JIPK 18 (2) (2024)
Jurnal Inovasi Pendidikan Kimia
http://journal.unnes.ac.id/nju/index.php/JIPK

Development of Hyper-content Module Based on Multiple Representations of Basic Law of Chemistry Material

Mar'atus Solikhah ✉, Nur Alawiyah, dan Sri Rahmania

Program Studi Pendidikan Kimia, Fakultas Sains dan Teknologi,
Universitas Islam Negeri Walisongo Semarang, Jawa Tengah, Indonesia

Info Artikel

Diterima Januari 2024
Disetujui Juni 2024
Dipublikasikan Juli 2024

Keywords:
teaching materials hyper content modules
multiple representations
basic laws of chemistry

Abstrak

Pendidikan di era digital ini memungkinkan peserta didik untuk belajar kapan dan di mana saja dengan mengakses internet, sehingga kemajuan teknologi menuntut perubahan peran guru sebagai pengelola sumber belajar, bukan sebagai sumber belajar. Kurangnya pemahaman konsep peserta didik pada materi hukum dasar kimia yang bersifat abstrak menjadi salah satu permasalahan dalam pembelajaran kimia. Pengembangan modul *hypercontent* berbasis multipel representasi pada materi hukum dasar kimia dilakukan untuk mengatasi kekurangan bahan ajar. Teknik *Research and Development* (R&D) model 4-D digunakan untuk melakukan penelitian di SMAN 5 Semarang yang hanya dilakukan sampai tahap *develop* saja. Teknik pengumpulan data berupa wawancara, serta penyebaran instrumen angket uji kelayakan dan kepraktisan. Data hasil uji kelayakan ahli media sebesar 89%, uji kelayakan ahli materi sebesar 90% dan uji kepraktisan oleh dua guru kimia sebesar 96% serta respon kepraktisan oleh peserta didik sebesar 81%. Berdasarkan data hasil penelitian menunjukkan bahwa penelitian ini terkategori sangat layak dan sangat praktis.

Abstract

Education in this digital era allows students to learn anytime and anywhere by accessing the internet, so technological advances demand changes in the role of teachers as managers of learning resources, not as learning resources. The lack of understanding of the concept of students on the material of the basic laws of chemistry, which is abstract, is one of the problems in learning chemistry. The development of hyper-content modules based on multiple representations of basic chemical law material is carried out to overcome the shortage of teaching materials. The research and Development (R&D) technique of the 4-D model was used to conduct research at SMAN 5 Semarang, which was undertaken only until the development stage. Data collection techniques were in the form of interviews and distributing questionnaire instruments for feasibility and practicality tests. The data from the media expert feasibility test was 89%, the material expert feasibility test was 90%, the practicality test by two chemistry teachers was 96%, and the practicality response by students was 81%. The data shows that this research is categorized as feasible and practical.

✉ Alamat korespondensi:
E-mail: marsolie601@gmail.com

p-ISSN 1979-0503
e-ISSN 2503-1244

INTRODUCTION

Advances in ICT in learning enable students to obtain various information easily. However, teachers are expected to be more proactive in searching for the necessary information. They can choose multiple details to present to students that they consider essential for their lives. So, the duties and responsibilities of educators become more complex. Teachers must protect students from various types of less useful information to ensure that students can develop their potential fully and appropriately. Thus, technological advances require a shift in the role of teachers from teaching resources to managing learning resources (Fathurrohman, 2017).

Teaching materials as learning resources that provide knowledge can help students understand concepts and can provide students with guidance on how to think, act, and develop in the digital era (Mardhiya, 2020). This is a challenge for teachers to be able to provide digital teaching materials. Various types of software can be used to create digital teaching materials, such as *Canva*, *PowerPoint*, *Prezzi*, and other software that can be used to design a screen display containing learning materials (Suryani *et al.*, 2018).

Chemistry is one of the subjects in the Independent Curriculum. Chemistry is a subject that relies on abstract ideas that are challenging for students to understand, especially when they are asked to believe something without seeing it (Safitri *et al.*, 2019). Chemical material is not tricky material, like the basic laws of chemistry. However, students were less precise in answering the questions. According to Wasonowati *et al.* (2014), the law of conservation of mass, the law of constant proportions, multiple comparisons, Gay Lussac's law, and Avogadro's law are some topics discussed in learning activities about the basic laws of chemistry. All laws studied include interrelated ideas; if one legal idea is not understood well, students will not understand other legal concepts. The cause of students' lack of understanding of the basic laws of chemistry is said to be students' weak conceptual foundation (Andani & Yulian, 2018). Conceptual understanding includes knowledge of topics relevant to the concept, such as the definition, nature, and description of a concept (Alawiyah *et al.*, 2018). Teachers can optimize learning outcomes and student understanding by utilizing the correct learning tools and prioritizing student needs (Andani & Yulian, 2018).

Researchers conducted observations of teachers and students at SMAN 5 Semarang through interviews, which revealed several obstacles in learning chemistry at school, such as students' center learning on basic chemistry law material, which was not yet optimal. Science learning is said to be complete if the completion percentage is more than 75% of students passing the minimum completion criteria (KKM) (Manurung *et al.*, 2021). Meanwhile, as evidenced by the number of 36 students, as many as 50% of their grades were still below the KKM, and using textbooks, worksheets, and modules as chemistry teaching materials is still widespread. Some of these teaching materials have an unattractive display style and do not highlight submicroscopic characteristics, another reason learning is not always done well. The teacher said that students did not consistently understand the abstract basic legal concepts of chemistry. The use of chemistry teaching resources is still in the form of textbooks, worksheets, and modules with an unattractive appearance design. It does not highlight submicroscopic features, which is also a factor in the implementation of learning not being optimal.

Based on the problems that occur, content modules based on multiple representations can be used as independent teaching materials in non-physical form according to student's learning styles, supported by reasonably complex module content and equipped with features such as animations, videos, and other articles (Anisa *et al.*, 2021). According to Siang, Ibrahim, and Rusmono (2017), modules are teaching materials students can use for learning. Meanwhile, hyper-content can be presented as teaching materials in hyper-content modules that use QR codes as a product advantage, making it easier for students to access sites from learning resources without typing in addresses or keywords for learning materials. Anyone can access the module, which can be applied to learning using an open-source learning system. Students can use hypercontent modules as a stand-alone learning tool. This is enhanced by rich module content, including graphics, articles, and videos (Anisa *et al.*, 2021). Videos such as YouTube video media are suitable for explaining science material, which requires practice in learning to increase students' understanding of concepts and motivation(Rahmania & Daulany, 2021). Also, Johnstone (2003) shows how three multiple levels of representation, namely macroscopic, submicroscopic, and symbolic, can be used to understand chemical events (Zidny *et al.*, 2015). Researchers are interested in providing a solution for developing a Hyper-content Module Based on Multiple Representations of the Basic Law of Chemistry Material.

METHODS

This research utilized Thiagarajan's development model, the 4-D model, which consists of four stages: Define, Design, Develop, and Disseminate (Sugiono, 2019). Due to time constraints, the research was only conducted up to the development stage. Product testing was carried out on a small scale. This model aimed to produce a Hypercontent Module Based on Multiple Representations of Basic Chemical Laws. The research utilized the R&D level 1 procedure. Only products obtained during the level 1 development research and their designs were internally verified (by experts and practitioners) but were not externally evaluated (through field testing).

In the Define stage, the needs analysis was performed through five steps: (a) initial analysis, (b) student analysis, (c) task analysis, (d) content analysis, and (e) learning objective specifications. Next, in the Design stage, the appropriate media for the learning objectives were chosen, the format of the media to be developed was selected, and the design was created. The final development stage produced the hyper-content module product, revised according to expert input. The revision process included: (a) validation of media materials by experts, (b) practicality assessment by chemistry teachers and students, (c) first design product revision, (d) small-scale testing with chemistry teachers and students and (e) second design product revision.

Data analysis involved experts in the field, media experts, and practicality assessment from teachers and students using a rating scale to determine the feasibility and practicality of the product obtained. This was achieved by Determining the ideal maximum score, Ideal maximum score = number of component items x maximum score, the obtained score by summing up the scores from each validator, and the percentage of ideality/practicality.

RESULTS AND DISCUSSION

Define Stage

The define stage was conducted through a preliminary study at SMAN 5 Semarang. The purpose was to understand the students' needs and emerging issues. It examined the Chemistry IPA SMA Learning Achievement (CP) on the topic of basic laws of chemistry in the Independent Curriculum. The study revealed that learning basic laws of chemistry using the independent curriculum was not optimal for chemistry learning. The use of chemistry teaching materials was not engaging and did not highlight submicroscopic aspects. Students lacked a representative understanding of abstract chemical laws. They had not experienced using a learning medium in the form of hypercontent modules based on multiple representations of basic laws of chemistry. These findings were obtained through direct interviews with teachers and students at SMAN 5 Semarang.

Design Stage

The design stage aimed to create a prototype of the learning medium. The design process was divided into three phases—first, media selection. The hyper-content module based on multiple representations was created to help students understand complex ideas on basic laws of chemistry. The concepts offered in the hyper-content module should depict the interaction between macroscopic, submicroscopic, and symbolic levels to enable students to conceptually grasp abstract ideas in chemical laws. The visually appealing design of the hyper content module, combining text, photos, and videos, aimed to inspire students, prepare them for self-directed learning, and help them develop critical thinking skills necessary to apply basic chemical laws in real-world situations. The Canva program was used to present the hypercontent module, resulting in the final products of QR codes and links.

Second, format selection. The format selection for the hypercontent module based on multiple representations for basic laws of chemistry consisted of several sections, including (a) Cover page: The cover page included the author's name, title, image, and owner's identity. (b) Welcome video: The welcome video contains an introduction to the hypercontent module. (c) Introduction: The introduction included learning achievements, learning maps, and learning procedures; (d) Content: The content consisted of core material such as Lavoisier's law, Proust's law, Dalton's law, and Gay Lussac's law. It also included practice questions for each core material, consisting of five multiple-choice questions, five essay questions, and discussions for each core material, composed of two BISSA (casual chemistry discussion) questions. (e) Summary and conclusion: The summary and conclusion included a recap of the core material, students' reflections, bibliography, and glossary. (f) Initial design: The hyper-content module used various fonts. However, DM Sans was the main font used for most of the content. Other fonts, such as oregano, open sans extra bold, and handy casual, were used to capture students' interest. The created hypercontent module is expected to enhance students' motivation and interest in self-learning and communication with teachers or peers. The hypercontent module, based on multiple chemical representations, combines various colors to make it more engaging.

Develop Stage

The research process concluded at this stage. Media experts, subject matter experts, chemistry teachers, and students evaluated the design of the hypercontent module for its validity and practicality, resulting in valid and practical percentage scores—the assessment aimed to improve the hypercontent module's design until it was deemed appropriate. The product's feasibility was assessed by media experts, namely Mr. Muhammad Agus Prayitno, M.Pd., and Ms. Sri Rahmania, M.Pd. The assessment is shown in the graph in Figure 1, which was categorized as highly valid.

The assessment criteria were based on three indicators: the highest score of 5 and the lowest of 1. The assessment by media experts resulted in a 100% score for the size of the hypercontent module, 90% for the cover design of the hypercontent module, and 87% for the content design of the hypercontent module, indicating that the hypercontent module is highly valid with an overall feasibility percentage of 89%, and no revisions are needed. The designed hyper content module can be improved by considering the suggestions from the media experts.

Regarding the validation of the content, it was evaluated by subject matter experts, namely Mr. Muhammad Agus Prayitno, M.Pd., and Ms. Sri Rahmania, M.Pd., with the assessment categorized as highly valid.

This indicator was based on 15 criteria, with a score of 5 and a lowest score of 1. Figure 2 showed that the percentage of content suitability was 95%, content accuracy was 93%, content up-to-dateness was 90%, fostering curiosity was 90%, presentation techniques were 85%, supporting materials were 100%, learning presentation was 90%, coherence and logical thinking were 90%, clarity was 90%, communicativeness was 90%, dialogic and interactive aspects were 90%, suitability with learners' development was 90%, suitability with language rules was 90%, contextual nature was 90%. Contextual components were 87%, with a suitability percentage of 90%. Therefore, the hyper-content module did not require additional adjustments, as the content experts deemed it very valid. The hyper content module that has been designed could be improved by considering the suggestions from the content experts.

Chemistry teachers and students assess the practicality of the product. The results of their assessments are categorized as very practical, as shown in Figure 3 and Figure 4.

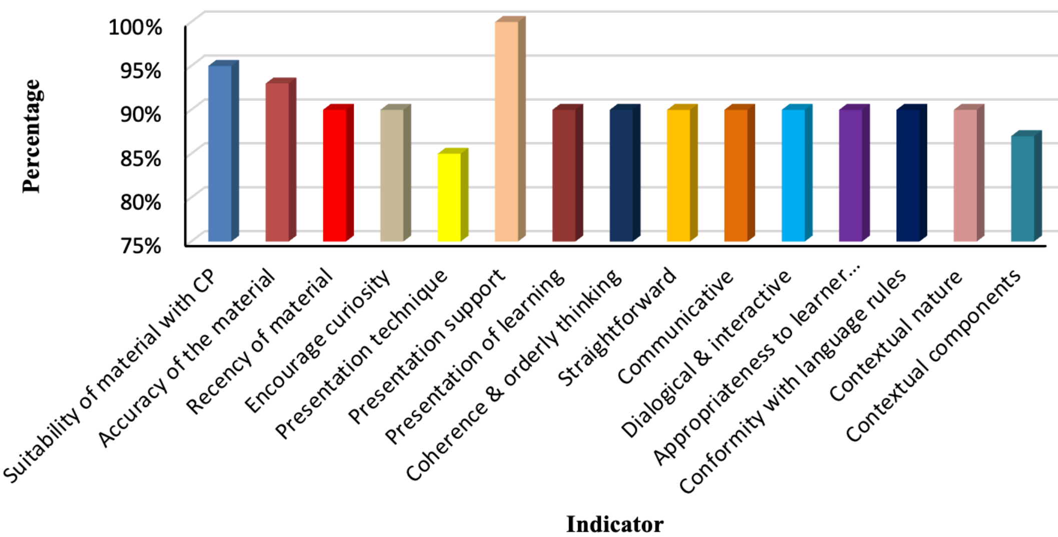

Figure 1. Percentage chart of validation by media experts

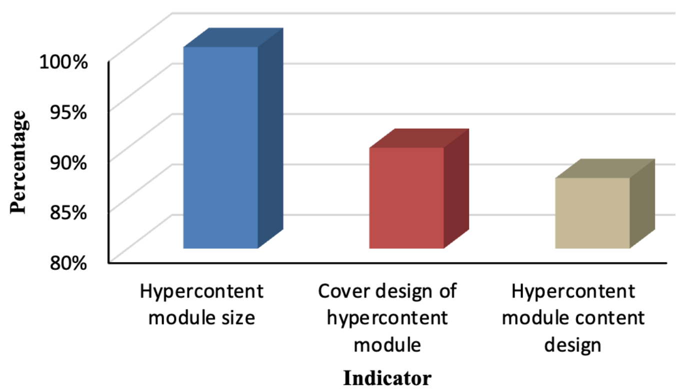

Figure 2. Percentage chart of validation by material experts

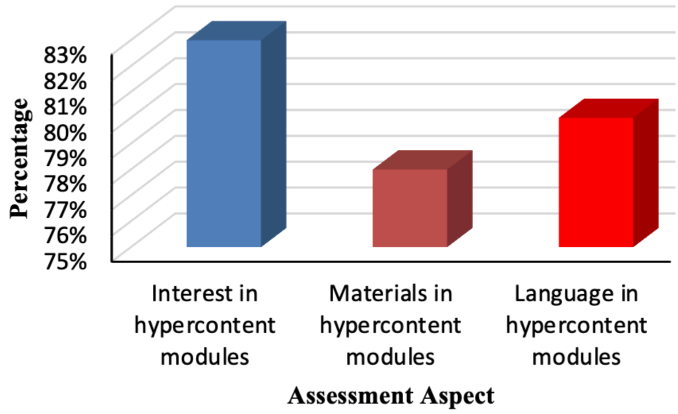

Figure 3. The graph shows the percentage of practicality assessments by chemistry teachers

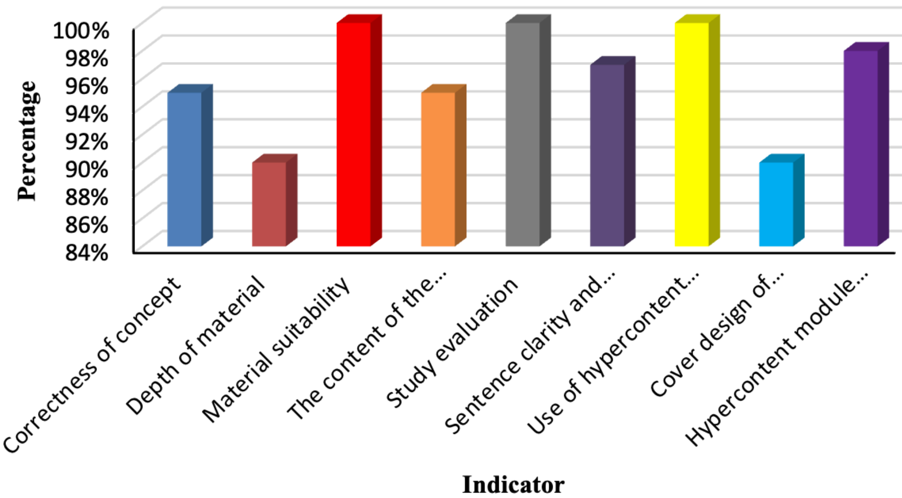

Figure 4. Graph of learner response

The practicality questionnaire for Chemistry teachers was based on nine characteristics with a maximum rating weight of 5 and a minimum rating weight of 1. Figure 3 shows that the percentage of concept accuracy was 95%, depth of material was 90%, material suitability was 100%, independent curriculum content was 95%, learning evaluation was 100%, clarity of sentences and readability level was 97%, use of hypercontent modules was 100%, hypercontent module cover design was 90%. Hyper-content module content design was 98%, with a percentage of teaching material practicality at 96%. It was rated as very practical and suitable for testing on high school students when they were learning the basic laws of chemistry (Figure 4).

The practicality questionnaire for students was based on three evaluations, with a maximum score of 5 and a minimum score of 1. According to Figure 8, the percentages of interest in hypercontent modules, content within the modules, and language used were 83%, 78%, and 80%, respectively, resulting in an overall practicality percentage of 81%, as evaluated by the students. Therefore, the hypercontent modules were considered very practical, indicating that they were suitable as teaching materials for basic laws of chemistry. The final product can be accessed through the provided link and QR Code.

The preliminary study at SMAN 5 Semarang revealed that the chemistry learning process on basic laws of chemistry using the independent curriculum was not optimal. The use of chemistry teaching materials was not engaging and did not emphasize the submicroscopic aspects, leading to a lack of students' representative understanding of abstract chemical laws (Safitri *et al.*, 2019).

The completion of science learning was considered successful if the percentage of students who achieved the minimum passing criteria (KKM) was more than 75% (Manurung *et al.*, 2021). However, out of 36 students, 50% scored below the KKM. Students' lack of understanding of basic chemical laws was due to their weak conceptual foundation. To improve learning outcomes and students' knowledge, teachers can utilize appropriate teaching materials that cater to students' needs (Andani & Yulian, 2018).

Hypercontent modules can be used as non-physical self-learning materials that cater to students' learning styles and are supported by complex content and features like animations, videos, and articles (Anisa *et al.*, 2021). Hypercontent modules can be accessed through desktop computers or smartphones. As more than 1.91 billion people, or about 25% of the world's population, already use smartphones, this number is predicted to keep increasing since almost everyone now owns a smartphone (Amin *et al*., 2020).

The hypercontent module, based on multiple representations of the basic laws of chemistry, is presented using the Canva application. The module, theme, and concept are all part of the hypercontent-based learning materials. Text, photos, and videos are used to present the module topics. With the help of hyper content, students can choose the subjects they want to learn.

The hyper-content module contains material concepts supplemented with supporting materials linked to various exciting content on *YouTube*, *Google*, and *Wikipedia*. This content can be accessed through desktop computers or smartphones using online links or scanned Quick Response Codes (QR Codes). The development of this hyper content module is expected to assist students in overcoming learning difficulties independently, foster a culture of reading, serve as a consideration for teachers in conducting learning activities, and function as a fun self-learning medium to understand the topic of basic laws of chemistry (Hidayat & Rusijono, 2020).

The aim of developing the hyper-content module is to enable students to use it as a learning and assessment tool to help them better understand the topic of basic laws of chemistry. Additionally, it aims to help students achieve learning objectives, particularly in the basic laws of chemistry. This objective is supported by previous research such as Anisa *et al*. (2021), which stated that the development of hyper content modules with HOTS orientation is a valuable and practical learning resource; Kirom (2021), which found that the development of digital hyper content modules on the history of Indonesian language development with HOTS orientation was appropriate; and Assma *et al.* (2018), which found that the module based on multiple representations on stoichiometry was suitable, with media suitability of 92.5% and content suitability of 91.5%, both falling into the very suitable category. Based on students' response questionnaires, the practicality test scored 88.17% and 86.89%, and the module's effectiveness, based on students' learning completeness scores, was 80.4%, falling into the very suitable category. The Research and Development (RnD) method was used for this study. Based on the research results, it can be concluded that the module is suitable, practical, and effective for use in the learning process.

The development of this hyper-content module was expected to bring innovation and inspiration to creating unique teaching resources for chemistry. The hyper-content module, based on multiple representations of basic laws of chemistry, was also envisioned as an enjoyable and engaging online learning medium, supporting self-learning activities.

CONCLUSION

It can be concluded that the hyper-content module product based on multiple representations for basic laws of chemistry was considered highly suitable as teaching material by media experts and content experts, with percentages of 89 and 90%, respectively. Additionally, the hypercontent module product based on multiple representations for basic laws of chemistry was deemed very practical by chemistry teachers and students, with percentages of 96 and 81%, respectively.

ACKNOWLEDGMENT

Firstly, the author would like to express gratitude and thanks to the Almighty God for bestowing His grace and guidance, enabling the author to remain consistent in completing this research. Secondly, the author would like to thank Mrs. Nur Alawiyah, M.Pd., as the supervisor, who has provided valuable writing knowledge throughout this research. Thirdly, the author would like to thank Mr. Muhammad Agus Prayitno, M.Pd., Mrs. Sri Rahmania, M.Pd., and all the chemistry teachers and students who willingly provided input for this research.

REFERENCES

Amin, M., Muslim, S., & Wirasti, M.K. 2020. Modul Pembelajaran Hypercontent Pengenalan Perangkat Jaringan Komputer Untuk Mahasiswa Asal Daerah 3T Di STKIP Surya. *Jurnal Nasional Pendidikan Teknik Informatika : JANAPATI*, 9(2): 1–15

Andani, D.T., & Yulian, M. 2018. Pengembangan Bahan Ajar Electronic Book Menggunakan Software Kvisoft Flipbook Pada Materi Hukum Dasar Kimia di SMA Negeri 1 Panton Reu Aceh Barat. *Jurnal IPA & Pembelajaran IPA*, 2(1): 1–6

Anisa, A., Nurdiyanti, N., & Thahir, R. 2021. Pengembangan Modul Hypercontent Berorientasi HOTS. *Edukatif : Jurnal Ilmu Pendidikan*, 3(6): 5161–5169

Alawiyah, N., Susilaningsih, E., & Sulistyaningsih, T. 2018. Analysis of Misconception on Solubility and Solubility Product Constant (KSP) Using Three-Tier Multiple Choice Test. *Journal of Innovative Science Education*, *7(*1): 122–129

Assma, S., Fadhilah, R., & Hadiarti, D. 2018. Pengembangan Modul Pembelajaran Kimia Berbasis Multipel Representasi Pada Materi Stoikiometri Kelas X SMAN 01 Rasau Jaya. *AR-RAZI Jurnal Ilmiah*, 6(1): 40–50

Fathurrohman, M. 2017. *Model-Model Pembelajaran Inovatif* (N. Hidayah (ed.); 1st ed.). Ar-Ruzz Media

Hidayat, M.R., & Rusijono. 2020. Pengembangan Modul Berbasis Hypercontent Materi Prinsip Dasar Pembuatan Animasi 2D Mata Pelajaran Animasi 2D Dan 3D Kelas XI Multimedia di SMK Muhammadiyah 2 Taman. *Jurnal Mahasiswa Teknologi Pendidikan*, 10(1): 1–8

Kemendikbudristek. 2022. Buku Saku: Tanya Jawab Kurikulum Merdeka. *Kementerian Pendidikan, Kebudayaan, Riset dan Teknologi, Kementerian Pendidikan, Kebudayaan, Riset dan Teknologi*, 9–46

Kirom, S. 2021. Pengembangan Modul Digital Hypercontent Pada Materi Sejarah Perkembangan Bahasa Indonesia Berorientasi HOTS. *Jurnal Ilmiah Wahana Pendidikan*, 7(8): 75–82

Manurung, S., Sijabat, A., Sitinjak, E.K., Silitonga, A.T.H., Kunci, K. 2021. Penerapan Metode Eksperimen Untuk Meningkatkan Ketuntasan Belajar Ipa Kelas V SD Negeri 030288 Sidikalang. *Jurnal Penelitian Dan Pengabdian Masyarakat Nommensen Siantar (JP2NS)*, 1(1)

Mardhiya, J. 2020. Bahan Ajar Elektronik (E-Book) Kimia Umum II Berbasis Kontekstual Materi Larutan: Desain dan Pengembangan. *EduTeach : Jurnal Edukasi dan Teknologi Pembelajaran*, 1(2): 100–107

Nugraha, J. 2022. *Mengenal Tujuan Kurikulum Merdeka, Pahami Bedanya dengan Kurikulum Sebelumnya*. Merdeka.Com. https://m.merdeka.com/jateng/mengenal-tujuan-kurikulum-merdeka-dan-penjelasannya-perlu-diketahui-kln.html?page=3

Rusmono. 2017. *Strategi Pembelajaran dengan Problem Based Learning itu Perlu*. Ghalia Indonesia

Rahmania, S., & Daulany, R. A. 2021. YouTube as an Alternative for Distance Learning (DL) Chemistry: Study of Interests and Motivation. *Journal of Educational Chemistry (JEC)*, 3(2): 83–92

Safitri, N.C., Nursaadah, E., & Wijayanti, I.E. 2019. Analisis Multipel Representasi Kimia Siswa pada Konsep Laju Reaksi. *EduChemia (Jurnal Kimia Dan Pendidikan)*, 4(1): 1

Sugiono. 2019. *Metode Penelitian Kuantitatif, Kualitiatif, dan R&D* (dan R. (Edisi K.A. Sugiono. (2019). Metode Penelitian Kuantitatif, Kualitiatif (ed.); Edisi Kedu). Alfabeta

Sugiyono, D. 2013. *Metode Penelitian Kuantitatif, Kualitatif, dan Tindakan*. Alfabeta

Suryani, N., Setiawan, A., & Putria, A. 2018. *Media Pembelajaran Inovatif dan Pengembangannya* (P. Latifah (ed.)). PT. Remaja Rosdakarya

Zidny, R., Sopandi, W., & Kusrijadi, A. K. 2015. Gambaran Level Submikroskopik untuk Menunjukkan Pemahaman Konsep Siswa Pada Materi Persamaan Kimia dan Stoikiometri. *Jurnal Penelitian dan Pembelajaran IPA*, 1(1): 42.