HYDROGEN
JURNAL KEPENDIDIKAN KIMIA
http://ojs.ikipmataram.ac.id/index.php/hydrogen/index

February 2023,11(1)
e-ISSN: 2656-3061
p-ISSN: 2338-6487
pp. 88-94

Development of Guided-Inquiry-Based Buffer Solution E-Module

Rahayu Putri Ilahi, Elvy Rahmi Mawarnis*, Mimi Herman
Department of Tadris Kimia, FTIK, UIN Mahmud Yunus Batusangkar, Jl. Jendral Sudirman No. 137, Sumatera Barat, Indonesia 27217
* Corresponding Author e-mail: elvyrahmimawarnis@mail.com

Article History
Received: 30-12-2022
Revised: 31-01-2023
Published: 15-02-2023

Keywords: chemistry, e-module, guided inquiry

Abstract
This study aimed to evaluate the validity and practicality of a Guided Inquiry-Based Chemistry E-module for 11th-grade students at SMAN 1 Sijunjung. The study was conducted using a Research and Development (R&D) approach with the 4-D model (define, design, develop, and disseminate), and only the define, design, and develop stages were carried out. During the define stage, the learning conditions and instructional requirements were understood, while the design stage involved preparing the Chemistry E-module. In the develop stage, the validity and practicality of the E-module prototype were tested. The results of the study show that the Guided Inquiry-Based Chemistry E-module met standards with regard to its construction validity, as evidenced by a result of 94.4%. The module was also found to be highly practical based on student perception, with 86.4% of students indicating that the E-module was useful in the classroom. Overall, the findings suggest that the developed Guided Inquiry-Based Chemistry E-module can serve as an effective learning resource for students.

How to Cite: Ilahi, R., Mawarnis, E., & Herman, M. (2023). Development of Guided-Inquiry-Based Buffer Solution E-Module. *Hydrogen: Jurnal Kependidikan Kimia, 11*(1), 88-94. doi:https://doi.org/10.33394/hjkk.v11i1.6869

https://doi.org/10.33394/hjkk.v11i1.6869

INTRODUCTION

Schools serve as a crucial venue and time for the government and society to prepare students for their future lives (Bafadhol, 2017). To facilitate this goal, the school implements various strategies to support the teaching and learning process, one of which is the use of teaching materials. Teaching materials refer to a set of knowledge, skills, and practices that students need to acquire in order to achieve the core and basic competencies expected in education. They play a role in facilitating individual learning and organizing student information (Nurdyansyah, 2018).

In practice, the use of teaching materials should be tailored to the characteristics of the learning process (Idris, 2018). For offline learning, materials such as books, modules, and worksheets (LKS) are commonly used (Ferawati, Saputri, & Nurmaesah, 2022). Meanwhile, for online learning, materials in the form of power points, videos, and electronic modules are more effective (Sakiah & Effendi, 2021). The availability of appropriate teaching materials is crucial for directing the learning process. Therefore, the quality and relevance to the target audience must be considered when developing teaching materials.

Previous research has shown that teachers often face challenges in selecting and determining appropriate teaching materials to meet the competency standards (SK) and basic competencies (KD) of their students (Siama, 2016). The dominance of textbook use remains despite the availability of alternative learning resources (Herawati & Muhtadi, 2018). In particular, the use of teaching materials in chemistry lessons is limited, with students relying primarily on package

books and LKS for study guides (Herawati & Muhtadi, 2018). This results in ineffective teaching and learning and disinterest among students, negatively impacting the learning process in the classroom. A similar situation was observed at State Senior High School (SMAN) 1 Sijunjung, where students reported difficulties in understanding the material due to monotonous teaching methods and challenging package books.

To address these problems, more effective and engaging teaching materials must be used, taking into consideration the needs and preferences of students. One such material is the E-module (Aisyah, Solfarina, & Yuliantika, 2021). E-modules are digital modules comprised of text and images, including simulations, suitable for learning purposes (Raharjo, Suryati, & Khery, 2017; Sunarya et al. 2018). They have been shown to increase student engagement and improve learning outcomes (Ersando, Muharini, Lestari, Sartika, & Rasmawan, 2022).

Another solution to the problem of students' lack of participation during learning is the development of an E-module based on Guided Inquiry. The Guided Inquiry model encourages students to actively engage in the learning process (Fahmia, Karjiyati, & Dalifa, 2019) and provides guidance or instruction to students as needed (Sholikhah, Winarti, & Kurniasih, 2014). The goal of this research is to determine the validity and practicality of the Guided Inquiry-Based Chemistry E-module.

METHOD

The study employed development research, also known as Research and Development (R&D) research, as the research method. R&D research is a method that involves the development of a product, such as a model or module, with valid product validity. In this study, the 4-D development model proposed by Thiargarajan et al. was used as the development model (Maydiantoro, 2021).

The 4-D model consists of four stages: Define, Design, Develop, and Disseminate. During the Define stage, initial conditions in the field were determined and the teaching materials to be developed were identified through (1) interviews with chemistry educators and 11th grade science students, (2) analysis of the 11th-grade science class chemistry learning syllabus, (3) examination of teaching materials used in schools, and (4) a literature review on E-module teaching materials.

In the Design stage, the Guided Inquiry-Based Chemistry E-module was designed using Flipping Book and Canva applications to make it interesting and understandable for students. In the Develop stage, the designed components were assembled and presented in the E-module, which then underwent validation and practicality stages.

Data was collected through interview guidelines, validation sheets, and practicality questionnaire sheets. The interview guidelines were used to gather information about problems in schools from both teachers and students to determine the necessary characteristics of the teaching materials. The validation sheets were used to measure the validity of the developed teaching materials, evaluating aspects such as format, language, and questionnaire statements. The practicality response questionnaire was used to assess students' perceptions of the developed E-module.

Data analysis techniques included validity and practicality analysis. Validity was determined by applying a validation questionnaire, which included validation of material substance, presentation feasibility, linguistic validation, and display eligibility (Haspen, Syafriani, & Ramli, 2021). The percentage of validity and practicality was calculated using the formula and interpreted as shown in Table 1.

$$P = \frac{\text{Score per item}}{\text{Score makximum}} \times 100\%$$

Tabel 1. Scoring categories.

Category	Score
Invalid/nonpractical	0%-20%
Less validity/less practical	21%-40%
Fair validity/fair practical	41%-60%
Good validity/good practical	61%-80%
Excellent validity/excellent practical	81%-100%

RESULTS AND DISCUSSION

Define Stage

The definition stage was carried out through multiple steps, including interviews with chemistry experts, interviews with 11th-grade science students, a literature analysis, and an analysis of learning objectives. The results of the interview with a chemistry teacher at SMA N 1 Sijunjung revealed that the teaching methods in the classroom were conventional and relied heavily on textbooks. This approach led to a lack of student engagement and made independent learning difficult. In response to these findings, the researcher designed a Guided Inquiry-Based Chemistry E-module.

The Guided Inquiry-Based Chemistry E-module is a digital teaching material that can be accessed via computers, laptops, tablets, or smartphones. The e-module is designed to increase student engagement and encourage independent learning (Cheva & Zainul, 2019). The module was created using a variety of literature and reference materials and was designed to be easily accessible to students.

Design Stage

The design stage involved creating the E-module in a format suitable for students. This involved considering factors such as material feasibility, readability, language use, and the inclusion of images and YouTube videos in the form of QR codes. A thorough literature analysis was conducted, and the design was based on the syllabus, core competencies, basic competencies, and competency achievement indicators.

The initial design of the E-module was created using Microsoft Word 2010 and was then transformed into an e-module using the Canva and Flipping Book applications. The e-module can be used online through a shared link or offline as a pdf. The module is divided into six sections covering the definition of buffer solutions, components or types of buffer solutions, preparation of buffer solutions, properties of buffer solutions, calculation of pH and pOH of buffer solutions, and the role of buffer solutions in daily life.

Each section includes a guided inquiry process with orientation, problem formulation, hypothesis formulation, data collection, hypothesis testing, data conclusion, and self-tests to help students understand the material. The module also includes QR codes linked to learning videos and a simple experiment, summary, and a learning evaluation consisting of 20 items.

Figure 1. E-Module display via mobile/android

Development Stage

Validity Test

The validity of the Guided Inquiry-based Chemistry E-module was tested by three validators. After incorporating the suggestions made by the validators, the resulting E-module was deemed to be valid. The validity of an instrument is determined by its ability to perform its measurement function and produce measurement results that align with its measurement objectives (Widodo, 2006). The validation process is carried out to assess the suitability of the product for use (Arimadona, 2016).

The validity of the E-module was assessed based on the assessment criteria outlined by the BNSP textbook. The assessment criteria included four aspects: 1) content feasibility, 2) language feasibility, 3) presentation feasibility, and 4) graphic feasibility (Susilo, et al. 2016). In order for the developed teaching material to be considered as a suitable learning resource, all four of these aspects must be met (Arsanti, 2018).

Tabel 2. Description of chemistry e-module validation

No	Aspects of validity	Validator			Total	Max. score	%	Category
		1	2	3				
1	Content	6	6	8	20	24	83,3	Excellent validity
2	Lay out	10	9	12	31	36	86,1	Excellent validity
3	Grammar	9	9	12	30	36	89	Excellent validity
4	Graphics	59	54	62	175	72	82	Excellent validity
	Total	84	77	94	251	162	83,3	Excellent validity

It is great to see that the Guided Inquiry based Chemistry E-module has been declared valid with a percentage of 83.3%. The use of a Guided Inquiry approach in the development of this E-module is expected to promote active and independent learning, which is essential in fostering students' critical thinking and problem-solving skills. Additionally, the alignment of the E-module with the objectives and competency standards set for the learning process will ensure that the students receive quality education. This is important in ensuring that the students are able to understand and retain the material being taught. Overall, the use of a valid E-module in the learning process is expected to enhance students' learning experience and lead to better outcomes.

Practicality Test

Following the validation and revision of the Guided Inquiry-based Chemistry E-module, the next step was to conduct a practicality test. The test was administered to 34 eleventh-grade science students at SMAN 1 Sijunjung. The test was conducted through a student response questionnaire and was completed in one meeting. The researchers facilitated learning using the Guided Inquiry-based Chemistry E-module on Buffer Solution Material and then collected student responses through the questionnaire (Table 3).

The aspects assessed in the student response questionnaire for the practicality test of the Guided Inquiry-based Chemistry E-module on Buffer Solution Material were ease of use, display, learning material, and language. According to Agustyaningrum and Gusmana (2017), the ease of use aspect refers to the ease in understanding the material and language presented in the E-module. The display aspect focuses on the presentation of the E-module. If the practicality test results reach the "good" category based on the criteria specified, then the material is considered practical.

Table 3. Descriptions of student response to chemistry e-module

No	Aspects of Practicality	Total	Max. Score	%	Remarks
1	Convenient	350	408	85,8	Excellent practical
2	Display	592	680	87,1	Excellent practical
3	Subject material	471	544	86,6	Excellent practical
4	Communicative	114	136	83,8	Excellent practical
	Total	1527	1768	86,4	Excellent practical

The results of the overall practicality test of the Guided Inquiry-based Chemistry E-module on buffer solution material received a percentage of 86.4% based on the student response questionnaire, categorizing it as very practical. A practicality test is considered practical when the developed teaching materials can be applied and utilized by students to understand the lesson. E-modules make it easier to explore the material taught by the teacher (Saputri, et al. 2020). Therefore, the Guided Inquiry-based Chemistry E-module on Buffer Solution Material is deemed practical. This pre-existing module is expected to be beneficial for both students and teachers during the learning process.

CONCLUSION

In conclusion, the Guided Inquiry based Chemistry E-module on Buffer Solution Material was found to be both valid and practical. The validity test resulted in 83.3% validation rate, which indicates that the E-module was considered suitable to be used as a teaching material in line with the expected learning objectives and competency standards. In addition, the practicality test conducted on 34 of 11^{th} grade science students resulted in a high percentage of 86.4% categorized as very practical, indicating that the E-module was user-friendly and able to assist

students in understanding the material. Overall, the development of this E-module is expected to enhance students' learning experiences by promoting independent learning and critical thinking skills. The results of this study show that the Guided Inquiry based Chemistry E-module on Buffer Solution Material is a valuable resource for both students and teachers and may have potential for wider implementation in science education. This research is carried out until the development stage, where at this stage validity and practicality tests are carried out, for further research it is recommended to conduct effectiveness tests and carry out disseminate stages.

BIBLIOGRAPHY

Agustyaningrum, N., & Gusmania, Y. (2017). Praktikalitas dan keefektifan modul geometri analitik ruang berbasis konstruktivisme. *Jurnal Dimensi*, *6*(3).

Aisyah, R. S. S., Solfarina, S., & Yuliantika, U. (2021). Pengembangan E-Modul Berbasis Pemecahan Masalah Pada Materi Larutan Elektrolit dan Non-Elektrolit (ELNOEL). *Hydrogen: Jurnal Kependidikan Kimia, 9*(1), 19-29.

Arsanti, M. (2018) Pengembangan Bahan Ajar Mata Kuliah Penulisan Kreatif Bermuatan NilaiNilai Pendidikan Karakter Religius Bagi Mahasiswa Prodi PBSI, FKIP, UNISSULA. KREDO: Jurnal Ilmiah Bahasa Dan Sastra 1(2).

Bafadhol, I. (2017) Lembaga Pendidikan Islam Di Indonesia. Jurnal Edukasi Islam Jurnal Pendidikan Islam Vol. 06 No. 11.

Cheva, V. K., & Zainul, R. (2019). Pengembangan e-modul berbasis inkuiri terbimbing pada materi sifat keperiodikan unsur untuk SMA/MA kelas X. *Jurnal Edukimia*, 28-36.

Ersando, E., Muharini, R., Lestari, I., Sartika, R. P., & Rasmawan, R. (2022). Pengembangan E-Modul Pemisahan Senyawa Fenolik dari Fraksi Simpur Air dengan Teknik Kromatografi Lapis Tipis (KLT) Preparatif Sebagai Sumber Belajar Kimia Bahan Alam. *Hydrogen: Jurnal Kependidikan Kimia, 10*(2), 109-121.

Fahmia, H., Karjiyati, V., & Dalifa, D. (2019). Pengaruh model guided inquiry terhadap hasil belajar siswa pada pembelajaran Matematika siswa SD Kota Bengkulu. *JURIDIKDAS: Jurnal Riset Pendidikan Dasar*, *2*(3), 237-244.

Ferawati, F., Saputri, F. H., & Nurmaesah, N. (2022). Peningkatan Produktivitas Guru SMK melalui Kreativitas Pembuatan Bahan Ajar E-Learning. *Sasambo: Jurnal Abdimas (Journal of Community Service)*, *4*(4), 578-586.

Haspen, C. D. T., Syafriani, S., & Ramli, R. (2021). Validitas E-Modul Fisika SMA Berbasis Inkuiri Terbimbing Terintegrasi Etnosains untuk Meningkatkan Kemampuan Berpikir Kreatif Peserta Didik. *Jurnal Eksakta Pendidikan (JEP)*, *5*(1), 95-101.

Herawati, N. S., & Muhtadi, A. (2018). Pengembangan modul elektronik (e-modul) interaktif pada mata pelajaran Kimia kelas XI SMA. *Jurnal inovasi teknologi pendidikan*, *5*(2), 180-191.

Idris, H. (2018). Pembelajaran model blended learning. *Jurnal Ilmiah Iqra', 5*(1).

Maydiantoro, A. (2021). Model-Model Penelitian Pengembangan (Research and Development). *Jurnal Pengembangan Profesi Pendidik Indonesia (JPPPI)*.

Nurdyansyah, N. (2018) Pengamnamgan Bahan Ajar Modul Ilmu Pengetahuan Alambagi Siswa Kelas IV Sekolah Dasar. Universitas Muhammadiyah Sidoarjo

Raharjo, M. W. C., Suryati, S., & Khery, Y. (2017). Pengembangan E-Modul Interaktif Menggunakan Adobe Flash Pada Materi Ikatan Kimia Untuk Mendorong Literasi Sains Siswa. *Hydrogen: Jurnal Kependidikan Kimia*, *5*(1), 8-13.

Sakiah, N. A., & Effendi, K. N. S. (2021). Analisis kebutuhan multimedia interaktif berbasis PowerPoint materi aljabar pada pembelajaran matematika SMP. *JP3M (Jurnal Penelitian Pendidikan Dan Pengajaran Matematika), 7*(1), 39-48.

Sholikhah, N., Winarti, E. R., & Kurniasih, A. W. (2014). Keefektifan model guided inquiry dengan pendekatan keterampilan metakognitif terhadap kemampuan pemecahan masalah. *Kreano, Jurnal Matematika Kreatif-Inovatif, 5*(1), 18-25.

Saputri, F., Jazim, J., & Vahlia, I. (2020). Pengembangan Bahan Ajar Matematika Menggunakan Pendekatan Realistic Mathematic Education (RME). *EMTEKA: Jurnal Pendidikan Matematika, 1*(1), 24-35.

Siama, S. (2016) Pengembagan Bahan Ajar Berbasis Pendekatan Saintifik Pada Materi Permasalahan Sosial Untuk Melatih Literasi Sosial Kela IV SDN Seloreji 03 Blitar. Jurnal Studi Pendidikan Islam. ISSN : 2252-3812.

Susilo, A., Siswandari and B. Bandi (2016) Pengembangan Modul Berbasis Pembelajaran Saintifik Untuk Peningkatan Kemampuan Mencipta Siswa Dalam Proses Pembelajaran Akuntansi Siswa Kelas XII SMA NI Slogohimo 2014. Jurnal Pendidikan Ilmu Sosil 26(1).

Yuniarti, V. F. M., Anriani, N., & Santosa, C. A. H. S. (2020). Pengembangan E-modul Berbasis Smartphone Pada Materi Integral Tak Tentu Berorientasi Keterampilan Abad Ke-21. *Jurnal Riset Teknologi dan Inovasi Pendidikan (JARTIKA), 3*(2), 222-233.