HYDROGEN
JOURNAL OF CHEMISTRY EDUCATION
https://e-journal.undikma.ac.id/index.php/hydrogen/index

October 2025. 13(5)
e-ISSN: 2656-3061
p-ISSN: 2338-6487
pp. 980-996

Development of *E* -Module of Basic Chemical Laws with SAVI Approach

Syita Auliah Juwita, Eny Enawaty*, Risya Sasri
Tanjungpura University , Jl. Prof. Dr. Hadari Nawawi, Bansir Laut, Southeast Pontianak District, Pontianak City, West Kalimantan, Indonesia 78124
* Corresponding Author e-mail: enyenawaty@fkip.untan.ac.id

Article History
Received: dd-M-2025
Revised: dd-M-2025
Published: 19-11-2025

Keywords: *E* -Module; SAVI; basic laws of chemistry.

Abstract
Along with the growing need for more interactive learning and with a technological approach, e-modules with the SAVI approach have become an alternative that can increase the effectiveness of learning. The purpose of this study was to determine the validity of the e-module of basic chemical laws with the SAVI approach and to determine students' responses to the e-module of basic chemical laws with the SAVI approach. This research was conducted at SMA Negeri 5 Pontianak Class XI Chemistry Major. This type of research is Research & Development (R&D), using the ADDIE development model (analysis, design, development, implementation, evaluation) with limitations on the development stage. The results of the study indicate that the e-module of basic chemical laws with the SAVI approach developed is categorized as very feasible and can be used with validation results from material experts of 97% (Very Valid), validation from language experts of 100% (Very Valid), validation from media experts of 96.13% (Very Valid), the results of the limited response test conducted by 12 students in class XI of Chemistry Interest consisting of three assessment aspects are categorized as very good with details of the module display aspect of 93.75% (Very Good), the material presentation aspect of 93.22% (Very Good), and the benefit aspect of 93.22% (Very Good), as well as the results of the extensive response test conducted by 24 students in class XI of Chemistry Interest obtained the module display aspect showed a score of 93% (Very Good), the material presentation aspect of 93.48%, and the benefit aspect of 94.53% (Very Good). This shows that the e-module of basic chemical laws with the SAVI approach is very feasible to be used in the learning process.

How to Cite: Juwita, S. A., Enawaty, E., & Sasri, R. (2025). Development of SAVI-Based Basic Chemical Law E -Module. Hydrogen: Jurnal Kependidikan Kimia, 13(5), 980–996. https://doi.org/10.33394/hjkk.v13i5.15124

https://doi.org/10.33394/hjkk.v13i5.15124

INTRODUCTION

Education plays a crucial role as the primary foundation for building a society and a nation. In the 21st century, education has undergone a paradigm shift, from teacher-centered to student-centered. This approach emphasizes the importance of giving students the freedom to explore various learning resources independently and actively. The Ministry of Education, Culture, Research, and Technology (Kemendikbudristek), through the *Merdeka Belajar program* , encourages the implementation of a flexible and adaptive curriculum tailored to the needs and characteristics of students. This program emphasizes the crucial role of educators as facilitators capable of creating innovative, creative, and enjoyable learning, while enabling students to develop their individual potential and learning styles.

In learning practice, each student has a different learning style, both in terms of readiness, interests, and learning profiles. Therefore, a learning approach that accommodates these differences is essential for a more optimal and meaningful learning process. One approach that aligns with the spirit of the Independent Curriculum is differentiated learning, which, according to Aprima (2022), can maximize students' learning potential by providing learning services tailored to their individual needs.

According to Faiz *et al* . (2022) , differentiated learning is a series of reasonable decisions taken by teachers by considering the individual needs of students. According to Wahyuningsari *et al* . (2022), this helps students not to feel frustrated or fail in their learning process. According to Husna & Aini (2023), differentiated learning is a learning strategy in the classroom that aims to meet the individual needs of students. In this approach, teachers facilitate students according to their needs, that each student has unique characteristics and therefore requires an individually tailored approach because not all students can be treated the same. According to Umbara, (2017), differentiated learning has the potential to increase student interest during the learning process. For example, students may become more active in asking questions or providing answers to teachers, as well as more actively involved in group discussions to solve problems and gather information related to the material being studied.

In the chemistry subject at SMA Negeri 5 Pontianak, grade X, even semester, the material on the basic laws of chemistry consists of Lavoisier's law, Proust's law, Dalton's law, Gay Lussac's law, and Avogadro's law. The material on the basic laws of chemistry is considered important because it is the basis that students must understand to be able to master the next subject, such as chemical calculations related to the concept of moles. Many students have difficulty in understanding this material because it involves learning about concepts that cannot be seen directly and have abstract, concrete, and mathematical properties (Hanum *et al.* , 2017) . According to Ristiyani *et al* . (2016) , the material on the basic laws of chemistry shows a fairly high level of difficulty. This difficulty is caused by the many concepts of calculations, chemical reactions, and theories that cover most of the material. Therefore, it is expected that students understand in depth each concept taught.

One learning approach that can be used to optimize student potential is the SAVI (somatic, auditory, visual, and intellectual) learning approach to the basic laws of chemistry. The SAVI learning approach is an abbreviation of Somatic, which refers to the use of body movements and physical activities through learning experiences; Auditory, which involves students' ability to answer and express opinions verbally; Visual, which relates to the use of the sense of sight through observation, drawing, pointing, reading media, and utilizing teaching aids; and Intellectual, which emphasizes the involvement of the mind in building and understanding concepts.

According to Veriansyah (2022), the implementation of the SAVI learning approach has a positive impact on improving student learning outcomes. This success is due to the approach's ability to provide students with opportunities to optimize their integrated intelligence by combining physical movement with intellectual activities. Furthermore, this approach can also improve student understanding of the material, as it guides students to construct their own knowledge. As a result, students not only understand the material better but also have stronger memory.

By using *e* -modules with the Savi approach, students can more easily understand abstract and complex chemical concepts. Furthermore, the use of technology in learning media can also provide better accessibility for students. *E* -modules can be accessed anytime and anywhere through digital devices, enabling students to learn independently. This can provide students with the flexibility to adapt to their learning styles, thus making learning more effective. The *e* -modules are designed with the aim of accommodating learning that suits students' needs regarding the basic laws of chemistry in accordance with the differentiated independent curriculum. *E* -modules with the Savi approach can provide a more engaging and interactive learning experience for students, thereby enriching their understanding of chemical concepts.

Based on research conducted by Veriansyah (2022) on class X students at SMAN 6 Pontianak, the results of observation data analysis showed that the average activity of control class students was 67.6 with a moderate category while in the experimental class the average student learning outcomes were 70.6 with a high category. Thus, it was concluded that the average learning achievement in the experimental class was significantly higher than the control class so that the implementation of the SAVI approach had a positive impact on student learning outcomes.

Based on the results of observations conducted at SMA Negeri 5 Pontianak, researchers observed that teachers in delivering material still use the lecture method, this results in students feeling bored and less interested in following the learning material, and can cause learning objectives not to be achieved. Student learning activities also appear low, lack of student involvement during the learning process in the classroom. Students appear less focused when the teacher delivers the material, rarely take notes on the explanations given, and tend to talk with friends or just sit without paying attention to what the teacher is saying . In this context, students act as passive recipients who only listen without providing responses in the form of questions or opinions. In other words, there is no unity of perception among students regarding the material being taught (Padmanaba *et al.* , 2018) .

Interviews with a 10th-grade chemistry teacher at Pontianak State Senior High School 5 revealed that the school has not yet implemented differentiated learning. This is because the implementation of the independent curriculum in schools is still relatively new , so educators' knowledge of differentiated learning is still limited. The concept of the independent curriculum emphasizes the importance of teachers' role in implementing differentiated learning (Gusteti & Neviyarni, 2022) .

To address the aforementioned issues, it is necessary to develop *an e* -learning module for students on the basic laws of chemistry. *This e* -module, developed using the SAVI approach, is designed to accommodate the needs of 10th-grade students in the basic laws of chemistry, in accordance with the Merdeka Curriculum.

METHOD

This research falls into the category of research and development *(* R&D). According to (Sugiono, 2016) , research and *development* (R&D) is a research method aimed at developing and validating products used in education and learning. Development research aims to create products based on field test results, which will then be revised and improved continuously (Monica *et al* ., 2023) . Meanwhile, according to Alwanuddin *et al* ., (2022) , the goal of development research is to produce products, concepts, methods, tools, programs, or methods that can help simplify and overcome various problems faced by humans.

The stages in this research use the ADDIE development design which consists of 5 stages, namely (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation (Hanum *et al* ., 2017) . In this research, it is limited to three stages, namely the analysis stage, the design stage, and the development stage. This is because the module is designed with the aim of accommodating learning that is appropriate to student needs.

The research subject in this study is *an e* -module on basic chemical laws with the SAVI approach developed to accommodate student needs according to the independent curriculum. This research was conducted in the even semester of the 2024/2025 academic year at SMA Negeri 5 Pontianak. The research subjects consisted of 11th grade students of SMA Negeri 5 Pontianak in the 2024/2025 academic year. The implementation of this study involved four classes, with the division of subjects into small-scale trials consisting of 12 students, and large-scale trials consisting of 24 students.

The research and development procedure using the ADDIE model consists of stages carried out in a specific sequence, namely *Analysis* , *Design* , *Development* , *Implementation* , and

Evaluation . This model emphasizes reflection and literacy at each stage, with the aim of providing continuous feedback for continuous improvement. This approach ensures that each phase contributes to the improvement and refinement of the overall learning process. The following is a work scheme for the research and development of *the e* -module on basic chemical laws using the SAVI approach, as described in Figure 1.

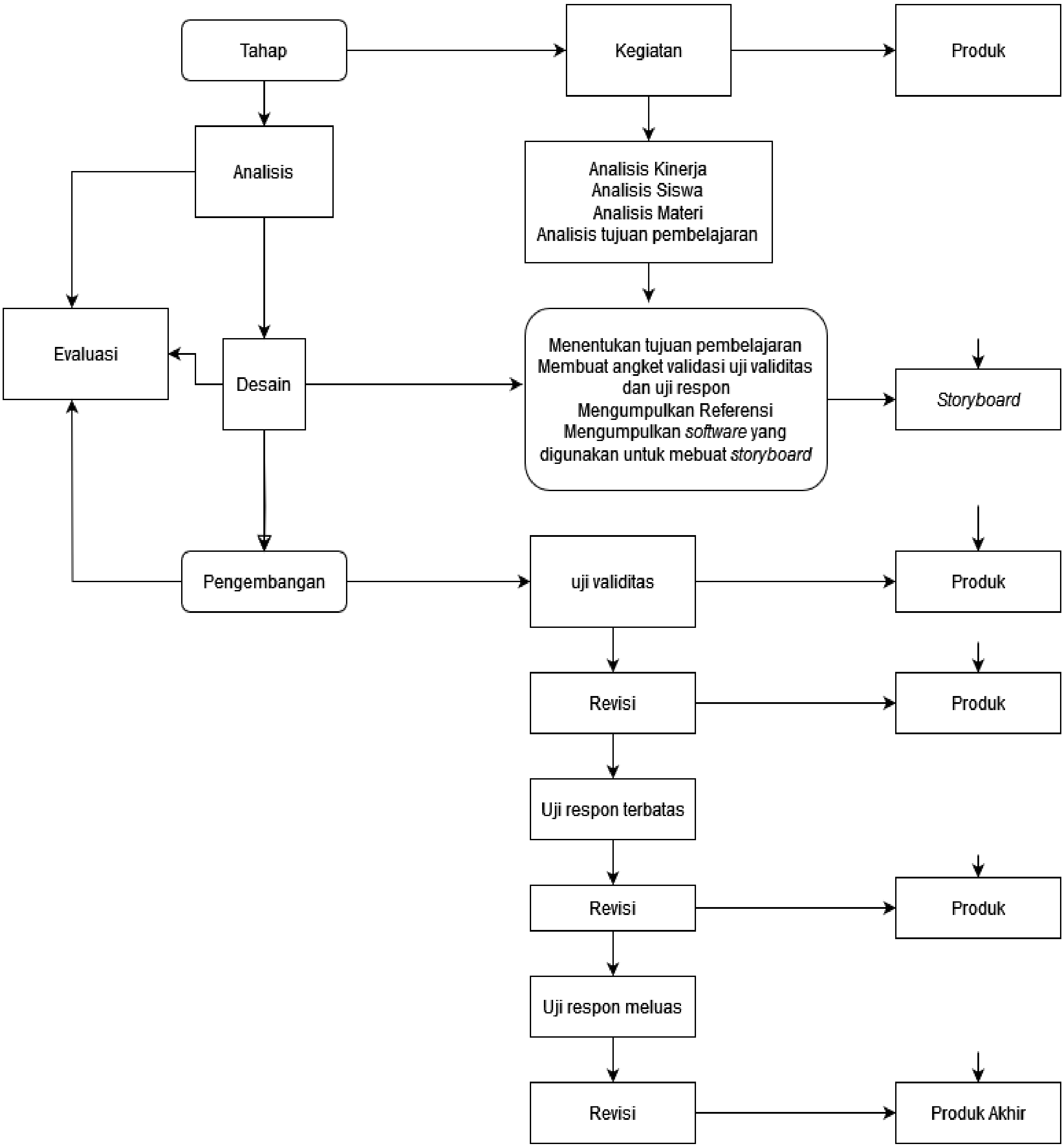


Figure 1. Research Procedure

The process of developing an electronic module with the SAVI approach for the material on basic chemical laws is carried out in four stages.

The first stage is analysis. Interviews were conducted with a chemistry teacher and 12 eleventh-grade students of SMA Negeri 5 Pontianak. The aim was to determine the difficulties faced by students in the basic laws of chemistry, the teaching materials used, the curriculum, learning outcomes, and the media needed by students. The sample was determined using a *purposive sampling technique* . Problem analysis was carried out by identifying problems that emerged during classroom learning based on observation results. Next, needs analysis was carried out by identifying the needs required by students based on the results of the problem analysis.

The second stage is design. This stage establishes learning outcomes, defines the content to be included in the developed module, and identifies sources or materials to be used in the module. Furthermore, the design stage also includes storyboarding, developing a validation questionnaire for validators, and developing a response test questionnaire for students.

The next step is the development stage . The electronic module with the SAVI approach is developed based on *the storyboard* that has been prepared. Next, the product will go through a validation stage by expert validators. Validation is carried out on aspects of material, language, and graphics. After that, the product will be revised according to input from the validator until it is deemed valid for response testing. According to (Alwi, 2012), validity testing is related to the problem of whether the instrument intended to measure something can actually measure something accurately. Validity testing, also known as question quality review, is carried out before the questions are tested on the parties who are used as research subjects. The response test was conducted on grade XI students at SMA Negeri 5 Pontianak in the 2024/2025 academic year on a small scale and a wider scale. The sample was determined using a *purposive sampling technique.*

The final stage is evaluation. Modifications are made through formative evaluation. Formative evaluation involves improvements generated from input from validators and respondents. Then, revisions and improvements are made based on input from expert validators and respondents.

In the analysis phase, data collection was conducted through direct interviews with a teacher and several students. The purpose of the interviews was to obtain information about the use of teaching materials and students' learning style preferences. In addition to the interviews, documentation of learning outcomes was also used to classify students into high, medium, and low achievement categories.

In the development stage, data collection was conducted through the distribution of validation questionnaires to material, language, and media validators. Material validation included aspects of *self-instruction, self-contained, stand-alone, adaptive, user-friendly,* and SAVI. Language validation assessed clarity, communicativeness, suitability for students, and compliance with Indonesian language rules. Media validation involved the design of the module's front page, the media within the module's content, and the software used. Furthermore, validation questionnaires were also distributed to students as part of the response test. In the response test, aspects evaluated included the module's appearance, material presentation, and its usefulness.

The interview data were described qualitatively. Then, the validation questionnaire and response test questionnaire data were analyzed using a Likert scale divided into four categories: 4 (strongly agree), 3 (agree), 2 (disagree), and 1 (strongly disagree). The validation questionnaire and response test data were analyzed qualitatively. The qualitative analysis of the validator's results was analyzed according to Akbar (2013):

$$V = \frac{SV}{SM} x 100\%$$

While,
V = Validity
SV = Total score according to validator
SM = Total maximum score

Determining the validity criteria of *e* -modules using the SAVI approach on the basic chemical law material according to the validator can be seen in Table 1.

Table 1. Validity Criteria of *E* -Module With SAVI Approach by Validator

No.	Percent	Category	Information
1.	0%-50%	Invalid	Cannot be tested.
2.	50.01%-70%	Less Valid	Testing is not recommended and major repairs are needed.
3.	70.01%-80%	Quite Valid	Can be tested with minor improvements.
4.	80.01%-100%	Very Valid	Can be tested without repair.

Then the data analysis results from the response test carried out by students were analyzed according to Akbar (2013):

$$P = \frac{SP}{SM} x100\%$$

With:
P = User validity
SV = Total score according to user
SM = Total maximum score

Determining the criteria for student response results to the e-Module using the SAVI approach on the basic chemical law material can be seen in Table 2.

Table 2. Criteria for Student Response Results to *E* -Modules with the SAVI Approach

No.	Number	Category
1.	0% - 50%	Not good
2.	50.01% - 70%	Not good
3.	70.01% - 80%	Pretty good
4.	80.01% - 100%	Very good

RESULTS AND DISCUSSION

The analysis stage in the ADDIE model aims to identify problems and discrepancies between established standards and their implementation. At this stage, problem analysis and needs analysis are conducted (Nurmawati, 2022). Problem analysis aims to identify learning issues that require solutions, both related to the program and the learning process. Problem analysis was conducted through interviews with a chemistry teacher and 12 students. Based on the interviews, several problems were identified, including difficulties in understanding material on basic chemical laws, limited availability of printed textbooks, printed textbooks that do not support various student learning styles, and a learning process that is still teacher-centered.

After the existing problems have been identified, the next step is to conduct a needs analysis. This needs analysis process is carried out based on the results of the problem analysis that has been obtained. The needs analysis aims to determine the skills or competencies that students must learn to improve learning outcomes (Sukmadinata, 2013). Based on the identified problems, there is a need for teaching materials on the basic laws of chemistry that are accessible to all students and able to accommodate their different learning styles. Therefore, *an e* -module was developed with the SAVI approach for the basic laws of chemistry material.

The next stage in the design process is product design, which includes several steps, including determining learning indicators based on the syllabus, collecting learning materials, collecting software to support module development, creating validation questionnaires and response tests, and creating *a storyboard* (Basori, 2016). Learning indicators are determined based on the syllabus prepared by the Ministry of Education and Culture. Learning materials are collected through literature studies from chemistry textbooks for high school and college levels. The software used in module development includes *Microsoft Word 2019, Canva, KineMaster, Prosa Ai,* and *Heyzine Flipbook* . The creation of validation questionnaires and response tests is based on previous studies with modifications as needed. *The storyboard* created illustrates the rough design of *the e* -module to be developed.

In the development stage, an electronic module was created using the SAVI approach, compiled based on a previously designed *storyboard (Imbar et al., 2021). The module was written using Microsoft Word 2019* and then imported into the *Canva application* . After that, *the e* -module was converted into PDF format. After that, the PDF module was imported into the *Heyzine Flipbook application* . In the *Heyzine Flipbook application* , videos edited using the *KineMaster application were added* , audio created with *Prosa Ai* , and images were added. After all *e* -module elements were completed, *the e* -module was exported as a link. *The e* -module creation process can be summarized in Figure 2.

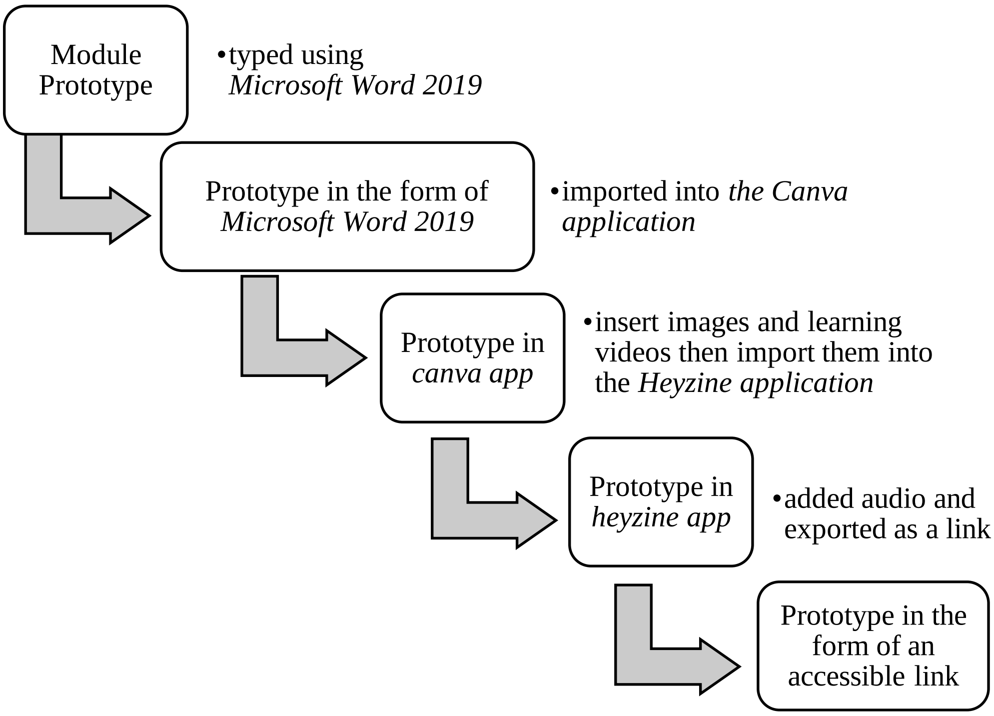


Figure 2. E-Module Creation Process

E -modules developed through a validation process by expert validators. The purpose of validation is to obtain assessments, input, and suggestions for improvement to perfect the learning module. Thus, the resulting module is free from errors and ready for testing (Rama *et al* ., 2022) . The validation carried out includes material validation, language validation, and media validation (Indriani *et al* ., 2017). Each validation aspect is assessed by two validators who are university lecturers and high school teachers (Enawaty *et al* ., 2021) . The validation process is carried out by providing validation questionnaire sheets to expert validators. The questionnaire used has been previously validated by expert questionnaire validators. The module assessment uses a Likert scale with four criteria, followed by criticism and suggestions provided subjectively by experts to ensure the resulting module is valid (Nalarita & Listiawan, 2019) .

Validation of the material and language was carried out by two expert validators who were lecturers in Chemistry Education from the Faculty of Teacher Training and Education, Tanjungpura University and a Chemistry teacher from SMA Negeri 9 Pontianak. The material validation questionnaire instrument included six assessment aspects, namely the independent learning aspect, content aspect, independence aspect, adaptive aspect, ease of use aspect, and SAVI aspect (*Somatic, Auditory, Visual, Intellectual*) as stated by (Permani, 2019) . These six aspects consisted of 17 material validation assessment items. Meanwhile, The language validation questionnaire covers four assessment aspects: straightforwardness, communication, appropriateness to student development, and consistency according to Indonesian language rules (Ardistya Puspita Sari & Indra Martha Rusmana, 2021) . These four aspects consist of five assessment items.

Table 3. Results of Material and Language Validity

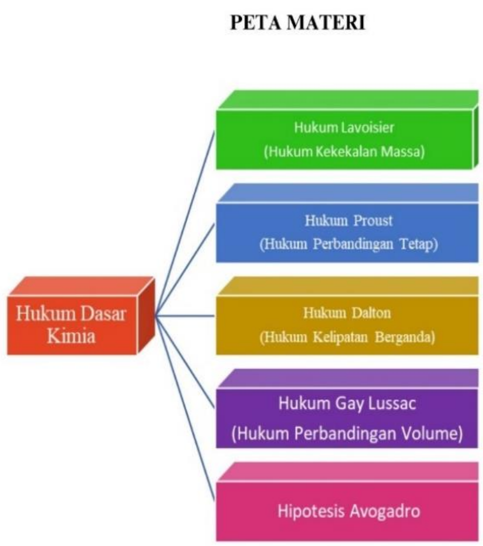
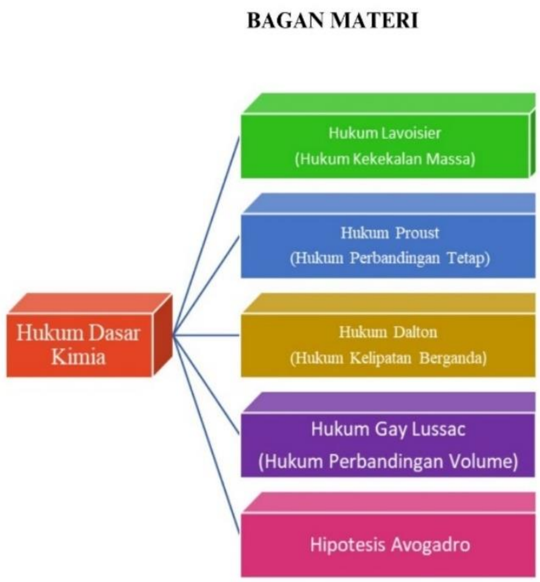
No.	**Assessment Items**	**Score (%)**
1.	Learning objectives are in accordance with predetermined learning outcomes.	87.5
2.	Learning materials are in accordance with the learning objectives to be achieved.	87.5
3.	The introduction of material in *the e* -module using the SAVI approach attracts students' curiosity.	87.5
4.	Packaging of material in *e* -modules with an interactive SAVI approach makes it easier for students to learn according to their learning style.	87.5
5.	The images presented in *the e* -module using the SAVI approach are appropriate to the material and help students understand the lesson material.	87.5
6.	The learning videos presented in *the e* -module with the SAVI approach are in accordance with the material and help students understand the lesson material.	100
7.	Formative tests on *e* -modules with the SAVI approach can measure students' understanding of the subject matter.	100
8.	The use of sentences in the material text is easy to understand.	100
9.	Use of language in simple learning videos.	100
10.	The use of sentences in the practical instructions is easy to understand.	100
11.	Summary of material in *the e* -module with the SAVI approach according to the lesson material.	87.5
12.	The learning materials in *the e* -module with the SAVI approach are arranged in full according to the specified main material.	100
13.	The study instructions and lesson materials presented enable students to learn independently using only *e* -modules using the SAVI approach.	87.5
14.	*E* -modules with the SAVI approach utilize technological developments so that they can be studied using *a cellphone* , tablet or laptop.	100
15.	E-modules with the SAVI approach utilize technology by integrating learning videos and various learning *YouTube channels* .	100
16.	Instructions on *the e* -module with the SAVI approach are easy for students to understand.	100
17.	*E* -modules with the SAVI approach are designed to be simple, interesting, and appropriate to students' learning styles, making them easy to understand.	100
18.	Sentences used are in accordance with good and correct Indonesian language rules.	100
19.	The vocabulary used is easy for students to understand	100
20.	The use of language is effective and efficient so that multiple interpretations do not occur.	100
21.	The information conveyed is clear	100
22.	The language used is polite and does not offend SARA	100

Table 3 shows that the results of the material validation include four assessment aspects, namely the self-learning aspect, the independence aspect, the adaptive aspect, and the ease of use aspect. It was found that 17 assessment items were categorized as very valid. Components in *the e* -module, such as the suitability of the material concept with basic competencies, the ease of use *of the e* -module, and its suitability with the development of science and technology, were declared very valid. In addition, visual components such as images, audio, and video in the module also received a very valid assessment. The use of images and animation elements is expected to assist teachers in delivering material and increase student interest in learning. In the learning process, teachers need to design effective strategies so that learning objectives can be achieved. In addition, an understanding of various variations in learning methods is very necessary to avoid the impression of monotony in the classroom, so that learning becomes more interesting and enjoyable for students *(* Nurul *et al* ., 2019) .

This study shows that the module is worthy of being tested with a response level of feasibility reaching 97%. Then, based on the results of the language validation in Table 3 (Numbers 18-22), it was found that all assessment items were categorized as very valid. The very valid category states that the module can be used without improvement. This indicates that the language components in the module, such as the use of simple, communicative, easy-to-understand language, and in accordance with Indonesian language rules, are declared very valid. According to Panjaitan *et al* ., (2021) , the use of appropriate language can prevent various interpretations, so that readers can more easily understand the information conveyed. This indicates that the module is suitable for response testing with a percentage of 100%.

Material expert validator 1 suggested that short videos be included in *the filebook's heyzine* , that the concept map section be renamed to a material chart, and that the formative test section's writing need to be tidied up because the spacing between questions is too close. Meanwhile, material expert validator 2 suggested that learning outcomes should be in accordance with the independent curriculum, and that other images related to the material be added besides photos of scientists on basic chemical laws to make it more interesting for students. Changes to *the e* -module based on suggestions from material and language expert validators can be seen in Table 4.

Table 4. Results Before and After Improvement in Material and Language Validation

No	Before Revision	After Revision
1.		

2.

Capaian Pembelajaran

Materi KD 3.5 dan 4.5 ini membahas tentang materi Hukum-Hukum Dasar Kimia dan Perhitungan Kimia. Materi tersebut diuraikan secara rinci agar dapat memfasilitasi peserta didik sehingga dapat menerapkan hukum-hukum dasar kimia dalam perhitungan kimia dan menggunakan hukum-hukum dasar kimia dalam perhitungan kimia.

Tujuan Pembelajaran

Adapun sub capaian pembelajaran untuk mendukung capaian pembelajaran tersebut adalah :

3.5.1 Membandingkan konsep hukum-hukum dasar kimia (Hukum Lavoisier,HukumProust,Hukum Dalton,Hukum Gay Lussac dan Hukum Avogadro).

3.5.2 Memeriksa data untuk menyimpulkan Hukum Lavoisier,HukumProust,Hukum Dalton,Hukum Gay Lussac dan Hukum Avogadro.

4.5.1 Menggunakan Hukum-Hukum dasar kimia untuk menyelesaikan perhitungan kimia.

Capaian Pembelajaran

Elemen: Pemahaman Kimia.

Pada akhir fase E, peserta didik mampu mengamati, menyelidiki dan menjelaskan fenomena sesuai kaidah kerja ilmiah dalam menjelaskan konsep kimia dalam kehidupan sehari hari; menerapkan konsep kimia dalam pengelolaan lingkungan termasuk menjelaskan fenomena pemanasan global; menuliskan reaksi kimia dan menerapkan hukum-hukum dasar kimia; memahami struktur atom dan aplikasinya dalam nanoteknologi

Tujuan Pembelajaran

Adapun tujuan pembelajaran untuk mendukung capaian pembelajaran tersebut adalah :

1. Peserta didik mampu menganalisis hukum lavoisier, hukum proust, hukum dalton, hukum gay-lussac dan hukum avogadro melalui literasi dari berbagai sumber serta memberikan contoh penerapan hukum tersebut pada suatu reaksi kimia.
2. Peserta didik mampu menerapkan hukum lavoisier, hukum proust, hukum dalton, hukum gay-lussac dan hukum avogadro untuk menyelesaikan kasus atau masalah dalam kehidupan sehari-hari

3.

Test Formatif

1. Jika diketahui persamaan reaksi : A + B --> C + D
   Diketahui massa A = 3 gram,massa B = 5 gram,sedangkan massa C yang terbentuk = 4 gram. Tentukan massa D yang dihasilkan !
2. Hidrogen bereaksi dengan oksigen membentuk air. Perbandingan unsur hydrogen dan oksigen di dalam air selalu tetap,hal ini sesuai dengan teori ?
3. Perbandingan massa unsur-unsur pembentuk senyawa Fe2O3 adalah ….(Ar Fe=56;O=16).
4. Nitrogen dan oksigen dengan perbandingan 7:2 membentuk senyawa dinitrogen pentaoksida. Jika 3,5 gram nitrogen yang bereaksi,berapakah massa oksigen yang bereaksi?
5. Perbandingan massa kalsium dengan oksigen dalam kalsium oksida adalah 5:2. Jika kalsium oksida yang dihasilkan 24,5 gr, berapakah massa kalsium yang bereaksi ?

Test Formatif

1. Diketahui reaksi:
   A+B→C+D
   Jika massa A = 3 gram, massa B = 5 gram, dan massa C yang terbentuk adalah 4 gram, tentukan massa D yang dihasilkan.
2. Hidrogen bereaksi dengan oksigen membentuk air. Perbandingan unsur hidrogen dan oksigen di dalam air selalu tetap. Hal ini sesuai dengan teori ...?
3. Perbandingan massa unsur-unsur dalam senyawa Fe_2O_3 adalah ... (Ar Fe = 56; O = 16).
4. Nitrogen dan oksigen dengan perbandingan 7:2 membentuk senyawa dinitrogen pentaoksida. Jika 3,5 gram nitrogen bereaksi, berapakah massa oksigen yang ikut bereaksi?
5. Perbandingan massa kalsium dengan oksigen dalam kalsium oksida adalah 5:2. Jika kalsium oksida yang dihasilkan adalah 24,5 gram, berapa massa kalsium yang bereaksi?

4.

Antoine Laurent Lavoisier (1743–1794) seorang ahli kimia berkebangsaan Prancis telah menyelidiki hubungan massa zat sebelum dan sesudah reaksi. Lavoisier menimbang zat-zat sebelum bereaksi kemudian menimbang hasil-hasil reaksinya. Ternyata massa zat sebelum dan sesudah bereaksi selalu sama. Akan tetapi, perubahan-perubahan materi umumnya berlangsung dalam sistem terbuka sehingga apabila hasil reaksi ada yang meninggalkan sistem (seperti pembakaran lilin) atau apabila sesuatu zat dari lingkungan diikat (seperti proses perkaratan besi yang mengikat oksigen dari udara) maka seolah-olah massa zat sebelum dan sesudah reaksi menjadi tidak sama. Dari percobaan yang dilakukan Lavoisier terhadap merkuri cair dan oksigen hingga terbentuk merkuri oksida yang berwarna merah, Lavoiser mengambil kesimpulan yang dikenal dengan hukum kekekalan massa yaitu:

Massa zat-zat sebelum dan sesudah reaksi adalah tetap

Antonie Laurent Lavoisier (1743-1794). Lahir di Paris anak seorang ahli hukum. Lavoiser dipandang sebagai bapak Ilmu Kimia Modern. Sebaiknya Anda tahu karena dia yang memulai penerapan metode ilmiah ke dalam percobaan-percobaan ilmu kimia.

Gambar 3

Gambar tersebut merupakan ilustrasi percobaan Antoine Lavoisier untuk membuktikan Hukum Kekekalan Massa. Dalam percobaan ini, merkuri (Hg) dipanaskan di dalam tabung leher angsa hingga bereaksi dengan oksigen (O_2) yang ada dalam udara di tabung, membentuk senyawa merkuri oksida (HgO). Tabung tersebut terhubung ke sistem tertutup yang menjaga reaksi berlangsung tanpa gangguan dari luar. Selama reaksi berlangsung, terlihat penurunan volume udara di dalam tabung karena sebagian oksigen bereaksi dengan merkuri. Setelah reaksi selesai, massa total sistem (tabung, merkuri, oksigen, dan hasil reaksi) diukur dan hasilnya tetap sama seperti sebelum reaksi dimulai.Dari percobaan yang dilakukan Lavoisier terhadap merkuri cair dan oksigen hingga terbentuk merkuri oksida yang berwarna merah, Lavoiser mengambil kesimpulan yang dikenal dengan hukum kekekalan massa yaitu:

5.

Untuk menambah wawasan anda terkait Hukum Lavoiser,silahkan Simak video penjelasan praktikum sederhana Hukum Lavoiser berikut dengan memindahkan QR Code di samping

https://bitly.cx/4Fvl

Video Pembelajaran

Untuk menambah wawasan anda terkait Hukum Lavoiser,silahkan Sima penjelasan praktikum sederhana Hukum Lavoiser berikut ini

After validating the material and language, media validation was conducted. Media validation was conducted by two validators: a Chemistry Education lecturer at Muhammadiyah University of Pontianak and a Chemistry teacher from Santo Paulus High School in Pontianak. The media validation questionnaire had three assessment aspects: coloring, on-screen display, and presentation. These three aspects were divided into 11 assessment items.

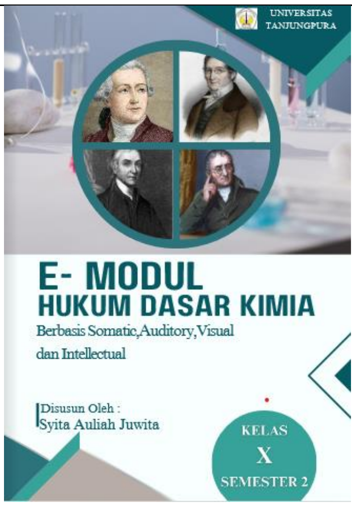
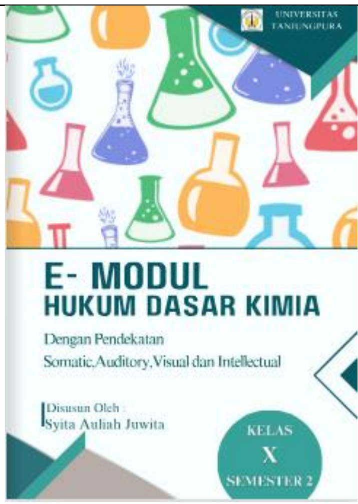
Table 5. Media Validity Results

No.	Assessment Items	Score (%)
1.	Attractive color combination	100
2.	Presentation of images and material discussed according to	87.5
3.	Having an attractive *e* -module design that is displayed (colors, images and letters)	100
4.	The sentences used are easy to understand	100
5.	Balanced text and image layout	87.5
6.	The color proportions are appropriate	87.5
7.	The title and content of *the e* -module are clear	100
8.	The type and size of letters used are clear and legible.	87.5
9.	The display and background colors match	100
10.	A description of the material in the entire *e* -module content is coherent	100
11.	*The e -module* content is interesting and can motivate students to learn.	100

Based on the media validation results in Table 5, it was found that all assessment items were categorized as very valid. The very valid category states that *the e* -module can be used without improvement. This shows that the media components in the module such as attractive color combinations, have an attractive power in the displayed *e -module design, the title and content of the e* -module are clear, the display color and *background* are appropriate, the description of the material in the entire *e* -module content is coherent (Mumpuni & Nurbaeti, 2019) and the content of *the e* -module is interesting and can motivate students to learn is declared very valid. This shows that *the e* -module is worthy of a response test with a percentage of 96.13%.

The expert validator provided additional suggestions, including improvements to *the cover* . The *cover improvement* in question included replacing the image of the expert on basic chemistry law to avoid plagiarism. Changes to *the e* -module based on the expert media validator's suggestions can be seen in Table 6.

Table 6. Results Before and After Repair in Media Validation

<table>
<tr><th>No.</th><th>Before Revision</th><th>After revision</th></tr>
<tr><td>1.</td><td>
</td><td>
</td></tr>
</table>

Overall validity in the material, language, and media aspects shows that the developed *e* -module is very valid. Based on Figure 3, it is proven that the percentage of material validity is 97%, language validity is 100%, and media validity is 96.13%.

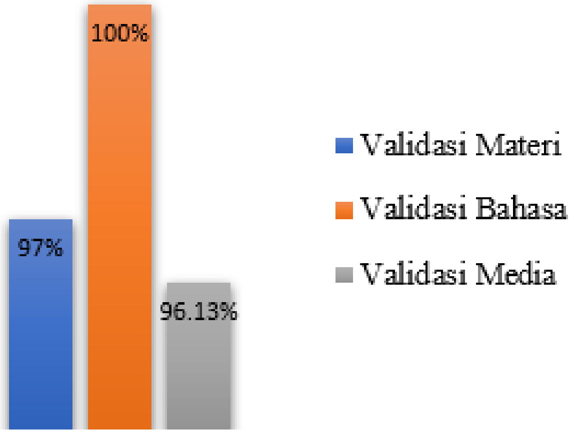


Figure 3. Average Validity Percentage

After validation, a limited-scale response test was conducted. Before conducting the limited-scale response test, the research questionnaire had been validated by a chemistry education lecturer from the Faculty of Teacher Training and Education, Tanjungpura University, and a chemistry teacher from SMA Negeri 3 Pontianak. The response test was conducted on 11th-grade students of SMAN 5 Pontianak. The purpose of this stage was to determine students' responses to the developed module. The response test was conducted on a limited scale and an expanded scale (Purwanto & Rizki, 2015) .

The limited-scale response test was conducted by 12 students (each class had 1 student representing auditory, 1 student representing visual, and 1 student representing kinesthetic), and the expanded-scale trial consisted of 24 students (each class had 2 students representing auditory, 2 students representing visual, and 2 students representing kinesthetic). The sample was taken based on a *purposive sampling technique* with the requirement that students had previously studied the basic laws of chemistry. The sample was also selected based on students taking chemistry subjects. The response test aimed to determine students' responses to the developed *e -module of basic laws of chemistry.*

Table 7. Results of Limited Scale Response Test

No.	Assessment Items	Score (%)
1.	The front page (*cover*) of *the e* -module looks attractive.	93.75
2.	The appearance of the contents in *the e* -module is attractive.	89.58
3.	The text in *the e* -module is easy to read	91.66
4.	The images in *the e* -module are clearly visible.	93.75
5.	Videos in *the e* -module can be played.	95.83
6.	The audio in *the e* -module sounds clear	89.58
7.	Navigation buttons work well.	87.5
8.	The instructions in *the e* -module are easy to understand.	85.41
9.	The images in *the e* -module correspond to the material.	91.66
10.	Tables in *the e* -module support the clarity of the material.	83.33
11.	Audio in *the e* -module supports the clarity of the material.	91.66
12.	Videos in *the e* -module support the clarity of the material.	93.75
13.	The glossary in *the e* -module can help students understand the material.	89.58
14.	The questions in *the e* -module are easy to understand.	81.25
15.	The summary in *the e* -module helps students remember the material.	85.41
16.	*E* -learning modules help to understand the basic laws of chemistry.	89.58

No.	Assessment Items	Score (%)
17.	*E* -modules help to assess one's own abilities.	83.33
18.	*E* -modules help with independent learning.	91.66
19.	*e* -module is interesting to study and read.	89.58

Based on Table 7, it shows that all assessment items are stated as very good. Based on the results of the media component evaluation, the module display aspect obtained an average percentage of 92%, which is included in the very good category. This shows that the appearance of the front page (*cover*) of *the e* -module, the appearance of the contents in *the e* -module, the text in *the e* -module is easy to read, the images in *the e* -module are clearly visible, the videos in *the e -module* can be played, the audio in *the e* -module is clear, and the navigation buttons can be used well. have met the expected standards. Thus, the media component has an attractive and clear appearance, which contributes to increasing user attention (Ridwan *et al* ., 2022) .

The material presentation aspect received a score of 87.76%, which is included in the very good category. This indicates that the material presented in *the e* -module is clear and easy to understand, and the audio and video in *the e* -module support the clarity of the material. Clear audio and video displays can increase student learning motivation (Nuraeni *et al* ., 2023) . Furthermore, the benefits aspect received a score of 88.54% with a very good category. Thus, this indicates that the learning *e* -module helps understand the material on basic chemical laws, *the e* -module helps assess one's own abilities, the *e* -module helps with independent learning, and this *e* -module is interesting to study and read (Rama *et al.* , 2022) . The detailed average assessment percentage of the limited response test can be seen in Figure 4.

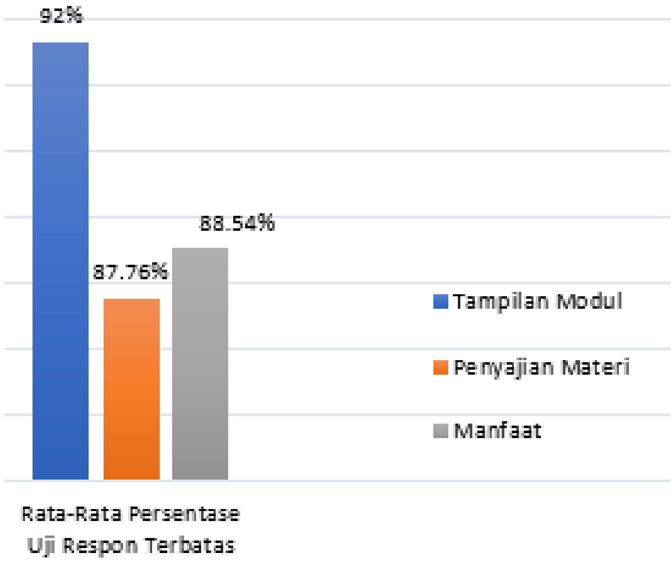


Figure 4. Percentage of Average Assessment of Limited Response Test

Based on Figure 4, the results of the limited response test, which consisted of three assessment aspects, were categorized as very good, with details of the module display aspect at 92%, the material presentation aspect at 87.76%, and the benefits aspect at 88.54%. After the limited-scale trial, a wider-scale trial was conducted with 24 students.

Table 8. Results of the Extended Scale Response Test

No.	Assessment Items	Score (%)
1.	The front page (*cover*) *of the e*- module looks attractive.	93.75
2.	The appearance of the contents in *the e* -module is attractive.	91.66
3.	The text in *the e* -module is easy to read	95.83
4.	The images in *the e* -module are clearly visible.	93.75
5.	Videos in *the e* -module can be played.	96.87

No.	Assessment Items	Score (%)
6.	The audio in the e-module is clear	92.70
7.	Navigation buttons work well.	95.83
8.	The instructions in *the e* -module are easy to understand.	94.79
9.	The images in *the e* -module correspond to the material.	95.83
10.	Tables in *the e* -module support the clarity of the material.	96.87
11.	Audio in *the e* -module supports the clarity of the material.	93.75
12.	Videos in *the e* -module support the clarity of the material.	95.83
13.	The glossary in *the e* -module can help students understand the material.	93.75
14.	The questions in *the e* -module are easy to understand.	92.70
15.	The summary in *the e* -module helps students remember the material.	87.5
16.	*E* -learning modules help to understand the basic laws of chemistry.	95.83
17.	*E* -modules help to assess one's own abilities.	92.70
18.	*E* -modules help with independent learning.	93.75
19.	*e* -module is interesting to study and read.	96.87

Based on the results of the widespread response test in Table 8, it shows that all assessment items received a very good category. However, there are two assessment items that have a lower percentage compared to the other items, namely number 15 with a score of 87.5%. This is due to several factors, such as the summary in the e-module has helped remember the material, there is a possibility that the presentation is not fully effective for all students, for example, it is not concise enough, not interesting enough, or does not highlight important points optimally enough. The average results of the widespread response test that can be seen in Figure 5 show that for the module display aspect, it shows a score of 94%, the material presentation aspect 93.88%, and the benefits aspect 94.79%.

Figure 5. Percentage of Average Assessment of Widespread Response Test

This demonstrates that various elements in *the e* -module on basic chemical laws using the SAVI approach, such as text, images, audio, and video, function optimally. Furthermore, the presentation of material through instructions in *the e* -module on basic chemical laws, images, audio, video, and questions has been shown to significantly support students' understanding of the material. Positive responses from several students also indicate that the developed module provides significant benefits. According to students, the use of audio and video significantly helps in understanding the material, increases student engagement, and facilitates the learning process without the need to borrow or carry books.

The validity assessment of the electronic module using the SAVI approach for the molecular shape material developed did not reach 100% during the validation and response testing stages.

However, the results met the very valid category, making the module suitable for use. Although some improvements are still needed, and an attractive e-module design can increase learning interest. This *e*- module also allows students to learn independently, both inside and outside the classroom.

CONCLUSION

The level of e-module *e* -module chemistry basic laws based on SAVI is the validation result from material experts of 97% (Very Valid), validation from language experts of 100% (Very Valid), and the assessment result by both validations from media experts of 96.13 (Very Valid), the results of the limited response test consisting of three assessment aspects are categorized as very good with details of the module display aspect of 92% (Very Good), the material presentation aspect of 87.76% (Very Good), and the benefit aspect of 88.54% (Very Good), and the results of the extended response test obtained the module display aspect showed a score of 94% (Very Good), the material presentation aspect of 93.88% (Very Good), and the benefit aspect of 94.79% (Very Good). Student responses to the developed product were very positive. Students assessed that *the e* -module provided made the learning process easier, with the material presented clearly and easily understood. In addition, the presence of practicum videos was very helpful in understanding the concept, and the attractive appearance of *the e -module increased interest in learning. This e* -module also allows students to learn independently, both inside and outside the classroom.

RECOMMENDATION

Further research is needed to complete the development stages of the ADDIE model, especially at the implementation and evaluation stages, and trials can be conducted on a wider scale to determine the effectiveness of this e-module in improving student learning outcomes, so that educators can apply the chemistry e-module with the SAVI approach as an alternative teaching material that supports independent learning, overcomes difficulties in delivering dense material, and increases students' interest and motivation to learn.

ACKNOWLEDGMENT

The researcher expresses his deepest appreciation and gratitude to his supervisor, examiners, and all parties at Tanjungpura University and SMAN 5 Pontianak for their guidance, support, and contributions in completing this scientific article. Their assistance and guidance were invaluable in improving the quality of this research.

BIBLIOGRAPHY

Alwanuddin, A., Hairida, H., Ulfah, M., Enawaty, E., & Rasmawan, R. (2022). Development of Electronic Modules Using the SAVI Approach on Molecular Shape Material. *Edukatif: Journal of Educational Sciences* , *4* (3), 4856–4873. https://doi.org/10.31004/edukatif.v4i3.2994

Alwi, I. (2012). Empirical Criteria in Determining Sample Size. *Formative Journal* , *2* (2), 140–148.

Aprima, D. (2022). Cendikia: Media Scientific Journal of Education Analysis of the Application of Differentiated Learning in the Implementation of the Independent Curriculum in Elementary School Mathematics Lessons. *Media Scientific Journal of*

Education, 13 (1), 95–101.

Ardistya Puspita Sari, & Indra Martha Rusmana. (2021). Development of Learning Media Using the Sparkol Videoscribe Approach on Congruence and Similarity Material at SMP Pgri 2 Bogor. *Lebesgue Journal: Scientific Journal of Mathematics Education, Mathematics and Statistics , 2* (1), 112–120. https://doi.org/10.46306/lb.v2i1.29

Enawaty, E., Studi, P., Kimia, P., & Tanjungpura, U. (2021). *Development of Practical Instructions for Determining pH Routes with Natural Indicators Using a Local Wisdom Approach . 9* (4), 110–116.

Faiz, A., Pratama, A., & Kurniawaty, I. (2022). Differentiated Learning in the Leading Teacher Program in Module 2.1. *Basicedu Journal , 6* (2), 2846–2853. https://jbasic.org/index.php/basicedu

Gusteti, MU, & Neviyarni. (2022). Differentiated Learning in Mathematics Learning in the Independent Curriculum. *Scientific Journal of Mathematics Education, Mathematics and Statistics , 3* (3), 636–646. https://doi.org/10.4324/9781003175735-15

Hanum, L., Ismayani, A., & Rahmi, R. (2017). Development of Bulletin Learning Media on Basic Chemical Laws. *Journal of Science and Science Learning (JIPI) , 1* (1), 42–48.

Husna, FE, & Aini, FQ (2023). *Differences in Student Learning Outcomes Between Differentiated Learning Processes Based on Learning Readiness and Based on Learning Styles in Chemical Bonding Material . 7* , 14189–14196.

Monica, I., Nurhamidah, & Elvinawati. (2023). Development of E-LKPD with a Problem Based Learning Approach on Basic Chemical Laws. *Journal of Chemical Education and Science , 7* (1), 33–43.

Mumpuni, A., & Nurbaeti, RU (2019). Analysis of Factors Influencing the Reading Interest of Elementary School Teacher Education Students. *Journal of Pedagogical Research , 3* (2), 123–132. https://doi.org/10.33373/dms.v11i2.4060

Nalarita, Y., & Listiawan, T. (2019). Development of Interactive Contextual E-Modules with a Web Approach for the Yulia Hydrocarbon Compound Chemistry Subject. *Indonesian Multitek Scientific Journal , 12* (2), 85–94.

Nuraeni, W., Kurnianti, E., & Hasanah, U. (2023). Analysis of the Use of Animated Videos as Integrated Learning Media on Elementary School Students' Learning Motivation. *Genta Mulia Journal , 14* (2), 81–95. https://doi.org/10.61290/gm.v14i2.415

Nurul, H., Baidowi, Amrullah, & Junaidi. (2019). Improving Teacher Professionalism Through Lesson Study Assisted by Learning Media at MTs Darul Qur'an Bengkel. *Journal of Education and Community Service , 2* (2), 325–327.

Padmanaba, IKG, Kirna, IM, & Sudria, IBN (2018). Development of Computer-Assisted Interactive Colloidal Chemistry Learning Media for High School Students. *Indonesian Journal of Chemical Education , 2* , 1–10.

Panjaitan*, RGP, Titin, T., & Wahyuni, ES (2021). The Feasibility of the Medicinal Plant Inventory Booklet as a Learning Medium. *Indonesian Journal of Science Education , 9* (1), 11–21. https://doi.org/10.24815/jpsi.v9i1.17966

Permani, A. (2019). *Development of Object-Oriented Programming Electronic Modules for Grade XI Software Engineering Students with the Four-D Model . 4* (May), 12–16. https://doi.org/10.21831/elinvo.v4i1.28260

Purwanto, Y., & Rizki, S. (2015). Developing Teaching Materials with a Contextual Approach to Set Material with the Assistance of Learning Videos. *AKSIOMA Journal of Mathematics Education* , *4* (1), 67–77. https://doi.org/10.24127/ajpm.v4i1.95

Rama, A., Putra, RR, Huda, Y., & Lapisa, R. (2022). *E-Module Development Using the Professional Flip PDF Application in the Elementary Education Curriculum Analysis Course* . *7* (1), 42–47.

Ridwan, A., Masriani, M., Sartika, R.P., Hairida, H., & Muharini, R. (2022). Development of a Biochemical Practice Guide Website Based on Guided Inquiry on Starch Identification Materials. *EduChemia (Jurnal Kimia Dan Pendidikan)* , *7* (1), 56. https://doi.org/10.30870/educhemia.v7i1.12607

Ristiyani, E., Kimia, P., Islam, U., Syarif, N., & Jakarta, H. (2016). Analysis of Chemistry Learning Difficulties of Students at SMAN X, South Tangerang City. *Journal of Science Research and Learning* , *2* (1), 18–29. https://jbasic.org/index.php/basicedu

Sugiono. (2016). *Quantitative, Qualitative, and R&D Research Methods* (April Issue).

Umbara, U. (2017). Implications of Constructivist Learning Theory in Mathematics Learning. *Scientific Mathematics Journal of STKIP Muhammadiyah Kuningan* , *3* (1).

Veriansyah, I. (2022). The Effect of Implementing the SAVI Learning Model on Student Learning Outcomes in Class X of SMAN 6 Pontianak. *Indonesian Journal of Social Science Education* , *7* , 71–80.

Wahyuningsari, D., Mujiwati, Y., Hilmiyah, L., Kusumawardani, F., & Sari, IP (2022). Differentiated Learning in the Context of Realizing Independent Learning. *Jurnal Jendela Pendidikan* , *2* (04), 529–535.