

## DIGITAL SCIENCE MAGAZINE BASED ON CONTEXTUAL LEARNING ON THE POLLUTED RIVER TOPIC

Saptiyah\*, Lukman Nulhakim, and Dwi Indah Suryani

Department of Natural Science Education, Teaching and Education Faculty, Sultan Ageng Tirtayasa University, Banten, Indonesia.

\*Email: [saptiyah027@gmail.com](mailto:saptiyah027@gmail.com)

Received: March 23, 2023. Accepted: May 1, 2023. Published: May 19, 2023

---

**Abstract:** This research is driven by the need for more utilization of opportunities for technological advances in the field of education, one of which is the creativity of educators in creating and using a learning media, resulting in less efficient learning implementation. digital science magazine (DSM) can be an alternative to interesting learning media that utilizes technology well. This study aims to determine DSM's validity and student attractiveness based on contextual learning on the theme of my polluted river. The method applied is Research and Development along with the ADDIE model (Analysis, Design, Development, Implement, and Evaluate). Material experts, media experts, and expert practitioners completed the validation assessment. At the same time, the assessment of attractiveness was carried out by students using student response questionnaires. Overall from the experts, the developed DSM obtained a validity level of 88.4% which is categorized as very valid. Based on the research, DSM, based on contextual learning developed, has a good level of validity and attractiveness so that it can be used in learning at school or independently at home by junior high school students.

**Keywords:** *Digital Science Magazine, Attractiveness, Contextual Learning, Polluted River*

---

### INTRODUCTION

The continuation of the 21st century makes science develop rapidly, and new technologies are born, marking the progress of the era. Various aspects of life have started to use technology to facilitate tasks; this is no different from the educational aspect. It is in line with the opinion of Tondeur et al. [1] that educational institutions have used digital technology to become facilities for learning support, both as information media (information access facilities) and as learning media (facilities to support learning activities and assignments). That's why developing science and technology is both a challenge and an opportunity for teachers and students [2]. Teachers must be good at using technology to produce innovations in learning, both in the form of learning models and learning media. Meanwhile, students are encouraged to be independent, agile, and productive in utilizing technology in their learning activities.

However, the findings in the field were not as beautiful as stated in theory. The findings obtained from the observations of two schools in Serang Regency in the past two years when distance learning and face-to-face learning were limited, it was found that science learning, which was the focus of researchers, was implemented only with the lecture method and assignments using textbooks or textbooks. Student worksheets are often used as a reference for learning resources. In addition, learning only uses learning media for a limited time and lacks teacher creativity in creating and using learning media. It often makes the

classroom atmosphere not conducive because students ignore the teacher's explanation.

Digital magazines can be used to learn about media innovations with technology. This magazine is a digital version of a print magazine because it does not use paper as raw material in presenting the information; you only need to access it via mobile phones, laptops, tablets, and other technologies. For most people, especially teenagers, magazines are nothing new. However, there are still a few magazines that focus on education. Apart from that fact, it turns out that magazines can fulfill an important role as learning media in the form of teaching materials. By definition, a magazine is a print media that is similar to a book but conveys its content in a more interesting and light way because it has more photos or pictures, and the text content is presented in shorter, denser, and clearer [3]. Digital magazines in this study are included in science magazines or semi-scientific magazines because the content of their studies is about lessons, namely lessons IPA.

DSM will be developed based on contextual learning. Contextual learning is an approach method used by teachers in explaining a subject matter that is related to what students encounter in everyday life [4]. In this case, the seven components of the CTL approach will be contained in the DSM, consisting of constructivism, inquiry, asking, learning communities, modeling, reflection, and authentic assessment.

My polluted river was chosen to be the learning theme in the development of DSM. It consists of several basic competencies regarding environmental pollution, elements, and compounds,

as well as ecosystems which are integrated with the integrated integration model. The integrated cohesiveness model is a cohesiveness model that collects various topics or disciplines to prioritize the concepts, abilities, and attitudes that are owned across these disciplines [5]. The choice of the theme My polluted river as a learning theme is based on the environment close to students, namely the river, where floods often occur when the rainy season comes. Because it aligns with personal experience and real life, this will directly involve students in the learning process.

In this regard, research will be conducted on the attractiveness of learning media in the form of DSM based on contextual learning on the theme my polluted river.

### RESEARCH METHODS

This research was conducted using a type of R&D (Research and Development) research method, which is research to develop and produce a product. This research will develop a digital science magazine based on contextual learning on the theme of my polluted river.

The ADDIE model by Molenda [6] is used in this research but is limited during the implementation stage until the limited trial. During the evaluation stage, only an initial evaluation is carried out because this research only focuses on the level of validity and attractiveness of the DSM product developed. The following is a description of the stages carried out:

#### 1. Analysis

Surveying class 9 students using a needs analysis questionnaire. This analysis is done to find out the gaps in science teaching in the classroom and identify the needs and characteristics of students so that they are adapted to the product to be developed. In addition, planning learning objectives and identifying the material's content that will be included in the product is adjusted to the student's learning environment.

#### 2. Design

The design was made in accordance with the findings of the previous needs analysis. Namely, the researcher made a mapping of core competencies and basic competencies on the theme of My Polluted River for planning the contents of the product material and creating a storyboard. Product design is an initial description of the product to be developed.

#### 3. Development

##### a. Product development

They are namely developing products to be developed based on the results of the product design at the design stage.

##### b. Expert Validation

They are namely making validation instruments and carrying out validation

assessments of products that have been developed. Material, media, and science practitioner/teacher experts carried out the validation assessment. These results are used as a guideline for improving and developing DSM products.

##### c. Product revision

Namely, product improvement activities if in the previous 2 processes suggestions for improvement were found.

### 4. Implement

Implementation of limited trials on DSM products by students who have been selected based on a purposive sampling technique to get the results of the attractiveness of DSM products.

### 5. Evaluate

After being implemented, the product must be evaluated. The evaluation carried out is an initial qualitative evaluation of the product, which can be obtained from student response questionnaires, interviews with science teachers, or field notes in schools. At this stage, the researcher considers the effects of learning in the past, determines the success of product development goals, measures what the objectives have achieved, and finds any information that can help students do well in learning.

In the assessment of expert validation and student responses, quantitative data and qualitative data were obtained to determine the level of validity obtained from calculations using the following formula:

$$P = \frac{f}{N} \times 100\%$$

Information :

P = The average value of the percentage

f = Gain score

N = Maximum score [7].

Table 1. Validation Test Criteria Scale [8].

Score in percent %	Category
25% - 43.75%	Invalid
43.76% - 62.50%	Quite valid
62.51% - 81.25%	Valid
81.26% - 100%	Very valid

Quantitative data to determine the level of attractiveness is obtained from calculations using the following formula:

$$X_i = \frac{\sum_{i=1}^n S_i}{S_{max}} \times 4$$

Information :

$X_i$  = The value of each student

$\sum S_i$  = Total score

$S_{max}$  = Maximum score [9]

Table 2. Student Response Criteria Scale [10].

Average	Category
$3.26 \leq \bar{x} \leq 4.00$	Very good/interesting
$2.51 \leq \bar{x} \leq 3.25$	Good/interesting
$1.76 \leq \bar{x} \leq 2.50$	Quite good/interesting
$1.01 \leq \bar{x} \leq 1.75$	Not good/interesting

## RESULTS AND DISCUSSION

### Results of ADDIE Model Development DSM Based on Contextual Learning

The research stages are carried out based on the ADDIE model, which consists of the analysis, design, development, implementation, and evaluation stages. The following is a description of the results of the ADDIE model development.

#### 1. Analysis

This stage produces data from the needs analysis questionnaire conducted on class 9 students. This activity is carried out to determine gaps in science teaching in the classroom and determine students' needs and character. Based on the needs analysis questionnaire answers, 60% of students need help to learn science material. Textbooks are more often used as a source of learning in class and in learning water pollution material; the method used by the teacher is maximum lectures and doing a practicum.

The learning sources and methods applied make students reluctant to re-learn science material outside of school hours. Learners think it would be better if the teaching materials displayed more sample images and communicative language. The use of science magazines was not found in water pollution material or the theme of my polluted river, so the researchers developed a science magazine containing science subject matter, namely my polluted river, with a digital base named DSM.

#### 2. Design

This stage resulted in mapping the core competencies and basic competencies of the polluted river theme material for planning the content of the product material consisting of basic competencies 3.8 (environmental pollution), 3.3 (substances and their characteristics), and 3.7 (ecosystems). In addition, the DSM storyboard was made to serve as an initial description of the product to be developed.

#### 3. Development

##### a. Product Development

At this stage, the results of a product in the form of learning media in the form of an electronic magazine named DSM with the theme "My Polluted River." As the name implies, each student can access this product digitally via Android. In this DSM, there is a

main presentation rubric which is the core of the theme raised, including water pollution content, elements and compounds, and ecosystems.



Figure 1. River Pollution

Water pollution is the entry of living things, substances, energy, or other components into the water, resulting in a decrease in water quality so that water no longer functions according to its use [23]. Water pollution is also defined as the deviation of water properties from its normal state [24]. Inorganic components, including various harmful heavy metals, can pollute water. Most heavy metal components come from industrial activities such as the textile industry, metal plating, paint/color inks, printing, agrochemicals, etc. [25]. These industries generally discharge their waste directly into sewers/water bodies without prior treatment. It can cause water pollution because the waste contains highly toxic elements.



Figure 2. Heavy Metal Contaminated River

Pollutants contain hazardous elements/chemicals such as alcohol/acetone and its esters and heavy metals such as chrome, cadmium, cobalt, manganese, and tin. There are three types of household waste, namely the first in the form of garbage. The second waste is wastewater generated from bathing and washing activities, and the third is dirt produced by humans [28]. Based on the causes of

wastewater pollution consists of industrial waste, household waste, and agricultural waste, all of which have a high contribution to water pollution because they contain elements and compounds that are harmful and harm ecosystems, especially water.



Figure 3. Discharge of Waste into Waters

An ecosystem is a reciprocal relationship between living things and their environment or a reciprocal relationship between biotic components and abiotic components that interact to maintain their balance [26]. Now, if there is a change in one of the components due to activities or interactions that exceed the ecosystem's tolerance threshold, there will be

dynamic changes in the ecosystem. The causes can vary, but for this time, we focus on one of the causes, namely environmental pollution, especially water pollution.

In addition to the main presentation, DSM presents additional rubrics containing interesting information that is still related to the theme to add insight into students' knowledge. Some of the additional rubrics developed are the scientist rubric which contains information on river care communities. Lensa Sain's rubric contains important information from news, history, etc. Cerins rubric (short story science) contains short stories about river pollution, and the techno sains rubric contains information about the technology used for WWTP (Waste Water Treatment Plant). Learning evaluation tools are also developed in DSM in the form of TTS (crossword) and word square (word search game) games.

The context of the main material taken in this polluted river theme applies an integrated model which, although it brings together a variety of subject matter, still prioritizes overlapping concepts from across these disciplines. The results of the material development and the flow displayed in DSM are as follows:

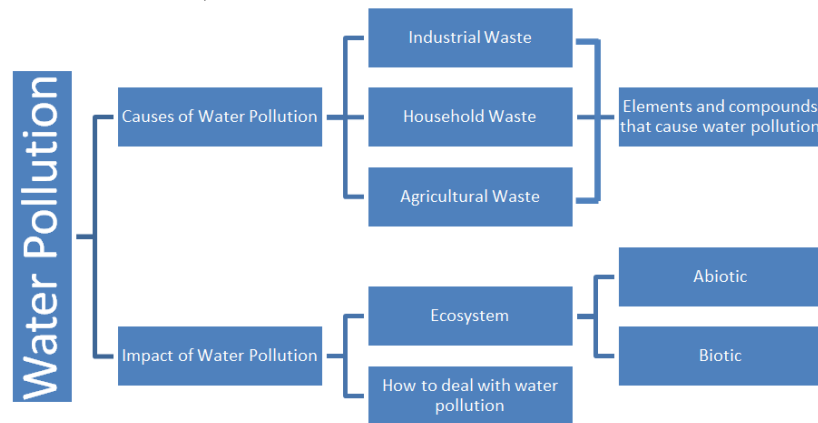


Figure 4. Material Flow on DSM

Determining the material content with the theme "My Polluted River" can realize contextual learning related to the river environment around students who have not paid attention to cleanliness and maintenance so that floods often occur due to overflowing water from rivers that cannot accommodate the large capacity of rainwater. In addition, the appointment of this material is closely related to the contextual learning model that expects students to try to find solutions to these problems and can certainly grow a culture of science literacy for students.

b. Expert Validation

The second stage of the development process is the validation test of the product that has been made. Validation is asking several

experts/experts who are knowledgeable to evaluate the products made. Consists of material validation, media validation, and validation of science practitioners.

**Material Validation of DSM Based on Contextual Learning**

Material validation is carried out by a material expert validator using a material validation assessment sheet to know the material's validity level in DSM based on contextual learning. The suggestions for improvement obtained will be a reference in revising DSM to make it even better. The following describes the results of validation by material experts.

Based on the table table 3, material validation has three aspects that are assessed, namely first, the

material aspect (content), which contains five criteria, gets an average percentage of 85.47 % in the very valid category. These results indicate that DSM is developed in accordance with the learning indicators that have been designed, and the contents of DSM include components to foster scientific literacy. A magazine that contains science learning material is usually called a science magazine. Magazines related to science are reading materials included in facilities to support a scientific literacy culture [11].

Table 3. Assessment of the Material Validator

Aspect	Percentage	Category
Material (content)	85.47%	Very Valid
Language	77.76%	Valid
Presentation	85.82%	Very Valid
Average yield	84.37%	Very Valid

Second, the language aspect gets a percentage of 77.76% with a valid category from material experts. This shows that the language used is by EYD rules, punctuation, and linguistic grammar. In addition, the suitability of language to the stage of development of students is also very important because language aims to help students both grow and develop, which, of course, is according to their level; if it is not according to their level, students will experience failure of understanding and frustration in learning [12]. However, seeing the results of the assessment were not optimal because they needed to be more legible. Therefore, improvements were needed in the development of this DSM.

Third, the presentation aspect gets a percentage of 85.82% which is in the very valid category, indicating that DSM is very good at presenting material that varies in delivery, displaying attractive supporting media, and paying attention to ethical codes and copyrights.

The level of material validity of the three aspects that have been previously described has an average percentage of 84.37% with a very valid category. These results conclude that the material/content of DSM is very good and can be continued for limited trials.

### Media Validation of DSM Based on Contextual Learning

Media validation was carried out by media expert validators using media validation instrument sheets to know the level of media validity in DSM based on contextual learning. The suggestions for improvement obtained will be a reference in revising DSM to make it even better. The following is a description of the validation results by media experts.

Table 4. Assessment of the Media Validator

Aspect	Percentage	Category
Graphics	85%	Very Valid
Average yield	85%	Very Valid

This media validation has one aspect, namely the graphical aspect, with the acquisition of a percentage of 85% which is included in the very valid category by media experts. The illustrations are presented attractively in the cover graphic, which includes typography using the appropriate and not excessive typeface so that the legibility function is preserved. According to the theme, the layout is presented harmoniously and proportionally so that a cover is formed that can convey the message of the contents of the magazine. It is appropriate that the cover covers of magazines are part of visual communication that combines typography, illustrations, and colors to convey meaning, meaning, or messages in magazines [13].

The graphics of the magazine's contents are similar to the cover, which consists of typography, illustrations, and layout. Using a typeface following the development of students does not use many variations on letters so that it is easy to read and the message is easy to understand. In line with the definition of typography, namely graphic elements that are the easiest to read through letters that guide understanding the reader's message [14]. Illustrations presented per the concept of the discussion raised can complement the explanation of the magazine's contents. Illustrations have a function, one of which is a descriptive function, which means that illustrative images replace written or text-based verbal explanations [13]. Vivid illustrations such as videos can make it easier and faster for someone to understand writing in a fun way. In addition, good layout placement of content components makes the magazine more attractive.

The validity level of the media in DSM based on contextual learning obtains an average result of 85% with a very valid category, thus concluding that DSM media is very good and can be used in limited trials.

### Science Practitioners Validation of DSM Based on Contextual Learning

Science practitioner validation was carried out by three science teachers using a science practitioner validation sheet. This validation aims to determine the level of validity in the use and suitability of DSM in learning. The suggestions for improvement obtained will be a reference in revising DSM to make it even better. The following describes the results of validation by expert science practitioners.

Table 5. Assessment of Science Practitioner Validators

Aspect	Science Practitioner			Percentage	Category
	I	II	III		
Material (content)	97.91%	93.75%	93.75%	95.13%	Very Valid
Language	100%	100%	95.83%	98.61%	Very Valid
Appearance	93.75%	100%	87.50%	93.75%	Very Valid
Average yield	97.50%	96.25%	91.25%	95.83%	Very Valid

Based on the table above, the validation of science practitioners has three assessed aspects. First, the material aspect (content) gets an average percentage of 95.13 % in the very valid category. This percentage shows the material is structured using the integrated cohesiveness model with the theme. The applicable core competencies and basic competencies curriculum pollute my river. Appropriateness of core and basic competencies used in product development is suitability for material or content [15]. The evaluation tool is presented attractively in the form of a crossword puzzle game. Presenting material evaluation tools or measuring success is very important because it is one of the criteria for making learning media [16].

Second, the language aspect gets an average result of 98.61% in the very valid category. These results mean that DSM has presented clear and appropriate language for junior high school students. The suitability of the language feasibility aspect is the suitability of using communicative, dialogical, and interactive language [17].

Third, the display aspect gets an average percentage of 93.83%, which is very valid. This assessment means the typography, illustration, and layout indicators have been properly presented. The appearance of the typography is adjusted to the material's character, the student's educational level, simplicity, ease of reading, and not using a lot of decorative letters. This aligns with the opinion that the most readable graphic elements are typography, which uses letters to guide the understanding of the reader's message [14]. The use of illustrations in a magazine can attract readers to read and study the contents of the magazine. Illustrations also support the explanation of the contents of the text. In addition, illustrations help writing be more communicative. In line with the opinion that illustration has a function, one of which is a descriptive function, which means that illustrative images replace written or text-based verbal explanations [13].

Simplicity, contrast, balance, harmony, and emphasis (stressing) are the basic principles of placing the right layout so that the main purpose of the layout can be realized by displaying communicative text and image elements to facilitate the reader's understanding of the information presented, in line with the opinion that layout is the process of collecting, structuring, and integrating graphic communication elements (text, photos/images, tables, etc.) to create

communicative, beautiful, and attractive visual communications so that they are legible, structured, product identity, and clear [18].

The validity level of science practitioners from the elaboration of the three aspects above obtains an average percentage of 95.83% in the very valid category. These results conclude that DSM is very good in its usefulness and suitability for science learning.

c. Product Revision

After the validation stage is carried out, of course, the product still has shortcomings. Therefore, improvements are needed according to the comments and suggestions of experts so that the product is suitable for use and balanced with the needs of students. If the validation assessment has been declared valid/worthy, then DSM is ready to be implemented or tested.

4. Implement

This implementation stage was carried out with a limited trial conducted at SMPN 1 Bojonegara, and the number of subjects was 12 grade 9 students. This activity aims to determine the level of attractiveness of DSM using a student response questionnaire. The response that students will give is an assessment of DSM regarding material content and presentation. The results of student responses to DSM are presented below.

Table 6. Assessment of Student Responses

Aspect	Score	Category
Content material	3.45	Very Good/Interesting
Presentation	3.48	Very Good/Interesting
Average yield	3.48	Very Good/Interesting

In the results of the material content aspect, there are assessment indicators, namely effectiveness, and efficiency, which show that DSM can facilitate understanding of material concepts, motivate and attract students to learn science lessons, and be used independently at home and school. This is in line with the opinion that the focus of questions for limited trials is effectiveness and efficiency [19]. In addition, the material indicators have explained the discussion in a clear, interesting way, and by the developmental stages of students making the material easy to understand. This is in line with the opinion that teaching materials or media that consider students'

developmental stages will make it easier for students to understand what they are learning [20].

The presentation includes the practicality and ease of operating DSM by simplifying print magazine media into digital or electronic, which can facilitate its use without time or place restrictions, both for students and teachers. The operation is also easy and not difficult because the shape is the same as an e-book or e-module that is often used in general. An indicator in supporting the teaching and learning process using media is the ease of use which means that the learning media is easy to operate [21].

The design of the learning media has been combined in an interesting way, including the design of the presentation of images and videos, the use of letters, the compatibility of the language with KBBI and PUEBI, and the use of communicative language, which makes DSM interesting and can make it easier for potential readers to understand the material on my river are polluted. The most important part is that the contents of the material or activities presented in each magazine rubric are by the theme. My river is polluted, in accordance with the opinion that learning media that are interesting and adapted to the needs of students can increase their motivation to learn [22].

The level of attractiveness of DSM from the two aspects discussed above obtained an average score of 3.48, categorized as very good and interesting. These results conclude that DSM is very good and interesting as a learning medium at the junior high school level.

## 5. Evaluate

After implementation, the product should be evaluated. The evaluation is an initial qualitative evaluation of the product, which can be obtained from student response questionnaires, science teacher interviews, or field notes at school.

## CONCLUSION

Based on the research on the attractiveness of MADIPA (Digital Science Magazine) based on contextual learning on the theme my river is polluted that has been carried out, it can be concluded the validity level of DSM obtained a percentage of 88,4% with a very valid category. The assessment consists of a material expert's assessment of 84,37% in a very valid category, a media expert's assessment of 85% in a very valid category, and a science practitioner (teacher) expert's assessment of 95,83% in a very valid category so that it can be used in limited trial activities at the junior high school level.

The attractiveness level of DSM obtained a score of 3,48 with a very good/attractive category with a maximum score of 4, so DSM is based on contextual learning. The theme of my river is pollution, which is very well-developed and interesting as a learning medium at the junior high school level.

## REFERENCES

- [1] Selwyn, N. (2011). *Education and Technology. Key Issues and Debates*. London: Continuum Int. Publ. Group.
- [2] Megahantara, G. S. (2017). Pengaruh teknologi terhadap pendidikan di abad 21. *Yogyakarta: Universitas Negeri Yogyakarta*.
- [3] Mustikarini, P. (2016). Pengembangan majalah fisika sebagai alternatif sumber belajar mandiri berkarakter islami melalui materi fluida dinamis untuk menumbuhkan sikap spiritual dan motivasi belajar siswa kelas XI SMA Negeri 1 Bantul. *Jurnal Pendidikan Fisika*, 5(2), 98-105.
- [4] Agustini, M., Nulhakim, L., & Hakim, Z. R. (2021). Pengembangan Media Pembelajaran Audio Visual Berbasis Contextual Learning Pada Materi Sumber Energi Dan Perubahannya Di Kelas Iv Sd. *Primary: Jurnal Pendidikan Guru Sekolah Dasar*, 10(2), 263-278.
- [5] Akib, E., Imran, M. E., Mahtari, S., Mahmud, M. R., Prawiyogy, A. G., Supriatna, I., & Ikhsan, M. H. (2020). Study on implementation of integrated curriculum in Indonesia. *IJORE: International Journal of Recent Educational Research*, 1(1), 39-57.
- [6] Molenda, M. (2003). In search of the elusive ADDIE model. *Performance improvement*, 42(5), 34-37.
- [7] Shofawati, A., Widodo, W., & Sari, D. A. P. (2023). The use of multimedia interactive to improve students science literacy in the new normal era. *Jurnal Pijar Mipa*, 18(1), 65-71.
- [8] Sugiyono, D. (2013). Metode penelitian pendidikan pendekatan kuantitatif, kualitatif dan R&D.
- [9] Husnadi, S. I., Ilhamdi, M. L., & Khair, B. N. (2021). Pengembangan Multimedia Interaktif Berbasis Macromedia Flash Professional 8 Pada Tema Daerah Tempat Tinggalku (Kearifan Lokal Lombok) untuk Siswa Sekolah Dasar. *Jurnal Pijar Mipa*, 16(2), 191-197.
- [10] Noviyanti, H., Al Hakim, Y., Kurniawan, E. S., & Akhdinirwanto, R. W. (2022). The implementation of virtual home laboratories to improve students psychomotor abilities. *Jurnal Pijar Mipa*, 17(6), 759-763.
- [11] dan Kebudayaan, K. P. (2017). Materi pendukung literasi digital. *Jakarta Timur: Kemendikbud*.
- [12] Fauziah, S. (2018). Pembelajaran Bahasa Yang Sesuai Dengan Perkembangan Anak. *Al-MUNZIR*, 11(2), 283-302.
- [13] Kusrianto, A. (2007). Pengantar Desain Komunikasi Visual, Jakarta.
- [14] Sudiana, D. (2001). Pengantar Tipografi. *Bandung: Rumah Produksi Dendi Sudiana*.
- [15] Wulandari, Y., & Purwanto, W. E. (2017). Kelayakan aspek materi dan media dalam pengembangan buku ajar sastra lama. *Jurnal*

- Penelitian Pendidikan Bahasa dan Sastra Indonesia*, 3(2), 162-172.
- [16] Sadiman, A. (2020). *Media Pendidikan (Pengertian, Pengembangan, Dan, Pemanfaatannya)*. Rajawali pers.
- [17] Widodo, M. (2015). *Teori Belajar Bahasa. Bandar Lampung: Universitas Lampung*.
- [18] Galura, R. (2014). Layout majalah sebagai sebuah cerminan identitas pembaca studi kasus layout majalah cosmopolitan dan aneka yes. *LONTAR: Jurnal Ilmu Komunikasi*, 2(3).
- [19] Copeland, S. (1996). *Planning and conducting formative evaluations*-Tessmer, M.
- [20] Kimianti, F., & Prasetyo, Z. K. (2019). Pengembangan e-modul ipa berbasis problem-based learning untuk meningkatkan literasi sains siswa. *Kwangsan: Jurnal Teknologi Pendidikan*, 7(2), 91-103.
- [21] Nuralan, S. (2021). Persepsi Siswa Terhadap Penggunaan Media Pada Masa Pandemi Covid-19 Di SMA Negeri I Tolitoli. *Jurnal Inovasi Penelitian*, 2(7), 1917-1924.
- [22] Nurrita, T. (2018). Pengembangan media pembelajaran untuk meningkatkan hasil belajar siswa. *Jurnal misykat*, 3(1), 171-187.
- [23] Widodo, W., Rachmadiarti, F., Hidayati, S. N., Suryanda, A., & Cahyana, U. (2017). *Ilmu pengetahuan alam. Jakarta: Pusat Kurikulum dan Perbukuan, Balitbang, Kemendikbud*.
- [24] Hadi, K. (2022). *Pengaruh Pemberian Lindi Dengan Dosis Berbeda Yang Difermentasi EM4 Terhadap Kelimpahan Chlorella SP* (Doctoral dissertation, Universitas Islam Riau).
- [25] Wiraatmaja, W. A. (2022). *Penerapan Asas Pencemar Membayar (Polluter Pays Principle) terhadap Tingkat Pencemaran Air Akibat Pembuangan Air Limbah Domestik di Kecamatan Ciracas, Jakarta Timur*.
- [26] Marbun, S. A. (2020). *Peran Walhi Kota Yogyakarta Dalam Pengendalian Pencemaran Di Sungai Gajah Wong Menurut Undang-Undang Nomor 32 Tahun 2009 Tentang Perlindungan dan Pengelolaan Lingkungan Hidup* (Doctoral dissertation, Universitas Atma Jaya Yogyakarta).
- [27] Wijana, N. (2014). *Biologi dan Lingkungan. Yogyakarta: Plantaxia*.