	Presentation of content	10,11,12, 3,14,15	596	720	82,77%	Very good
					Total Score	**1499**
					Score Max	**1800**
					Percentage	**83,27%**
					Criteria	**Very good**

Based on the results obtained from the teacher practicality test, it was concluded that the practicum guide provided clear and detailed instructions regarding the practicum steps, and the use of natural indicators of butterfly pea flowers could be used as an alternative method in carrying out acid-base titration practicum. The use of natural indicators of butterfly pea flowers in acid base titration practice provides variety and uniqueness to the chemistry practicum learning process in the classroom because natural indicators of butterfly pea flowers are more environmentally friendly and easier to obtain than synthetic indicators.

The results of the student response test obtained an average percentage of 83% with the criteria "very good" and the practicality test by chemistry teachers obtained an average percentage of 94% with the criteria "very practical". Based on the results of both student response tests and teacher practicality tests, it can be stated that the practicum guide is suitable for use in chemistry practicum learning. The results of this research are supported by previous research conducted by Rusiani & Lazulva, (2017) which stated that the practicum guide on acid-base titration material using a natural pH indicator based on a scientific approach was declared practical in the very practical category, namely with a percentage of 85,71%. Rusiani & Lazulva, (2017) stated that the pH range of Red lip leaf extract was 7,37-9,57 with a pink-yellow color change. Meanwhile, the color change of butterfly pea flower extract in the titration of a strong acid with a strong base is to pink purplish at pH 1-2, light blue at pH 7, and light green at pH range 8-12. The results of this research are supported by previous research by Suryadnyani et al, (2021) which found that the butterfly pea flower ethanol extract colour change red in acidic and greenis blue in basic.The color change is caused by the nature of anthocyanins in butterfly extract which are sensitive to pH.

CONCLUSION

The practicum guide for acid-base titration with the butterfly pea flower indicator developed is valid and practical. This practicum guide can be used by teachers in conducting acid-base titration experiments that are more environmentally friendly because they use natural indicators that are easy to obtain.

RECOMMENDATIONS

This practical guide uses wet extract of butterfly pea flowers as an acid-base indicator. It is necessary to research and develop a dry extract of butterfly pea flower indicator and test its durability at room temperature.

BIBLIOGRAPHY

Abugri, D. A., Apea, O. B., & Pritchett, G. (2012). Investigation of a Simple and Cheap Source of a Natural Indicator for Acid-Base Titration: Effects of System Conditions on Natural Indicators. *Green and Sustainable Chemistry*, *02*(03), 117–122. https://doi.org/10.4236/gsc.2012.23017

Agustina, R., Rahma, S., & Chrismania Sandhira, A. (2022). Karakteristik Trayek pH Indikator Alami dan Aplikasinya pada Titrasi Asam dan Basa. *Bivalen: Chemical Studies Journal*, *5*(2), 51–56. http://jurnal.fkip.unmul.ac.id/index.php/bivalen

Aini, F. Q., Fitriza, Z., Iswendi, I., Rivaldo, I., & ... (2023). Enhancing Students' Science Process Skills through the Implementation of POGIL-based General Chemistry Experiment Manual: A Quantitative Study. *Hydrogen: Jurnal …*, *11*(April). https://e-journal.undikma.ac.id/index.php/hydrogen/article/view/7498%0Ahttps://e-journal.undikma.ac.id/index.php/hydrogen/article/viewFile/7498/4491

Ardiansyah, B., Ramdani, A., Hakim, A., Makhrus, M., Education, S., Study, D., Nusa, W., Province, T., & Quality, E. (2023). Preliminary Study: Study of Supporting Facilities for Natural Science Mini Project Practicum Models of Junior High Schools in Mataram. *Hydrogen: Jurnal Kependidikan Kimia*, *11*(December), 904–911.

Baunsele, A. B., Tukan, M. B., Kopon, A. M., Boelan, G., Komisia, F., Uron Leba, M. A., &

Lawung, Y. D. (2020). Peningkatan Pemahaman Terhadap Ilmu Kimia Melalui Kegiatan Praktikum Kimia Sederhana Di Kota Soe. *Jurnal Pengabdiankepada Masyarakat*, *1*(2), 43–48. http://dx.doi.org/10.36257/apts.vxix

Fitri, C. B. S., & Fikroh, R. A. (2021). The Potential of Clitoria ternatea L. Extracts as an Alternative Indicator in Acid-Base Titration. *Jurnal IPA & Pembelajaran IPA*, *5*(4), 340–352. https://doi.org/10.24815/jipi.v5i4.23183

Hidayah, F. F., Imaduddin, M., Yuliyanto, E., Gunawan, G., & Djunaidi, M. C. (2022). Introducing the Small-Scale Chemistry Approach Through Inquiry-Based Laboratory Activities For Pre-Service Teachers. *EduChemia (Jurnal Kimia Dan Pendidikan)*, *7*(1), 14. https://doi.org/10.30870/educhemia.v7i1.13084

Kapilraj, N., Keerthanan, S., & Sithambaresan, M. (2019). Natural Plant Extracts as Acid-Base Indicator and Determination of Their pKa Value. *Journal of Chemistry*, *2019*. https://doi.org/10.1155/2019/2031342

Nurfatimah, S. A., Hasna, S., & Rostika, D. (2022). Membangun Kualitas Pendidikan di Indonesia dalam Mewujudkan Program Sustainable Development Goals (SDGs). *Jurnal Basicedu*, *6*(4), 6145–6154. https://doi.org/10.31004/basicedu.v6i4.3183

Purwono, B., & Mahardiani, C. (2010). Synthesis of Azo Compounds Derivative From Eugenol and Its Application As a Titration Indicator. *Indonesian Journal of Chemistry*, *9*(1), 95–98. https://doi.org/10.22146/ijc.21568

Putra, A. (2022). Model GI-GI: Sistem Pembelajaran Active Learning Berbasis Student Centred Menggunakan Pendekatan Scientific Approach dalam Rangka Mewujudkan Tujuan ke Empat SDGs. *Improvement: Jurnal Ilmiah Untuk Peningkatan Mutu Manajemen Pendidikan*, *9*(02), 105–121. https://doi.org/10.21009/improvement.v9i2.31354

Ratmini, W. S. (2017). The Implementation of Chemistry Practicum at SMA Laboratorium Undiksha Singaraja in the School. *Jpi*, *6*(2), 242–254. https://doi.org/10.23887/jpi-undiksha.v6i2.11881

Rusiani, A. F., & Lazulva. (2017). Menggunakan Indikator Alami Berbasis Pendekatan Saintifik. *Tadris Kimiya*, *2* no *2*, 11.

Safitri, A. O., Yunianti, V. D., & Rostika, D. (2022). Upaya Peningkatan Pendidikan Berkualitas di Indonesia: Analisis Pencapaian Sustainable Development Goals (SDGs). *Jurnal Basicedu*, *6*(4), 7096–7106. https://doi.org/10.31004/basicedu.v6i4.3296

Soedirga, L. C., Matita, I. C., & Sidharta, J. (2023). Physicochemical Characteristics of Butterfly Pea Flower Petals Steep Obtained at Different Steeping Temperature and Time. *Reaktor*, *23*(1), 9–15. http://ejournal.undip.ac.id/index.php/reaktor/

Wahab, A., Sartika, R. P., Studi, P., Kimia, P., & Tanjungpura, U. (2021). Pengembangan Penuntun Praktikum Titrasi Asam Basa Berbasis Inquiri Terbimbing. *Education and Development*, *9*(3), 75–80.