

Feasibility of Electronic Magazine Learning Media on the Subtopic of Abnormalities and Disorders in the Circulatory System for 11th-Grade High School Students

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ABSTRACT The rapid development of information and communication technology has influenced the field of education, which can be utilized in the learning process through the application of technology in learning media usage. Abnormalities and disorders in the circulatory system are complex subtopics involving interconnected organs in the blood circulation process, occurring inside the body and not directly observable. Therefore, it is necessary to use media to visualize these subtopics. One learning media that can be utilized is electronic magazines. This research aims to assess the suitability of electronic magazines as a learning media for abnormalities and disorders in the circulatory system subtopics. The study employs the Research and Development method with five stages: problem identification, data collection, product design, design validation, and design revision. Data analysis utilizes Aiken's V Content-validity Coefficient. The validation results of the electronic magazine learning media for abnormalities and disorders in the circulatory system subtopics, assessed across four criteria—format, content, language, and presentation—yielded a coefficient value of 0.91, indicating very high validity. Therefore, it can be concluded that electronic magazines are suitable for use as a learning media for abnormalities and disorders in the circulatory system subtopics.

Keywords Abnormalities and disorders in the circulatory system subtopics, Electronic magazine, Learning media

1. INTRODUCTION

Currently, information and communication technology is rapidly developing and influencing various aspects of life, including education (Lestari & Wirasty, 2019; Huda, 2020; Ghory & Ghafory, 2021; Rubiantica, Sutomo, & Suhardi, 2021; Salsabila & Agustian, 2021; Akram, Abdelrady, Al-Adwan, & Ramzan, 2022; Wityastuti, Masrofah, Haqqi, & Salsabila, 2022; Kalyani, 2024). In the field of education, the advancement of information and communication technology can be utilized in the learning process to enhance its quality (Lestari & Wirasty, 2019; Ghory & Ghafory, 2021; Kouser & Majid, 2021; Nurfadillah, Azhar, Aini, Apriansyah, & Setiani, 2021; Salsabila & Agustian, 2021; Akram, Abdelrady, Al-Adwan, & Ramzan, 2022). The use of information and communication technology in the learning process can create effective, efficient, and engaging learning experiences (Huda, 2020; Kouser & Majid, 2021; Nurfadillah, Azhar, Aini, Apriansyah, & Setiani, 2021; Akram, Abdelrady, Al-Adwan, & Ramzan,

2022; Wityastuti, Masrofah, Haqqi, & Salsabila, 2022). One utilization of information and communication technology in the learning process is through the use of learning media (Lestari & Wirasty, 2019; Rubiantica, Sutomo, & Suhardi, 2021; Salsabila & Agustian, 2021; Sulistiani et al., 2023).

Learning media refers to everything used to facilitate the delivery of learning materials in the learning process to achieve learning objectives (Hadzami, Nurdiansih, & Sari, 2023; Wulandari, Salsabila, Cahyani, Nurazizah, & Ulfiah, 2023). The use of learning media can visualize abstract learning materials into more concrete forms, making them easier to understand (Abdulrahman et al., 2020; Kustandi, Farhan, Zianadezdha, & Fitri, 2021; Melati et al., 2023). Innovative, engaging, and interactive learning media can stimulate interest, desire, motivation, and stimulation for

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learning (Abdulrahman et al., 2020; Hadzami, Nurdiansih, & Sari, 2023; Wulandari, Salsabila, Cahyani, Nurazizah, & Ulfiah, 2023). The use of learning media is not restricted by space and time, thus it can be used anywhere and anytime (Kustandi, Farhan, Zianadezdha, & Fitri, 2021; Lestari, Yuhanna, & Lukitasari, 2023; Mdhlalose & Mlambo, 2023; Melati et al., 2023; Wang, Chen, Yu, Liu, & Jing, 2024). Furthermore, the use of learning media can create a pleasant, effective, efficient, and meaningful learning atmosphere, thereby achieving learning objectives and improving the quality of learning (Mdhlalose & Mlambo, 2023; Lestari, Yuhanna, & Lukitasari, 2023; Wulandari, Salsabila, Cahyani, Nurazizah, & Ulfiah, 2023; Wang, Chen, Yu, Liu, & Jing, 2024).

Abnormalities and disorders in the circulatory system are subtopics of the circulatory system (Porsche, Tulenan, & Sugiarso, 2019; Ardiansyah & Sumarno, 2021). The circulatory system is a subject in biology that covers the organs comprising the circulatory system, the circulation process, as well as abnormalities and disorders in the circulatory system (Porsche, Tulenan, & Sugiarso, 2019; Ardiansyah & Sumarno, 2021). The circulatory system is a complex topic involving interconnected organs participating in the circulation process, which can lead to abnormalities and disorders (Porsche, Tulenan, & Sugiarso, 2019; Balela, Kaspul, & Arsyad, 2021). The circulatory system, which cannot be directly observed as it occurs inside the body, contributes to the difficulty students face in understanding the topic (Porsche, Tulenan, & Sugiarso, 2019; Ardiansyah & Sumarno, 2021; Balela, Kaspul, & Arsyad, 2021). In the learning process, visualizing the circulatory system through media is essential to facilitate comprehension (Hardiyanti, Mustami, & Mu'nisa, 2020; Ardiansyah & Sumarno, 2021).

One of the learning media that utilizes and applies technology for educational purposes is electronic magazines (Fuad, Karim, & Palennari, 2020; Rohmah, Saputra, & Listyarini, 2020; Munawaroh, Ahmadah, & Purbaningrum, 2021; Gultom, Haryati, & Anwar, 2022; Gusnira & Wikarya, 2022; Handika, Syafii, & Mahadi, 2022; Nuraida, Susanti, & Jailani, 2022; Azhari, Tanjung, & Akhyar, 2023; Septiana & Rohmadi, 2023; Sirih, Arifin, & Idris, 2023). Electronic magazines are digital-based magazines packaged in the form of files or applications that can be accessed online via computers, laptops, and smartphones (Rohmah, Saputra, & Listyarini, 2020; Munawaroh, Ahmadah, & Purbaningrum, 2021; Nuraida, Susanti, & Jailani, 2022; Ananda, Yunianika, Hadianti, & Supratmi, 2023). Electronic magazines can contain learning materials by integrating various elements such as text, graphics, images, photos, audio, video, and animations to facilitate understanding of the learning content (Fuad, Karim, & Palennari, 2020; Munawaroh, Ahmadah, & Purbaningrum, 2021; Alfiah, Edwita, & Supriatna, 2022; Handika, Syafii, & Mahadi, 2022; Nuraida, Susanti, &

Jailani, 2022; Azhari, Tanjung, & Akhyar, 2023; Septiana & Rohmadi, 2023; Sirih, Arifin, & Idris, 2023). Presented in a digital-based format, electronic magazines are designed with full color, varied text, complemented by images, and use simple language to create an engaging and non-boring impression, making them attractive in the learning process (Alfiah, Edwita, & Supriatna, 2022; Gultom, Haryati, & Anwar, 2022; Nuraida, Susanti, & Jailani, 2022). Moreover, electronic magazine learning media is user-friendly as it can be accessed via students' smartphones, laptops, and school computers (Gusnira & Wikarya, 2022; Ananda, Yunianika, Hadianti, & Supratmi, 2023; Septiana & Rohmadi, 2023).

So far, electronic magazine learning media has been widely used in the learning process. Fuad, Karim, & Palennari (2020) stated that the use of electronic magazines in plant growth and development topics, supplemented with images, animations, learning videos, and crossword puzzles, can capture students' attention and enhance their motivation. Electronic magazine learning media for electrolyte and non-electrolyte solution topics are presented symbolically, microscopically, and macroscopically, thus assisting students in understanding the learning material at three representative levels (Jariati & Yenti, 2020). The use of electronic magazine learning media for the circulatory system topic can enhance critical thinking skills through quizzes and Higher Order Thinking Skills (HOTS)-based exercises in assessments (Nuraida, Susanti, & Jailani, 2022). Alfiah, Edwita, & Supriatna (2022) found that electronic magazine learning media based on a scientific approach can facilitate students in understanding the properties of light in mirrors, thereby improving students' learning outcomes. Furthermore, the use of Android-based electronic magazines can also facilitate students in understanding spatial concepts, thereby enhancing their learning outcomes (Kasriana, Ode, & Magfirah, 2023).

Generally, learning media development includes existing learning materials (Panjaitan, Titin, & Wahyuni, 2021). Additionally, learning media development can incorporate relevant research findings related to the learning materials (Panjaitan, Titin, & Wahyuni, 2021; Panjaitan, Maulidya, & Yokhebed, 2022; Kristi, Panjaitan, & Mardiyanningsih, 2023). Some developments in learning media include research findings integrated into the learning materials, such as the development of booklets as learning media equipped with an inventory of medicinal plants (Panjaitan, Titin, & Wahyuni, 2021), booklet development as learning media incorporating research on the benefits and processing of food from the Zuriat palm fruit (*Hyphaene thebaica* (L.) Mart.) (Panjaitan, Maulidya, & Yokhebed, 2022), encyclopedia development as learning media for disease and circulatory system disorders supplemented with an inventory of medicinal plants for hypertension (Kristi, Panjaitan, & Mardiyanningsih, 2023),

pocket book development as learning media for subtopics on breastfeeding and family planning, supplemented with an inventory of lactation-promoting plants (Aprilianti, Panjaitan, Titin, & Lestari, 2024), and booklet development as learning media for subtopics on fertilization, pregnancy, and childbirth, supplemented with an inventory of medicinal plants for postpartum care (Hartika, Panjaitan, & Tenriawaru, 2024).

Based on the discussion regarding the rapid advancement of information and communication technology, the complexity of abnormalities and disorders in the circulatory system subtopic, the numerous advantages of using electronic magazine learning media, and the development of learning media enhanced with research findings, these factors motivated researchers to develop electronic magazine learning media on abnormalities and disorders in the circulatory system subtopics. This development is complemented by testing the anti-hypercholesterolemic activity of noni leaves extract (*Morinda citrifolia* L.).

2. METHOD

This research utilizes the Research and Development (R&D) method as outlined by Sugiyono (2021), albeit not all stages were implemented. The stages conducted in this study up to the fifth stage include potential and problem, data collection, product design, design validation, and design revision (Figure 1). Data collection by doing of testing the anti-hypercholesterolemic properties of noni leaves extract and literature studies on the subtopic of circulatory system disorders, information regarding hypercholesterolemia, and the potential of noni leaves. Based on the results of data collection, product design involves creating electronic magazine learning media on the topic of disorders and disturbances in the circulatory system. The steps for creating electronic magazine learning media refer to Asfuriyah (2014), which include formulating the basic competencies (KD) that must be mastered, gathering materials for electronic magazine learning media, determining evaluation tools, structuring the content of electronic magazine learning media, and organizing the structure of electronic magazine learning media. The creation of electronic magazine learning media on the topic of disorders and disturbances in the circulatory system uses Canva and Fliphtml5 applications. Then, the electronic magazine learning media on disorders and disturbances in the circulatory system was validation by four validators using a validation sheet consisting of 4 evaluation aspects with 10 criteria based on Herman, Tenriawaru, & Candramila (2021) with modifications. The validation sheet for electronic magazine learning media on disorders and disturbances in the circulatory system uses scoring on a Likert scale.

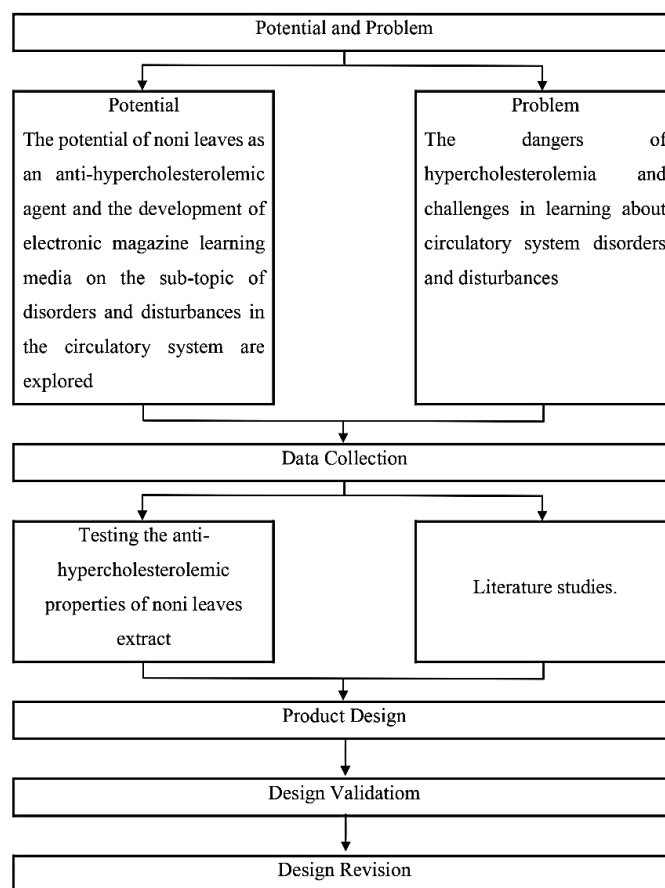


Figure 1 Chart of research methods

The data of validation results of the electronic magazine learning media on disorders and disturbances in the circulatory system will be analyzed utilizing the Content-validity Coefficient method using Aiken's V calculation (referring to Aiken, 1985). The formula for Aiken's V calculation:

$$V = \frac{\sum S}{n(C-1)}$$

Description:

V = validity score

$\sum S$ = r-Lo

r = scores given by validators

Lo = the lowest rating score

n = the number of validators

C = the highest rating score

The results of Aiken's V calculation will be categorized based on the criteria for learning media validity according to Retnawati (2016) Table 1.

Table 1 Criteria for the validity of learning media

Mean Score	Validity Level
$0,8 < V < 1,0$	Very Valid
$0,4 < V < 0,8$	Valid
$0 < V < 0,4$	Less Valid

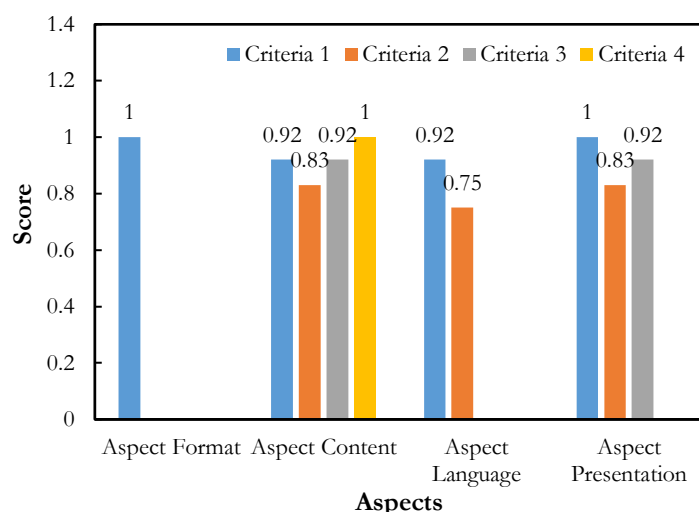


Figure 2 Graph validation results of electronic magazine learning media subtopic of disorders and disorders of the circulatory

3. RESULT AND DISCUSSION

Design validation is a process of assessment aimed at determining the feasibility and validity of a product (Sugiyono, 2021). The product generated in this research is an electronic magazine learning media focusing on disorders and disturbances in the circulatory system. The design validation conducted in this study specifically targets the validation of the electronic magazine learning media on disorders and disturbances in the circulatory system. The validation of this electronic magazine learning media utilizes a validation sheet with four assessment aspects: format, content, language, and presentation. Four validators participated in the validation process. The overall result of the validation for the electronic magazine learning media on disorders and disturbances in the circulatory system yielded a score of 0.91, indicating a very valid category. The detailed validation results can be found in Figure 2 and Table 2.

3.1 Format Aspects

The validation aspect of electronic magazine learning media begins with the format aspect. In this aspect, the sole assessment criterion is the completeness of magazine components. The validation result for electronic magazine

learning media in the format aspect, with the assessment criterion being the completeness of magazine components, obtained a score of 1.00, categorized as very valid. This indicates that the electronic magazine learning media was developed with complete components, including the front cover, editor's note, table of contents, learning objectives and competencies, content pages, evaluation questions, bibliography, and back cover (Figure 3). The content pages of the electronic magazine learning media on the subtopic of abnormalities and disorders of the circulatory system consist of four sections: scientific articles, spotlight section, get learn more section, and bio info section. The *scientific articles* section contains subtopics on abnormalities and disorders of the circulatory system. The *spotlight* section provides information on hypercholesterolemia. The *get learn more* section presents the results of anti-hypercholesterolemia testing of noni leaves extract. The *bio info* section contains information about the potential of noni leaves. This is consistent with Suryani (2015); Herman, Tenriawaru, & Candramila (2021); Gultom, Haryati, & Anwar (2022), who stated that the components of electronic magazine learning media include the front cover, editor's note, table of contents, content pages, and back cover.

Table 2 Validation results of electronic magazine learning media subtopic of disorders and disorders of the circulatory system

Assessment Aspects	No.	Assessment Criteria	Category
Format	1	The completeness of magazine components	Very valid
Content	2	Alignment of presented material with basic competencies and learning objectives	Very valid
	3	Depth of material presented in the magazine	Very valid
	4	The comprehensiveness of material presented in the magazine	Very valid
	5	Availability of references as sources of information in the magazine	Very valid
Language	6	Ease of understanding sentences from the effectiveness, completeness of sentence components, and choice of diction	Very valid
	7	Consistency of grammar in the magazine content with the General Guidelines for Indonesian Spelling (PUEBI)	Valid
Presentation	8	Appeal of displayed images in the magazine	Very valid
	9	Readability of the font used in the magazine	Very valid
	10	Suitability of color combinations on each page of the magazine	Very valid



Figure 3 The completeness of magazine components with the following sections: the front cover (a), editorial team (b), table of contents (c), competencies and learning objectives (d), content pages (e), evaluation questions (f), bibliography (g), and back cover (h)

3.2 Content Aspects

The second validation aspect of electronic magazine learning media is the content aspect. This aspect consists of four assessment criteria: alignment of presented material with basic competencies and learning objectives, depth of presented material, comprehensiveness of presented material in the magazine, and availability of references as sources of information in the magazine. The first assessment criterion in the content aspect, which is alignment of presented material with basic competencies and learning objectives, obtained a score of 0.92, categorized as very valid. This indicates that the subtopic on abnormalities and disorders of the circulatory system presented in the magazine aligns with basic competencies (KD) 3.6 and 4.6, as well as the learning objectives achieved in the subtopic on abnormalities and disorders of the circulatory system, thus enabling the creation of effective, efficient, meaningful, and high-quality learning (Figure 4). Consistent with Panjaitan, Maulidya, & Yokhebed (2022); Sarip, Amintarti, & Utami (2022), it is stated that presenting

material aligned with basic competencies and learning objectives can maximize the learning process.

The second assessment criterion in the content aspect, which is the depth of presented material, obtained a score of 0.83, categorized as very valid. This indicates that the subtopic on abnormalities and disorders of the circulatory system has been presented in depth, as it not only includes learning materials but also incorporates research findings thus enhancing the knowledge and understanding of the students (Figure 5). In line with Panjaitan, Titin, & Wahyuni (2021); Kristi, Panjaitan, & Mardiyanningsih (2023), it is noted that the development of learning media involves not only incorporating existing learning materials but also adding relevant research findings to enhance the learning content.



Figure 4 The alignment of the subtopics on abnormalities and disorders of the circulatory system presented with Basic Competency (KD) 3.6, KD 4.6, and learning objectives

The third assessment criterion in the content aspect, which is the comprehensiveness of presented material, obtained a score of 0.92, categorized as very valid. This indicates that the electronic magazine learning media includes the subtopic on abnormalities and disorders of the circulatory system across various sections: scientific articles, information on hypercholesterolemia in the *spotlight* section, testing of noni leaves extract for anti-hypercholesterolemia in the *get learn more* section, and the potential of noni leaves in the *bio info* section thus facilitating the students' understanding (Figure 6). Consistent with Beatha, Daningsih, & Titin (2018); Nurhuda, Syamswisna, & Tenriawaru (2023), it is stated that magazine content includes several sections such as scientific articles, spotlight sections, get learn more sections, bio info, and scientist profiles.

The fourth assessment criterion in the content aspect, which is the availability of references as sources of information in the magazine, obtained a score of 1.00, categorized as very valid. This indicates that the electronic magazine learning media on the subtopic of abnormalities and disorders of the circulatory system utilizes references as sources of information presented in the bibliography section (Figure 7). Consistent with Herman, Tenriawaru, & Candramila (2021); Sirih, Arifin, & Idris (2023), it is noted that all information presented in electronic magazine learning media includes clear references.

3.3 Language Aspects

The third validation aspect of electronic magazine learning media is the language aspect. This aspect comprises two assessment criteria: ease of understanding sentences from the effectiveness, completeness of sentence components, and choice of diction; and compliance of grammar in the magazine content with the General Guidelines for Indonesian Spelling (PUEBI). The first assessment criterion in the language aspect, which is the



Figure 5 The subtopic on abnormalities and disorders of the circulatory system is presented in-depth, complemented by relevant research findings

ease of understanding sentences from the effectiveness, completeness of sentence components, and choice of diction, obtained a score of 0.92, categorized as very valid. This indicates that the electronic magazine learning media on the subtopic of abnormalities and disorders of the circulatory system uses effective sentences and appropriate diction, making it easy to understand students. Consistent with Panjaitan, Maulidya, & Yokhebed (2022); Handika, Syafii, & Mahadi (2022); Septiana & Rohmadi (2023), it is noted that the use of precise, concise, and clear sentences can facilitate student comprehension. The second assessment criterion in the language aspect, which is the compliance of grammar in the magazine content with the General Guidelines for Indonesian Spelling (PUEBI), obtained a score of 0.75, categorized as valid.

This indicates that the content of the electronic magazine learning media on the subtopic of abnormalities and disorders of the circulatory system uses grammar in accordance with the General Guidelines for Indonesian Spelling (PUEBI) thereby making it easier for learners to understand. Consistent with Herman, Tenriawaru, & Candramila (2021); Panjaitan, Maulidya, & Yokhebed (2022), it is stated that using appropriate language and adhering to established linguistic rules can enhance student understanding.



Figure 6 The electronic magazine learning media, covering the subtopic on abnormalities and disorders of the circulatory system, includes comprehensive materials in its scientific articles (a), hypercholesterolemia information in the spotlight section (b), testing of noni leaves extract for anti-hypercholesterolemia in the get learn more section (c), and information about the potential of noni leaves in the info section (d).

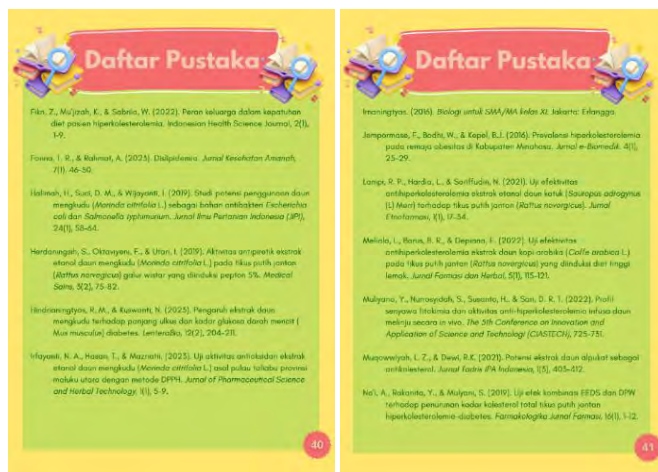


Figure 7 The availability of references in the electronic magazine learning media on the subtopic of abnormalities and disorders of the circulatory system as sources of information included in the bibliography section

3.4 Presentation Aspects

The fourth validation aspect of electronic magazine learning media is the presentation aspect. This aspect consists of three assessment criteria: attractiveness of displayed images in the magazine, readability of the font used in the magazine, and appropriateness of color combinations on each page of the magazine. The first assessment criterion in the presentation aspect, which is the attractiveness of displayed images in the magazine, obtained a score of 1.00, categorized as very valid. This indicates that the electronic magazine learning media on the subtopic of abnormalities and disorders of the circulatory system displays visually appealing images thereby increasing the desire, motivation, and interest in learning among students (Figure 8). In line with Sirih, Arifin, & Idris (2023), it is stated that using images in learning media can enhance interest and reduce boredom

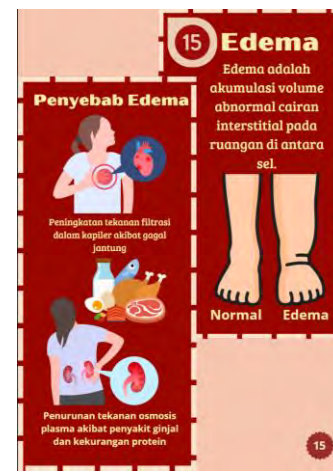


Figure 8 The attractiveness of the images displayed in the electronic magazine learning media on the subtopic of abnormalities and disorders of the circulatory system

during the learning process. Additionally, the appropriate use of images to visualize learning materials can facilitate understanding (Handika, Syafii, & Mahadi, 2022).

The second assessment criterion in the presentation aspect, which is the readability of the font used in the electronic magazine learning media on the subtopic of abnormalities and disorders of the circulatory system, obtained a score of 0.83, categorized as very valid. This indicates that the magazine uses fonts that are clear and easy to read thereby enhancing the desire, motivation, and interest in learning among students, as well as facilitating their understanding (Figure 9). Consistent with Panjaitan, Maulidya, & Yokhebed (2022); Sundari, Suryani, & Kurniasih (2022); Sirih, Arifin, & Idris (2023), appropriate font type and size in learning media ensure clear readability. Additionally, using simple fonts creates a relaxed and engaging reading experience, capturing attention to



Figure 9 The readability of the font in the electronic magazine learning media on the subtopic of abnormalities and disorders of the circulatory system

continue reading (Herman, Tenriawaru, & Candramila, 2021).

The third assessment criterion in the presentation aspect, which is the appropriateness of color combinations on each page of the electronic magazine learning media on the subtopic of abnormalities and disorders of the circulatory system, obtained a score of 0.92, categorized as very valid. This indicates that there are appropriate color combinations on every page of the electronic magazine learning media on the subtopic of abnormalities and disorders of the circulatory system making it more engaging and less tedious, thereby enhancing the interest, desire, and motivation to learn among students (Figure 10). Consistent with Herman, Tenriawaru, & Candramila (2021); Sirih, Arifin, & Idris (2023), it is noted that contrasting color combinations can enhance reader interest.

4. CONCLUSION

The development of electronic magazine learning media for the subtopic of abnormalities and disorders of the circulatory system proceeds through five stages: problem identification, data collection, product design, design validation, and design revision. Validation of the electronic magazine learning media covers four assessment aspects: format, content, language, and presentation. The validation results yield a score of 0.91, classified as very valid, indicating that the electronic magazine is suitable for use as a learning media for the subtopic of abnormalities and disorders of the circulatory system. The electronic magazine as a learning medium on the subtopic of abnormalities and disorders of the circulatory system contains complete components, including the front cover, editorial team, table of contents, competency standards and learning objectives, content pages, evaluation questions, bibliography, and back cover. The learning media in the electronic magazine features subtopics related to abnormalities and disorders of the circulatory system that



Figure 10 The suitability of color combinations on each page of the electronic magazine learning media on the subtopic of abnormalities and disorders of the circulatory system

align with the basic competencies and learning objectives, supplemented by information on hypercholesterolemia, research findings regarding the antihypercholesterolemic effects of noni leaf extract, and the potential of noni leaves. The learning media of the electronic magazine for the subtopic of abnormalities and disorders of the circulatory system utilizes accessible language for better comprehension and is presented with an appealing layout.

REFERENCES

- Abdulrahman, M. D., Faruk, N., Oloyede, A. A., Surajudeen-Bakinde, N. T., Olawoyin, L. A., Mejabi, O. V., Imam-Fulani, Y. O., Fahm, A. O., & Azeez, A. L. (2020). Multimedia tools in the teaching and learning processes: A systematic review. *Heliyon*, 6(11), e05312. <https://doi.org/10.1016/j.heliyon.2020.e05312>
- Akram, H., Abdelrady, A. H., Al-Adwan, A. S., & Ramzan, M. (2022). Teachers' perceptions of technology integration in teaching-learning practices: A systematic review. *Frontiers in Psychology*, 13, Article 920317. <https://doi.org/10.3389/fpsyg.2022.920317>
- Alfiah, P. N., Edwita, & Supriatna, A. R. (2022). Pengembangan media pembelajaran e-magazine berbasis pendekatan saintifik pada pembelajaran IPA materi sifat-sifat cahaya kelas IV SD [Development of e-magazine learning media based on a scientific approach to science learning on the properties of light for grade IV elementary school students]. *Efektor*, 9(2), 230–241. <https://doi.org/10.29407/e.v9i2.17067>
- Ananda, R., Yunianika, I. T., Hadiani, S., & Supratni, N. (2023). Pemanfaatan platform penerbitan digital Issuu: Media publikasi majalah digital [Utilizing the Issuu digital publishing platform: Digital magazine publication media]. *I-Com: Indonesian Community Journal*, 3(2), 609–617. <https://doi.org/10.33379/icom.v3i2.2576>
- Aprilianti, M., Panjaitan, R. G. P., Titin, & Lestari, L. A. (2024). Feasibility of a pocket book on breast milk and family planning sub-materials based on an inventory of plants that facilitate breast milk. *Jurnal Pendidikan Sains Indonesia*, 12(1), 95–110. <https://doi.org/10.24815/jpsi.v12i1.34407>
- Ardiansyah, R. F., & Sumarno, A. (2021). Pengembangan multimedia interaktif materi sistem sirkulasi mata pelajaran biologi kelas XI [Development of interactive multimedia for circulatory system material for class XI biology subjects]. *Jurnal Mahasiswa Teknologi Pendidikan*, 1(17), 1–11.
- Asfuriyah, S. (2014). Pengembangan majalah sains berbasis contextual learning sebagai media pembelajaran IPA tema pemanasan global

- untuk SMP [Development of a science magazine based on contextual learning as a science learning media on the theme of global warming for junior high schools.]. *[Skripsi]*. Universitas Negeri Semarang.
- Azhari, N. S., Tanjung, I. F., & Akhyar, S. (2023). Pengembangan e-magazine pada materi sistem ekskresi terintegrasi nilai keislaman [Development of e-magazine on excretion system material integrated with Islamic values]. *Jurnal Binomial*, 6(2), 185–200. <https://doi.org/10.46918/bn.v6i2.1963>
- Balela, G. S. A., Kaspul, & Arsyad, M. (2021). Kepraktisan lembar kerja peserta didik konsep sistem peredaran darah biologi SMA berbasis keterampilan berpikir kritis [The practicality of student worksheets on high school biology blood circulation system concepts based on critical thinking skills]. *Jurnal Studi Guru Dan Pembelajaran*, 4(1), 180–188. <https://doi.org/10.30605/jsgp.4.1.2021.556>
- Beatha, Y. A., Daningsih, E., & Titin. (2018). Kelayakan majalah materi keanekaragaman hayati dari buah baladok jempari dan titidan [Feasibility of biodiversity material magazine from baladok, jempari, and titidan fruits]. *Jurnal Pendidikan Dan Pembelajaran Khatulistiwa*, 7(12), 1–8.
- Fuad, A., Karim, H., & Palennari, M. (2020). Pengembangan media pembelajaran e-magazine sebagai sumber belajar biologi siswa kelas XII [Development of e-magazine learning media as a biology learning resource for grade XII students]. *Biology Teaching and Learning*, 3(1), 38–45. <https://doi.org/10.35580/btl.v3i1.14298>
- Ghory, S., & Ghafory, H. (2021). The impact of modern technology in the teaching and learning process. *International Journal of Innovative Research and Scientific Studies*, 4(3), 168–173. <https://doi.org/10.53894/ijirss.v4i3.73>
- Gultom, F. K., Haryati, S., & Anwar, L. (2022). Pengembangan majalah kimia elektronik e-chemagz menggunakan flip pdf professional pada materi ikatan kimia [Development of e-chemistry electronic magazine e-chemagz using flip pdf professional on chemical bonding material]. *Jurnal Pendidikan Kimia Universitas Riau*, 7(2), 74–87. <https://doi.org/10.33578/jpk-unri.v7i2.7822>
- Gusnira, R. H., & Wikarya, Y. (2022). Pengembangan media pembelajaran majalah digital berbasis web blog pada materi seni rupa dua dimensi kelas X SMA Negeri 3 Painan [Development of digital magazine learning media based on web blogs on two-dimensional art material for class X of SMA Negeri 3 Painan]. *Serupa The Journal of Art Education*, 11(3), 254–262. <https://doi.org/10.24036/stjce.v11i3.118257>
- Hadzami, H. H., Nurdiansih, I. W., & Sari, I. J. (2023). Analisis kebutuhan siswa terhadap pengembangan media pembelajaran digital keanekaragaman hayati untuk meningkatkan literasi lingkungan [Analysis of students' needs for developing digital learning media on biodiversity to enhance environmental literacy]. *Jurnal Biologi Edukasi*, 15(1), 72–78. <https://doi.org/10.24815/jbe.v15i1.31060>
- Handika, R., Syafii, W., & Mahadi, I. (2022). Pengembangan majalah elektronik biologi berbasis multimedia pada materi plantae kelas X SMA/MA [Development of multimedia-based electronic biology magazines for Plantae material in grade X of high school/MA]. *Bio-Lectura: Jurnal Pendidikan Biologi*, 9(2), 198–205. <https://doi.org/10.31849/bl.v9i2.11430>
- Hardiyanti, S., Mustami, M. K., & Mu'nisa, A. (2020). Pengembangan game puzzle berbasis construct 2 sebagai media pembelajaran sistem peredaran darah kelas XI di SMA Negeri 1 Selayar [Development of Construct 2-based puzzle games as learning media for the circulatory system in grade XI at SMA Negeri 1 Selayar]. *Biolearning Journal*, 7(1), 6–11. <https://doi.org/10.36232/jurnalbiolearning.v7i1.503>
- Hartika, W., Panjaitan, R. G. P., & Tenriawaru, A. B. (2024). Human pregnancy and birth: The enrichment of a booklet with medicinal plants for postpartum wellness. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 10(1), 265–272. <https://doi.org/10.22219/jpbi.v10i1.30027>
- Herman, M. A. B., Tenriawaru, A. B., & Candramila, W. (2021). Penyajian konsep metode ilmiah dalam pengembangan majalah elektronik sebagai media pembelajaran kelas X SMA [Presentation of the scientific method concept in the development of electronic magazines as learning media for grade X high school]. *Bioma: Jurnal Biologi Dan Pembelajaran Biologi*, 6(2), 160–173. <https://doi.org/10.32528/bioma.v6i2.5600>
- Huda, I. A. (2020). Perkembangan teknologi informasi dan komunikasi (TIK) terhadap kualitas pembelajaran di sekolah dasar [The development of information and communication technology (ICT) on the quality of learning in elementary schools]. *Jurnal Pendidikan Dan Konseling*, 2(1), 121–125.
- Jariati, E., & Yenti, E. (2020). Pengembangan e-magazine berbasis multipel representasi untuk pembelajaran kimia di SMA pada materi larutan elektrolit dan non elektrolit [Development of e-magazine based on multiple representations for chemistry learning in high school on electrolyte and non-electrolyte solution material]. *Journal of Natural Science and Integration*, 3(2), 138–150. <https://doi.org/10.24014/jnsi.v3i2.10131>
- Kalyani, L. K. (2024). The role of technology in education: Enhancing learning outcomes and 21st century skills. *International Journal of Scientific Research in Modern Science and Technology*, 3(4), 5–10. <https://doi.org/10.59828/ijrmst.v3i4.199>
- Kasriana, Ode, R., & Magfirah, I. (2023). Penggunaan sumber belajar majalah elektronik (e-magazine) berbasis android materi ajar bangun ruang untuk meningkatkan hasil belajar peserta didik [The use of Android-based electronic magazine (e-magazine) learning resources for spatial geometry teaching materials to improve student learning outcomes]. *Jurnal Review Pendidikan dan Pengajaran*, 6(4), 605–611.
- Kouser, S., & Majid, I. (2021). Technological tools for enhancing teaching and learning process. *Towards Excellence*, 13(1), 366–373. <https://doi.org/10.37867/te130133>
- Kristi, Y., Panjaitan, R. G. P., & Mardiyanningsih, A. N. (2023). The eligibility of the encyclopedia of circulatory system diseases and disorders based on traditional medicinal plants for hypertension as learning media. *JUPI (Jurnal IPA dan Pembelajaran IPA)*, 7(3), 234–246. <https://doi.org/10.24815/jupi.v7i3.32300>
- Kustandi, C., Farhan, M., Zianadezdha, A., & Fitri, A. K. (2021). Pemanfaatan media visual dalam tercapainya tujuan pembelajaran [Utilization of visual media in achieving learning objectives]. *Akademika: Jurnal Teknologi Pendidikan*, 10(2), 291–299. <https://doi.org/10.34005/akademika.v10i02.1402>
- Lestari, D. W., Yuhanna, W. I., & Lukitasari, M. (2023). Pengembangan media bio pop-up book terintegrasi science, environment, technology, and society (SETS) pada pembelajaran biologi materi daur biogeokimia [Development of integrated bio pop-up book media for science, environment, technology, and society (SETS) in biology learning on biogeochemical cycle material]. *Jurnal Edukasi Matematika dan Sains*, 8(2), 130–139.
- Lestari, N., & Wirasty, R. (2019). Pemanfaatan multimedia dalam media pembelajaran interaktif untuk meningkatkan minat belajar siswa [Utilization of multimedia in interactive learning media to increase students' interest in learning]. *Amaliyah: Jurnal Pengabdian kepada Masyarakat*, 3(2), 349–353. <https://doi.org/10.32696/ajpkm.v3i2.289>
- Mdhlalose, D., & Mlambo, G. (2023). Integration of technology in education and its impact on learning and teaching. *Asian Journal of Education and Social Studies*, 47(2), 54–63. <https://doi.org/10.9734/ajess/2023/v47i21021>
- Melati, E., Fayola, A. D., Hita, I. P. A. D., Saputra, A. M. A., Zamzami, & Ninasari, A. (2023). Pemanfaatan animasi sebagai media pembelajaran berbasis teknologi untuk meningkatkan motivasi belajar [Utilization of animation as a technology-based learning medium to increase learning motivation]. *Journal on Education*, 6(1), 732–741. <https://doi.org/10.31004/joe.v6i1.2988>
- Munawaroh, S., Ahmadah, I. F., & Purbaningrum, M. (2021). E-magmath berbasis flipbook pada materi himpunan di kelas VII

- SMP/MTs [E-flipbook-based magmath on set material in class VII SMP/MTs]. *JPMI-Jurnal Pembelajaran Matematika Inovatif*, 4(1), 45–54. <https://doi.org/10.22460/jpmi.v4i1.45-54>
- Nuraida, N., Susanti, T., & Jailani, M. S. (2022). Desain e-magazine pada mata pelajaran biologi bermuatan high order thinking skill (HOTS) untuk siswa SMA/MA [E-magazine design on biology subjects containing high order thinking skills (HOTS) for high school students]. *Jurnal Biotek*, 10(1), 83–101. <https://doi.org/10.24252/jb.v10i1.26052>
- Nurfadillah, S., Azhar, C. R., Aini, D. N., Apriansyah, F., & Setiani, R. (2021). Pengembangan media pembelajaran berbasis teknologi untuk meningkatkan hasil belajar siswa SD Negeri Pinang 1 [Development of technology-based learning media to improve learning outcomes of students at Pinang 1 Elementary School]. *BINTANG: Jurnal Pendidikan dan Sains*, 3(1), 153–163. <https://ejournal.stitpn.ac.id/index.php/bintang>
- Nurhuda, Syamswisna, & Tenriawaru, A. B. (2023). Kelayakan majalah sebagai bahan pengayaan pada submateri keanekaragaman gen, jenis, ekosistem kelas X SMA [The suitability of magazines as enrichment materials for the sub-material on genetic, species and ecosystem diversity for class X SMA]. *Jurnal Pendidikan dan Pembelajaran Katulistiwa*, 12(7), 1779–1787.
- Panjaitan, R. G. P., Maulidya, A., & Yokhebed. (2022). Kelayakan media flash flipbook pada submateri darah [Feasibility of flash flipbook media on blood submaterials]. *Jurnal Pendidikan Informatika dan Sains*, 11(2), 77–87. <https://doi.org/10.31571/saintek.v11i2.2643>
- Panjaitan, R. G. P., Titin, & Wahyuni, E. S. (2021). Kelayakan booklet inventarisasi tumbuhan berkhasiat obat sebagai media pembelajaran [The suitability of the medicinal plant inventory booklet as a learning medium]. *Jurnal Pendidikan Sains Indonesia*, 9(1), 11–21. <https://doi.org/10.24815/jpsi.v9i1.17966>
- Porsche, D., Tulenan, V., & Sugiarso, B. A. (2019). Aplikasi pembelajaran interaktif sistem peredaran darah manusia untuk kelas 5 Sekolah Dasar [Interactive learning application of the human circulatory system for grade 5 of elementary school]. *Jurnal Teknik Informatika*, 14(2), 173–183.
- Retnawati, H. (2016). Proving content validity of self-regulated learning scale (the comparison of aiken index and expanded gregory index). *REiD: Research and Evaluation in Education*, 2(2), 155–164.
- Rohmah, A., Saputra, H. J., & Listyarini, I. (2020). Pengembangan e-magazine berbasis android dalam pembelajaran kelas V Sekolah Dasar [Development of Android-based e-magazine in learning for grade V of elementary school]. *Elementary School*, 7(2), 290–296.
- Rubiantica, R., Sutomo, M., & Suhardi, A. A. (2021). Media pembelajaran interaktif lectora inspire sebagai inovasi pembelajaran [Lectora Inspire interactive learning media as a learning innovation]. *PESAT: Jurnal Pendidikan, Sosial, Agama*, 7(3), 98–104.
- Salsabila, U. H., & Agustian, N. (2021). Peran teknologi pendidikan dalam pembelajaran [The role of educational technology in learning]. *Islamika: Jurnal Keislaman dan Ilmu Pendidikan*, 3(1), 123–133. <https://doi.org/10.36088/islamika.v3i1.1047>
- Sarip, M., Amintarti, S., & Utami, N. H. (2022). Validitas dan keterbacaan media ajar e-booklet untuk siswa SMA/MA materi keanekaragaman hayati [Validity and readability of e-booklet teaching media for high school students on biodiversity material]. *JUPEIS: Jurnal Pendidikan dan Ilmu Sosial*, 1(1), 43–59. <https://doi.org/10.57218/jupeis.vol1.iss1.30>
- Septiana, N., & Rohmadi, M. (2023). Pengembangan majalah fisika pada materi usaha dan energi terintegrasi Islam [Development of physics magazine on integrated Islamic business and energy material]. *JIPFRI (Jurnal Inovasi Pendidikan Fisika dan Riset Ilmiah)*, 7(2), 93–105. <https://doi.org/10.30599/jipfri.v7i2.1207>
- Sirih, M., Arifin, K., & Idris, D. R. I. M. (2023). Pengembangan e-biomagazine filum arthropoda di hutan pendidikan Tatangge kawasan Taman Nasional Rawa Aopa Watumohai [Development of an e-biomagazine of the arthropod phylum in the Tatangge educational forest in the Rawa Aopa Watumohai National Park area]. *AMPIBI: Jurnal Alumni Pendidikan Biologi*, 8(1), 68–76. <http://dx.doi.org/10.36709/ampibi.v8i1.14>
- Sugiyono. (2021). *Metode penelitian kuantitatif, kualitatif, dan R&D [Quantitative, qualitative, and R&D research methods]*. Bandung: Alfabeta.
- Sulistiani, H., Isnain, A. R., Rahmanto, Y., Saputra, V. H., Lovika, P., Febriansyah, R., & Chandra, A. (2023). Workshop teknologi metaverse sebagai media pembelajaran [Metaverse technology workshop as a learning medium]. *Journal of Social Sciences and Technology for Community Service (JSSTCS)*, 4(1), 74–79. <https://ejournal.teknokrat.ac.id/index.php/JSSTCS/article/view/2642>
- Sundari, S. N., Suryani, D. I., & Kurniasih, S. (2022). Uji efisiensi e-magscience berbasis flip pdf professional tema makanan dan kesehatanku untuk menumbuhkan kemampuan berpikir kritis siswa SMP [Efficiency test of e-magscience based on flip pdf professional theme of my food and health to develop critical thinking skills of junior high school students]. *PENDIPA Journal of Science Education*, 6(3), 664–673. <https://doi.org/10.33369/pendipa.6.3.664-673>
- Suryani, I. F. (2015). Pengembangan majalah biore (biologi reproduksi) submateri kelainan dan penyakit pada sistem reproduksi sebagai sumber belajar mandiri siswa SMA/MA [Development of the Biore (reproductive biology) magazine with sub-material on disorders and diseases of the reproductive system as a source of independent learning for high school students]. [Skripsi]. UIN Sunan Kalijaga Yogyakarta.
- Wang, C., Chen, X., Yu, T., Liu, Y., & Jing, Y. (2024). Education reform and change driven by digital technology: A bibliometric study from a global perspective. *Humanities and Social Sciences Communications*, 11(256), 17. <https://doi.org/10.1057/s41599-024-02717-y>
- Wityastuti, E. Z., Masrofah, S., Haqqi, T. A. F., & Salsabila, U. H. (2022). Implementasi penggunaan media pembelajaran digital di masa pandemi COVID-19 [Implementation of the use of digital learning media during the COVID-19 pandemic]. *Jurnal Penelitian Inovatif (JUPIN)*, 2(1), 39–46. <https://doi.org/10.54082/jupin.39>
- Wulandari, A. P., Salsabila, A. A., Cahyani, K., Nurazizah, T. S., & Ulfiah, Z. (2023). Pentingnya media pembelajaran dalam proses belajar mengajar [The importance of learning media in the teaching and learning process]. *Journal on Education*, 5(2), 3928–3936. <https://doi.org/10.31004/joe.v5i2.1074>