



Feasibility Analysis of an E-Magazine on Conventional Biotechnology Subtopic Based on Proximate Analysis Results of Cincalok Fermentation

Filardha Azelia Vallahayil¹, Laili Fitri Yeni¹, Anisyah Yuniarti^{1*}

¹ Biology Education, Faculty of Teacher Training and Education, Universitas Tanjungpura, Pontianak, Indonesia.

Received: October 19, 2025

Revised: November 23, 2025

Accepted: December 25, 2025

Published: December 31, 2025

Corresponding Author:

Anisyah Yuniarti

anisyah.yuniarti@fkip.untan.ac.id

DOI: [10.29303/jppipa.v11i12.13995](https://doi.org/10.29303/jppipa.v11i12.13995)

© 2025 The Authors. This open access article is distributed under a (CC-BY License)



Abstract: The E-magazine is an innovative, technology-based learning media that is expected to enhance the effectiveness of Biology education. This study aims to develop and analyze the feasibility of an e-magazine on conventional biotechnology based on the proximate analysis of cincalok fermentation. This research employed the Research and Development (R&D) method, involving stages of proximate analysis, design, development, and validation. The proximate analysis of cincalok revealed a moisture content of 8.88%, ash 11.30%, fat 4.35%, protein 35.27%, and carbohydrate 40.20%. These factual data were integrated as the scientific content of the e-magazine to provide contextual learning materials. Validation by five experts yielded a Content Validity Ratio (CVR) of 1.00 and a Content Validity Index (CVI) of 1.00 across all aspects, including format, content, and language. Based on these results, the e-magazine is concluded to be a highly valid and feasible digital learning medium. This media serves as a scientifically-grounded resource to support biotechnology education by utilizing local potential.

Keywords: Conventional biotechnology; E-magazine; Feasibility; Learning media; Validation

Introduction

Cincalok is one of the traditional foods from West Kalimantan made from fermented small shrimp (*Acetes* sp.) (Nurhamidah et al., 2020; Risnawati et al., 2021). This fermentation process occurs naturally over several days and involves the activity of microorganisms, especially lactic acid bacteria, which play an important role in the formation of a characteristic sour and savory taste in food. Some studies report that bacteria such as *Lactobacillus* sp. commonly found in traditional fermentation products (Pratiwi et al., 2015) indicating that similar microorganisms are most likely involved in cincalok fermentation. Cincalok is commonly used by the public as a flavor enhancer or side dish (Sugiharto, 2024). In addition to being a food product, cincalok is also a local wisdom and cultural heritage that remains closely related to people's daily lives.

The nutritional content of cincalok shows its potential as a contextual learning resource in biotechnology because, as a traditional fermented product (Selviana et al., 2021), it involves microbial metabolism, biochemical changes, and complex nutritional characteristics that can be observed through proximate analysis such as water, protein, fat, carbohydrate, and ash (Setiarto, 2020). These measurable changes make abstract fermentation concepts more concrete for students, addressing the problem identified by Nisa et al. (2023) that biotechnology is often perceived as abstract when learning lacks contextual and everyday examples. This aligns with Kopnina (2020) view that meaningful education must connect knowledge with students real-life experiences. Education is a continuous process that plays a vital role in personal development and equips individuals with capacity to make informed decisions throughout their lives (Pherson-Geyser et al., 2020). However, interviews with

How to Cite:

Vallahayil, F. A., Yuniarti, A., & Yeni, L. . F. (2025). Feasibility Analysis of an E-Magazine on Conventional Biotechnology Subtopic Based on Proximate Analysis Results of Cincalok Fermentation. *Jurnal Penelitian Pendidikan IPA*, 11(12), 1332-1342.
<https://doi.org/10.29303/jppipa.v11i12.13995>

a biology teacher at SMA Negeri 8 Pontianak on November 13, 2024 revealed that fermentation examples are still limited to tempe and tapai, with learning media mainly using YouTube and PowerPoint, indicating that local potential such as cincalok has not been optimally utilized, which is consistent with Gumilar et al. (2023) that the lack of local context reduces the meaningfulness and effectiveness of learning.

Interviews with students also gave the result that students showed a high interest in technology-based learning media. In the context of 21st century learning, technology integration is no longer optional but essential to support effective learning processes. The use of technology in learning is considered to be able to encourage students motivation and interest in the material presented (Hidayat et al., 2020). Learning media that are less interactive and unattractive can contribute to low levels of students scientific literacy (Hartomo & Sukmawati, 2024). The opinion of Erdogan (2019) emphasized that technology based learning media can increase student engagement and motivation if aligned with learning objectives. Ritter et al. (2017) state that creative thinking skills have a very broad influence, especially in digital learning where students are required to explore information, generate ideas, and solve problems independently. Mandalia et al. (2025) also highlights that digital based learning media provide flexibility and accessibility that support student-centered learning, especially if designed according to student characteristics and needs. Students tend to prefer learning content that is visual, interactive, and easily accessible through digital devices. In addition, digital literacy includes the ability to access, analyze, evaluate, through various digital technologies (Feng & Sumettikoon, 2024).

This shows that there is a need for learning media that not only support curriculum demands but also align with student learning preferences and local contexts. The opinion of Hastini et al. (2022) emphasizes that contextual and interesting learning resources are able to increase student motivation and understanding. In addition, Al-Rahmi et al. (2015) emphasized that appropriate learning media improves the quality of learning by encouraging active participation and accommodating individual learning characteristics.

One type of learning media that is considered suitable for these needs is an electronic magazine or e-magazine. Electronic Magazine is a digital learning media that can be accessed electronically, allowing flexible use anytime and anywhere. According to Fitriah et al. (2022), magazines as a learning medium present information using communicative language supported by visual elements, so that students can learn independently and understand concepts more easily. Next Sadiah et al. (2024) found that digital learning

media with attractive visual designs can increase student engagement and active participation during the learning process.

The contents of e-magazines are generally arranged in an attractive format and can contain images, infographics, animations, and videos that are relevant to learning materials so as to create a more enjoyable learning experience (Sania et al., 2024). Fuad et al. (2020) also showed that e-magazine based learning media was feasible to use in the classroom, with a feasibility rate of 82%. In addition, e-magazines have been shown to be effective in increasing students' reading interest and comprehension (Anggraini et al., 2022). As an informative visual media, e-magazine is arranged in a concise and systematic manner so that it is suitable to support conceptual understanding (Mustikarini, 2016). The Association of Education and Communication Technology (AECT) states that media are all forms and channels of communication used throughout the teaching and learning process (Ibrahim et al., 2022). This emphasizes that the use of media need to adjust the needs of student and the material being taught.

Looking at the potential of cincalok as a local fermentation product that is rich in cultural values and the need for innovative, contextual, and Technology Based Learning media, the development of e-magazine based on the results of proximate analysis of cincalok can be a relevant alternative to conventional biotechnology learning. Therefore, this study aims to analyze the feasibility of e-magazine developed based on the results of analysis of proximate fermentation cincalok.

Method

The method used in this study was Research and Development (R&D). The process of developing the learning media was carried out through several stages, namely interviews, proximate analysis of cincalok, design, development, and validation.

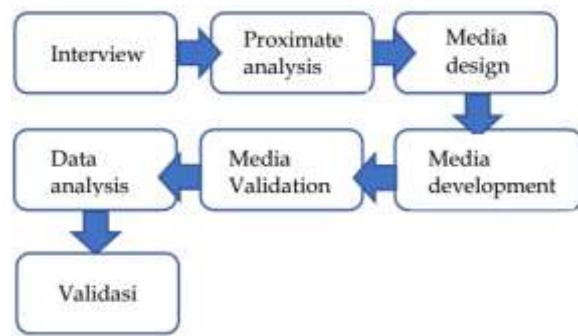


Figure 1. Product development flow of the e-magazine

Each stage was designed to ensure that the developed e-magazine meets learning needs effectively

and with good quality. The interview stage was conducted to identify students needs, learning objectives, and the characteristics of instructional media according to the context and target users. The information obtained from this stage became the basis for determining the content and form of the media.

As a scientific basis for developing the e-magazine content, a proximate analysis of cincalok was conducted prior to the media design stage. This analysis aimed to determine the nutritional composition of cincalok, including moisture, protein, fat, ash, carbohydrate, pH, total lactic acid bacteria (LAB), and amino acids. Moisture content was analyzed using the oven method, protein using the Kjeldahl method, fat using the Soxhlet method, and ash using a muffle furnace. Carbohydrate content was calculated by the difference method, pH was measured using an electrometric method, total LAB was determined using the standard plate count method, and amino acids were analyzed using a spectrophotometer. The results of the proximate analysis were used as the scientific basis for preparing the e-magazine content so that the material presented was supported by valid scientific data.

In the design stage, the structure, content, visual appearance, and navigation of the e-magazine were planned. This included the selection of graphic elements, layout arrangement, and organization of materials so that they could be presented in an attractive, informative, and easy to understand manner. The media was developed using the Canva platform, and the final product can be accessed via Google Drive.

The development stage involved producing the e-magazine based on the prepared design. At this stage, the validation instruments were also developed and tested. Before being used, the validation instrument was first examined using a Guttman scale (Yes = 1; No = 0) by two lecturers of Biology Education, Faculty of Teacher Training and Education, Universitas Tanjungpura, to ensure that each item was appropriate and suitable for evaluating the media.

The media validation was conducted by five validators, consisting of two Biology Education lecturers from FKIP Universitas Tanjungpura as material experts and three Biology teachers from SMA Negeri 3, SMA Negeri 8, and SMA Negeri 10 Pontianak as media practitioners. The media was evaluated using a 4-point Likert scale, where scores of 1-2 indicate "not relevant" and scores of 3-4 indicate "relevant".

The validation stage aimed to determine the feasibility of the developed media based on three main aspects, namely format, content, and language. The evaluation instrument was adapted from Susilana et al. (2007). The data obtained from the validators were analyzed using the Content Validity Ratio (CVR) and Content Validity Index (CVI) as proposed by Lawshe

(1975) to determine the level of agreement among the validators regarding the relevance of each assessment criterion.

$$CVR = \frac{\frac{Ne - \frac{N}{2}}{\frac{N}{2}}}{2} \quad (1)$$

Where:

CVR = Content Validity Ratio

Ne = Number of panelists/validators who agree

N = total number of panelists/validators

The CVR value was calculated for each item based on the number of validators who rated the item reaches 3.00-4.00 if < 3.00 then it is considered to disagree with the validity of the learning media. After the CVR value for each criterion is obtained, the next step is to calculate the CVI (Content Validity Index) value, which is the average of all CVR values that have been calculated.

$$CVI = \frac{\sum CVR}{Jumlah sub kriteria} \quad (2)$$

The CVI value is in the range of 0 to 1, and an instrument is declared feasible if at least half of the validators state that the media is valid. Conversely, if less than a quarter of the validators rate the media as invalid, then the media is considered not to meet the criteria of feasibility.

In addition to content validity analysis, the overall feasibility of the media was calculated using a Likert scale.

$$Percentage = \frac{\text{Total Likert score}}{\text{Maximum score}} \times 100 \quad (3)$$

Result and Discussion

The stages of media development in this study consist of design, design, and development stages, which are carried out systematically to produce e-magazine learning media that are in accordance with the needs of students and Biology learning objectives.

The design stage begins with the identification of needs and curriculum review through the analysis of Learning Outcomes (CP). Based on these CP, a Learning Objective Pathway (ATP) was developed which contains a sequence of competencies that must be mastered by students. From this ATP, Learning Objectives (TP) are then derived which become the basis for determining teaching materials, designing learning activities, determining indicators of competency achievement, compiling time allocations, and selecting relevant learning resources according to Biology subjects.

Based on the results of interviews with Biology teachers at SMA Negeri 8 Pontianak on November 13, 2024, it is known that the fermentation material taught

so far is still limited to products such as tempeh and tapai, while local potential such as cincalok has not been utilized in learning. This shows that there is an opportunity to integrate local potential into Biology material to make it more contextual and relevant to the students environment. In addition, students also showed high interest in technology-based learning media, especially those that can be accessed through devices such as laptops and smart phones. Therefore, an e-magazine was developed as an interactive learning media that combines local potential-based content with digital technology to increase students interest and understanding in learning Biology.

The design stage aims to organize the structure and content of learning media systematically and attractively. The material developed focused on the topic of conventional biotechnology, with a subfocus on local fermented products, namely cincalok. The material structure includes: introduction to the concept of biotechnology, history and inventors, fermentation process, types of fermentation, to the introduction of cincalok products as an example of local biotechnology.

The media was designed by prioritizing an attractive visual appearance and ease of use. Some of the design principles applied include the use of easy-to-read fonts (title: 75 pt; subtitle: 45 and 32 pt; content: 17 pt) with font types such as Agrandie, Lora, Great Vibes, Inria Serif, Alice, and Calibri. The color combination was chosen to be harmonious and comfortable to look at, with a neat and informative layout. In addition to text and images, the e-magazine also features interactive elements such as supporting illustrations and quizzes to increase learner participation. The design process was carried out using the Canva application, then converted into PDF format so that the media can be accessed digitally and interactively.

The development stage is the realization process of the media design that has been prepared. The e-magazine was developed based on the results of the previous analysis and design, by considering visual aspects, content, and interactivity. The creation process was carried out using the Canva application to organize content and appearance, then converted to PDF format.

The e-magazine media developed consists of 23 pages, including the front and back covers, with the following material coverage: definition of conventional biotechnology, inventors, benefits of biotechnology, the concept of fermentation, types of fermentation, examples of conventional biotechnology products, introduction of cincalok as a local product, the benefits of cincalok, the process of making cincalok, the results of cincalok proximate analysis, and evaluation quizzes to measure students understanding.

As part of the learning content presented in the e-magazine, the characteristics of cincalok are

strengthened through the results of proximate analysis. Based on the results of proximate analysis, cincalok has a moisture content of 8.88%, ash content of 11.30%, fat content of 4.35%, protein content of 35.27%, and carbohydrate content of 40.20%, indicating that this fermented product is dominated by protein and carbohydrates as the main nutritional components. The pH value of cincalok was 4.40, reflecting its acidic nature as a result of the fermentation process, which also plays a role in inhibiting the growth of spoilage microorganisms. The total lactic acid bacteria (LAB) count reached 1.9×10^9 cfu/gram, indicating high fermentation activity and potential as a functional food. In addition, the amino acid content of 40.69 ppm shows the breakdown of proteins into simpler compounds, contributing to the characteristic flavor as well as improved digestibility and nutritional value of cincalok. The e-magazine can be accessed through the QR code in figure 2.

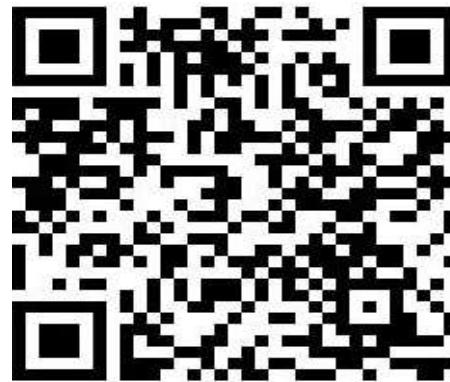


Figure 2. QR code e-magazine

The QR code presented in Figure 2 contains learning media e-magazine of conventional biotechnology submaterials from the results of proximate analysis of cincalok fermentation products. The content layout of the e-magazine can be seen in figure 3.

Before the media is validated, instrument validation is carried out with a validation sheet that refers to the eligibility aspects of content, format, and language, using a Guttman scale (Yes = 1, No = 0) as described by Sugiyono (2013). The instrument validity test was carried out by two lecturers of Biology Education FKIP UNTAN. The instrument validity test obtained results worthy of use.

The media was carried out based on the approach of Susilana et al. (2007), with five validators selected, namely two FKIP UNTAN lecturers and three high school grade X Biology teachers who implement the Merdeka Curriculum and are relevant to the research context. The validated aspects include format (10 criteria), content (2 criteria), and language (3 criteria).



Figure 3. The e-magazine consists of :1) Front cover, 2) Greeting and editorial team, 3) CP and TP, 4) Main content, 5) Quiz, 6) Developer profile, 7) Back cover

Table 1. Content Validity Results (CVR and CVI)

Aspect	Criteria	CVR	Description
Format	Attractiveness of the e-magazine display.	1.00	Valid
	Suitability of the e-magazine format.	1.00	Valid
	Cover with illustration.	1.00	Valid
	Presence of editorial greeting & editorial team.	1.00	Valid
	Inclusion of learning achievements and objectives.	1.00	Valid
	Presence of conventional biotechnology material.	1.00	Valid
	Inclusion of a quiz on conventional biotechnology material.	1.00	Valid
	Harmony of color and text in the e-magazine.	1.00	Valid
	Illustrations/images are related to and support clarity in the sub-material of conventional biotechnology in the e-magazine.	1.00	Valid
	Ease of use of the media.	1.00	Valid
Content	Appropriate font usage in the e-magazine.	1.00	Valid
	The presentation of sub-materials in the e-magazine conveys information completely, clearly, and is easy to understand.	1.00	Valid
	The information delivery in the e-magazine is accurate and the content aligns with its function as a learning medium.	1.00	Valid
Language	Language appropriateness in the media according to the cognitive level and vocabulary of high school students.	1.00	Valid
	Effectiveness of the sentences used.	1.00	Valid
	Use of words according to the general guidelines for Indonesian spelling (PUEBI)	1.00	Valid
CVI		1.00	Valid

Based on the validation results, the format aspect, which consisted of 11 criteria, was declared valid. The e-magazine demonstrates an attractive visual appearance that supports student engagement in digital learning.

An appealing design helps present learning materials in a more engaging, creative, and meaningful way for students (Bua, 2022). This finding is in line with Dyanti et al. (2022), who stated that digital learning media

designed with appealing visuals can increase students' interest and involvement in learning activities. Variations in visual presentation and learning components also contribute to making learning more dynamic and fostering students' interest (Sulisworo et al., 2019).

Table 2. Media Feasibility Assessment Results

Aspect	Mean score	Percentage (%)
Format	3.73	93.25
Content	3.90	97.50
Language	4.00	100
Total	3.88	96.92 (valid)

The structure of the e-magazine, including the cover, competencies, indicators, materials, and practice sections, was considered appropriate and well organized. A clear and systematic structure supports an effective learning flow (Rasidi et al., 2021), while structured and orderly digital content helps students understand material more easily and improves their learning experience (Yulia et al., 2024).

The use of relevant cover illustrations and supporting images was positively evaluated, as visuals can stimulate students' interest and support the representation of learning concepts (Dyanti et al., 2022; Rukmana et al., 2018). Learning materials that are packaged attractively are known to foster learning motivation, which is positively correlated with conceptual understanding and learning success (Darling-Hammond et al., 2020).

In addition, the inclusion of editorial greetings and the editorial team enhances the credibility of the e-magazine as a learning medium (Azhar et al., 2020). Harmonious color combinations and appropriate color contrast improve readability and visual comfort (Gautama et al., 2019). The use of suitable fonts also supports readability, comfort, and the overall identity of learning media (Batubara, 2020; Suprapto, 2020). Furthermore, the e-magazine is easy to use and accessible across various digital devices, supporting independent learning and flexible access (Sundari, 2015). Easy access and interactive digital media can further increase student engagement and interaction, making learning activities more active and meaningful (O'Grady-Jones & Grant, 2023). Digital learning media like e-magazine can be distributed through online platforms and social media, allowing learning material to reach a wider audience (Geraldo & Pinto, 2020).

The content aspect, which consisted of two criteria, was declared valid. The coverage of sub-materials was considered complete and attractively presented, enabling students to explore learning topics comprehensively. Learning media that integrate structured content with exercises are effective in

increasing students learning motivation. This is consistent with Yulia et al. (2024), who emphasized that clear and comprehensive digital content improves students learning experiences.

The clarity and completeness of the information presented further support students understanding. Systematically arranged material helps learners comprehend concepts more easily and apply knowledge more effectively (Ritonga et al., 2022). The presentation of conventional biotechnology material, supported by relevant visuals, also facilitates clearer conceptual understanding (Yulia et al., 2024).

Interactive components such as quizzes reinforce learning by encouraging practice and active participation (Andriyani et al., 2020). Quizzes function to stimulate students motivation and attention by introducing important and new terms related to the learning material (Lauc et al., 2020), while interactive digital elements encourage students to be more active and engaged in the learning process (Dyanti et al., 2022).

The language aspect demonstrated that the information presented in the e-magazine is accurate and appropriate for learning purposes. The accuracy and appropriateness of information ensure content reliability and relevance for students (Widiastuti, 2019). The language used is also appropriate to students cognitive levels, as suitable vocabulary selection supports comprehension and effective learning (Sari & Darwiyah, 2017).

Furthermore, effective sentence construction and compliance with PUEBI contribute to text clarity and ease of understanding (Ramadhanti, 2015). Clear and well-structured language helps students process information more efficiently and supports the overall effectiveness of the learning media.

The consistently high CVR values indicate that the e-magazine is highly feasible as a digital learning medium. The development of learning media can provide learning motivation, meaningful learning experiences, and make learning activities more interesting, thereby helping students understand learning material more easily (Leasa et al., 2021). The suggestions provided are used as a reference for improving the media and can be seen in the table 3.

Suggestions provided by the validators were used as references to improve the quality of the e-magazine. The revised design of the e-magazine is shown in Table 2 below. Based on the validation results, the e-magazine media is declared valid in terms of content and feasible for use in school learning processes. The advantages of this e-magazine include its attractive and varied appearance, interactive features, flexibility, time efficiency, and the integration of local fermentation potential as learning material. However, the disadvantages include a relatively long development

time, dependence on technology and internet connection, and a design that may be less comfortable for some users. As a solution, it is recommended to

improve development time efficiency, provide an offline version, and enhance design quality and text readability.

Table 3. Revisions Based on Validators Suggestions

Suggestion Validator	Before	After
Refine the visual identity by adding sea-themed elements to the cover and optimizing the table of contents (TOC) layout.	 <p>The cover used a dull brown/cream theme with limited imagery, while the TOC was too narrow, causing text to wrap and appear cut off.</p>	 <p>The cover now features a sea-themed design (and the TOC layout has been expanded to ensure all items fit on a single line).</p>
Rephrase learning objectives using operational verbs and include specific goals regarding conventional biotechnology and the nutritional benefits of cincalok.	 <p>Objectives lacked operational verbs and did not cover conventional biotechnology or cincalok's nutritional profile.</p>	 <p>Objectives are now defined with clear operational verbs and include focused goals on biotechnology processes and the nutritional value of cincalok.</p>
Expand the depth of the cincalok material and apply a distinct font for the "Fun Fact" section to improve content hierarchy.	 <p>Cincalok material was limited to a single page, and the "Fun Fact" section lacked visual distinction due to uniform typography.</p>	 <p>Content has been expanded to three comprehensive pages, and a unique font is now used for "Fun Facts" to make them stand out.</p>

Suggestion Validator	Before	After
Add quiz questions about proximate analysis.		

Quiz questions were still mostly focused on conventional biotechnology, with only one question related to cincalok.

Quiz questions about proximate analysis have increased to five questions.

Conclusion

The e-magazine on conventional biotechnology was successfully developed by integrating the complete proximate analysis data of cincalok, which consists of moisture (8.88%), ash (11.30%), fat (4.35%), protein (35.27%), and carbohydrate (40.20%). Based on the evaluation by five experts, the Content Validity Ratio (CVR) and Content Validity Index (CVI) reached 1.00, indicating a perfect agreement among validators regarding the medias appropriateness in terms of format, content, and language. Consequently, the e-magazine is a valid and contextually grounded learning resource that bridges laboratory findings with educational materials. Future research is recommended to conduct field testing to evaluate the practicality and pedagogical impact of this media on students.

Acknowledgments

I would like to express my gratitude to SMA Negeri 3, SMA Negeri 8, and SMA Negeri 10 Pontianak for permitting this research. I also thank the lecturers for their guidance and the Head of the Laboratory for granting access to conduct the research and providing the necessary facilities.

Author Contributions

Conceptualization: L., A.; Methodology: L., A.; Validation: L., A.; Investigation: F.; Resources: F.; Data curation: F., L., A.; Writing—original draft preparation: F.; Writing—review and editing: L., A.; Visualization: F.; Supervision: L., A. All authors have read and agreed to the published version of the manuscript.

Funding

This research received no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

References

Al-Rahmi, W., Othman, M. S., & Yusuf, L. M. (2015). The Role of Social Media for Collaborative Learning to Improve Academic Performance of Students and Researchers in Malaysian Higher Education. *The International Review of Research in Open and Distributed Learning*, 16(4). <https://doi.org/10.19173/irrodl.v16i4.2326>

Andriyani, F., Saraswati, R. R., Melasari, D., Putri, A., & Sumardani, D. (2020). Monopoly Learning Media: Education Media in Structure and Function of Plant Tissue Theory. *Jurnal Pembelajaran dan Biologi Nukleus*, 6(1), 81-87. <https://doi.org/10.36987/jpbn.v6i1.1559>

Anggraini, V., Priyanto, A., Yulsyofriend, Y., & Yeni, I. (2022). Inovasi media e-magazine untuk stimulasi kemampuan sains anak usia dini. *Jurnal Pendidikan Tambusai*, 6(2), 11530-11537. <https://doi.org/10.31004/jptam.v6i2.4272>

Azhar, H., Suhardiman, S., & Hasanah, U. (2020). Pengembangan Media Pembelajaran Majalah Mitigasi Angin Putting Beliung Terinterkoneksi Ayat-Ayat Al-Qur'an Dalam Pembelajaran Fisika. *JPF (Jurnal Pendidikan Fisika) Universitas Islam Negeri Alauddin Makassar*, 8(2), 140-148. <https://doi.org/10.24252/jpf.v8i2.14232>

Batubara, H. H. (2020). *Media pembelajaran efektif*. Semarang: Fatawa Publishing.

Bua, M. T. (2022). Kemenarikan media berbantuan aplikasi dalam pembelajaran di sekolah dasar. *Jurnal Pendidikan Dasar Borneo (Judikdas Borneo)*, 4(2), 1-8. <https://doi.org/10.35334/judikdasborneo.v4i2.2905>

Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications for educational practice of the science of learning and

development. *Applied Developmental Science*, 24(2), 97-140.
<https://doi.org/10.1080/10888691.2018.1537791>

Dyanti, C. R., Rahmatan, H., Halim, A., Syukri, M., & Elisa. (2022). The effect of the kahoot application as a learning media on students learning outcomes on the material of wave vibration. *Jurnal Penelitian Pendidikan IPA*, 8(3), 1483-1488.
<https://doi.org/10.29303/jppipa.v8i3.1476>

Erdogan, V. (2019). Integrating 4C Skills of 21st century into 4 language skills in efl classes. *International Journal of Education and Research*, 7(11), 113-124. Retrieved from <https://share.google/y7j3H3HKuDZwk9gQc>

Feng, L., & Sumettikoon, P. (2024). An empirical analysis of EFL teachers in chinese higher education institutions. *International Journal of Education Technology in Higher Education*, 21(1).
<https://doi.org/10.1186/s41239-024-00474-1>

Fitriah, L., & Ita, I. (2022). Development of BioPhy Magazine Containing Local Wisdom to Improve Problem Solving Ability and Promote Environmental Awareness Campaign. *Jurnal Penelitian Pendidikan IPA*, 8(3), 1061-1073.
<https://doi.org/10.29303/jppipa.v8i3.1275>

Fuad, A., Karim, H., & Palennari, M. (2020). Pengembangan media pembelajaran E-magazine sebagai sumber belajar biologi siswa kelas XII. *Biology Teaching and Learning*, 3(1), 38-45. Retrieved from <https://ojs.unm.ac.id/btl/article/view/14298>

Gautama, N. M., Santosa, H., & Swandi, I. W. (2019). Pemanfaatan warna pada poster buku cerita bergambar sejarah Pura Pulaki. *Jurnal Desain*, 7(1), 71-84. Retrieved from https://journal.lppmunindra.ac.id/index.php/Jurnal_Desain/article/view/3833

Geraldo, G., & Pinto, M. D. S. (2020). The use of social media instagram to disseminate sustanable infromation. *International Journal of Librarinship*, 5(2), 4-12.
<https://doi.org/10.23974/ijol.2020.vol5.2.170>

Gumilar, N. M. A. R., Sudarmin, & Marwoto, P. (2023). Development of Science Learning Media Assisted by Ethno-Vlog Sisingaan and Gembyung Dance to Improve Creative Thinking Skills. *Jurnal Penelitian Pendidikan IPA*, 9(8), 6472-6479.
<https://doi.org/10.29303/jppipa.v9i8.3605>

Hartomo, R. M., & Sukmawati, W. (2024). The effect of digital flipbook media on improving science literay on human digestive system materials among elementary school students. *Jurnal Penelitian Pendidikan IPA*, 10(9), 6260-6270.
<https://doi.org/10.29303/jppipa.v10i9.7994>

Hastini, F., & Tanjung, I. F. (2022). Development of Biology Magazine (Biozine) Integrated Islamic Values in Biotechnology Materials. *Jurnal Pembelajaran dan Biologi Nukleus*, 8(2), 317-329.
<https://doi.org/10.36987/jpbn.v8i2.2798>

Hidayat, H., Mulyani, H., Nurhasanah, S. D., Khairunnisa, W., & Sholihah, Z. (2020). Peranan teknologi dan media pembelajaran bagi siswa sekolah dasar di dalam pembelajaran pendidikan kewarganegaraan. *Jurnal Pendidikan Kewarganegaraan Undiksha*, 8(2), 57-65. Retrieved from <https://ejournal.undiksha.ac.id/index.php/JJPP/article/view/24759>

Ibrahim, M. A., Fauzan, M. L. Y., Raihan, P., & Nuriyah, S. (2022). Jenis, klasifikasi dan karakteristik media pembelajaran. *Al-Mirah: Jurnal Pendidikan Islam*, 4(2), 106-113. Retrieved from <https://id.scribd.com/document/636995869/Untitled>

Kopnina, H. (2020). Education for the future? Critical evaluation of education for sustainable development goals. *The Journal of Environmental Education*, 51(4), 280-291.
<https://doi.org/10.1080/00958964.2019.1710444>

Lauc, T., Jagodić, G. K., & Bistrović, J. (2020). Effects of multimedia instructional message on motivation and cademic performance of elementary school students in Croatia. *International Journal of Instruction*, 13(4), 491-508.
<https://doi.org/10.29333/iji.2020.13431a>

Lawshe, C. H. (1975). A quantitative approach to content validity. *Personnel Psychology*, 28(4), 563-575. Retrieved from <https://parsmodir.com/wp-content/uploads/2015/03/lawshe.pdf>

Leasa, M., Batlolona, J. R., & Talakua, M. (2021). Elementary Students' Creative Thinking Skills In Science In The Maluku Islands, Indonesia. *Creativity Studies*, 14(1), 74-89.
<https://doi.org/10.3846/cs.2021.11244>

Mandalia, R., Maasawet, E. T., Tarigan, D., Hakim, A., Hudiyono, Y., Subagiyo, L., Masitah, Herliani, & Candra, K. P. (2025). Development of Virtual Media Nata De Pina Based on Articulate Storyline to Improve Science Process Skills (SPS) of Grade IX Students in Biotechnology Material. *Jurnal Penelitian Pendidikan IPA*, 11(1), 513-521.
<https://doi.org/10.29303/jppipa.v11i1.9840>

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. Retrieved from <https://core.ac.uk/download/pdf/33537848.pdf>

Nisa, W. M., Fatmawati, U., & Santosa, S. (2023). Food Fermentation as a Virtual Laboratory Learning Media to Empower Student's Science Process Skills. *Jurnal Penelitian Pendidikan IPA*, 9(4), 2296-2304. <https://doi.org/10.29303/jppipa.v9i4.2117>

Nurhamidah, A., Warsidah, W., & Idiawati, N. (2020). Isolasi dan karakterisasi Bakteri Asam Laktat (BAL) dari Ale-ale dan Cincalok. *Jurnal Laut Khatulistiwa*, 2(3), 85. <https://doi.org/10.26418/lkuntan.v2i3.34780>

O'Grady-Jones, M., & Grant, M. M. (2023). Ready Coder One: Collaborative Game Design-Based Learning on Gifted Fourth Graders' 21st Century Skills. *Gifted Child Today*, 46(2), 84-107. <https://doi.org/10.1177/10762175221149259>

Pherson-Geyser, M., Villiers, R., & Kavai, P. (2020). The use of experiential learning as a teaching strategy in life sciences. *International Journal of Instruction*, 13(3), 877-894. Retrieved from <https://eric.ed.gov/?id=EJ1259307>

Pratiwi, E. I., Yeni, L. F., & Wahyuni, E. S. (2015). Pembuatan Video Teknik Isolasi dan Karakterisasi Bakteri Asam Laktat Pekasam Ikan Kembung Kelas X. *Jurnal Pendidikan Dan Pembelajaran Khatulistiwa (JPPK)*, 4(5). <https://doi.org/10.26418/jppk.v4i5.10173>

Ramadhanti, D. (2015). Penggunaan Kalimat Efektif dalam Karya Ilmiah Siswa: Aplikasi Semantik Studi Kasus Siswa Kelas XI SMK Negeri 2 Lembah Gumanti. *Gramatika STKIP PGRI Sumatera Barat*, 1(2). <https://doi.org/10.22202/jg.2015.v1i2.1236>

Rasidi, R., Djudin, T., & Arsyid, S. B. (2021). Pengembangan Media E-Magazine Pada Materi Getaran, Gelombang Dan Bunyi Di Kelas VIII SMP. *Jurnal Pendidikan Dan Pembelajaran Khatulistiwa (JPPK)*, 10(9). Retrieved from <https://jurnal.untan.ac.id/index.php/jpdpb/article/view/49382>

Risnawati, N., Nurbaeti, S. N., & Kurniawan, H. (2021). Pengaruh Variasi Konsentrasi Karaginan Kombinasi Emulgator Anionik dan Nonionik Terhadap Formulasi Losion Astaxanthin Ekstrak Minyak Cincalok. *Jurnal Sains Dan Kesehatan*, 3(2), 101-109. Retrieved from <https://jsk.ff.unmul.ac.id/index.php/JSK/article/view/212>

Ritonga, A. P., Andini, N. P., & Iklmah, L. (2022). Pengembangan Bahan Ajaran Media. *Jurnal Multidisiplin Dehasen (MUDE)*, 1(3). <https://doi.org/10.37676/mude.v1i3.2612>

Ritter, S. M., & Mostert, N. (2017). Enhancement of creative thinking skills using a cognitive based creativity training. *Journal of Cognitive Enhancement*, 1(3), 243-253. <https://doi.org/10.1007/s41465-016-0002-3>

Rukmana, L., Syamswisna, S., & Yokhebed, Y. (2018). Kelayakan media booklet submateri keanekaragaman hayati kelas X SMA. *Jurnal Pendidikan Dan Pembelajaran Khatulistiwa (JPPK)*, 7(2). Retrieved from <https://jurnal.untan.ac.id/index.php/jpdpb/article/view/23908>

Sadiyah, T. L., Faturrohman, M., Leksono, S. M., Ds, Y. N., & Prihamdani, D. (2024). The Effect of Kupin Media to Increase Motivation in IPAS Learning Based on the Merdeka Curriculum at the Elementary School Level. *Jurnal Penelitian Pendidikan IPA*, 10(10), 7415-7419. <https://doi.org/10.29303/jppipa.v10i10.8713>

Sania, R., Yeni, L. F., & Yuniarti, A. (2024). Analisis Kelayakan E-Magazine pada Submateri Peranan Bakteri Kelas X SMA. *Bioscientist : Jurnal Ilmiah Biologi*, 12(1), 1030. <https://doi.org/10.33394/bioscientist.v12i1.11192>

Sari, S. A., & Darwiyah, T. (2017). Innovative mgazine development on petroleum materials for senior high school. *Advances in Social Science, Education and Humanities Research*, 104, 286-291. <https://doi.org/10.2991/aisteel-17.2017.59>

Selviana, A., Warsidah, W., & Prayitno, D. I. (2021). Pengukuran Kadar Astaxanthin dan Aktivitas Antioksidan dalam Fraksi Lipid Cincalok. *Jurnal Laut Khatulistiwa*, 4(2), 64. <https://doi.org/10.26418/lkuntan.v4i2.45263>

Setiarto, R. H. B. (2020). *Teknologi Fermentasi Pangan Tradisional dan Produk Olahannya*. Bogor: Guepedia.

Sugiharto, F. T. (2024). Diversifikasi dan Kandungan Gizi Produk Olahan Hasil Perikanan Laut di Kota Kinabalu, Sabah, Malaysia. *Farmers : Journal of Community Services*, 5(2), 111-116. <https://doi.org/10.24198/fjcs.v5i2.52614>

Sugiyono. (2013). *Statistik untuk penelitian*. Bandung: CV Alfabeta.

Sundari, J. (2015). Pengelolaan Berita Pada Majalah Commagz Dengan Membangun E-Magazine. *Paradigma*, 17(1), 65-67. Retrieved from https://www.academia.edu/74743800/Pengelolaan_Berita_Pada_Majalah_Commagz_Dengan_Membangun_E_Magazine

Suprapto, R. (2020). Analisis visual perancangan huruf berlatar ornamen. *Jurnal Adat: Jurnal Seni, Desain & Budaya Dewan Kesenian Tangerang Selatan*, 2(3), 6-16. Retrieved from <https://jurnaladat.or.id/artikel-35.html>

Susilana, R., & Riyana, C. (2007). *Media Pembelajaran: Hakikat Pengembangan, Pemanfaatan, dan Penilaian*. Bandung: Wacana Prima.

Widiastuti, N. (2019). Berita Viral di Media Sosial Sebagai Sumber Informasi Media Massa Konvensional. *Jurnal Digital Media Dan*

Relationship, 1(1), 23–30.
<https://doi.org/10.51977/jdigital.v1i1.161>

Yulia, E., Situmorang, B., & Pakpahan, B. M. (2024). Feasibility of Engineering Mechanics E-Modules Developed Using the Four-D Model. *Jurnal Penelitian Pendidikan IPA*, 10(7), 3805–3814.
<https://doi.org/10.29303/jppipa.v10i7.7692>