RESEARCH ARTICLE

Development of contextual e-magazine on circulatory system material for eleventh graders

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Abstract: Electronic teaching materials have an important role in improving the quality of learning, making learning more interactive, and making the learning process more flexible and productive. The development of the increasingly sophisticated era, technology, information, and communication have also developed and have an impact on learning media, initially educators used print media as a tool in the learning process, then educators combined technological developments with learning media, so that electronic learning media were created, one of which was electronic teaching materials in the form of e-magazines. This study aims to produce contextual e-magazine learning media for circulatory system material for class XI high school students that are valid and practical. The method in this study is to use the Plomp model development method. The development stage of this model begins with the initial investigation stage (preliminary research), the development or prototyping phase, and the assessment phase. The instruments used in this study were validity and practicality assessment sheets. Based on the results and discussions conducted, it was concluded that the contextual e-magazine based on circulatory system material for grade XI high school students developed in this study has achieved a validation value of 97.27% with very valid criteria and a practicality value of 96.64% with very practical criteria so that it is suitable for use as a biology teaching material for grade XI high school students.

Keywords: circulation system; contextual approach; e-magazine

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Introduction

Information and communication technology has advantages such as speed in obtaining information, facilitating human work and trying to reduce paper use in daily activities, thus requiring technological developments (Ozdamar-Keskin et al., 2020). The development of technology has had a major influence on the learning process over the past decade. The learning process has become easier, especially in accessing learning materials. Students and educators can access materials online through various digital platforms including electronic-based media (Akhsan et al., 2023).

Electronic-based media has a positive impact because of the various advantages it has. Electronic-based media is able to create a variety of material content that can be accessed easily, attractively and interactively. Interactive media is needed in learning, especially to visualize biology learning materials with abstract concepts (Camilla Masyita & Yusi Risnani, 2023). Learning means a series of activities involving information and the environment that are arranged in a planned manner (Nur'Aini, 2022). The environment in question is not only a place where learning takes place, but also includes learning materials, methods, media, and equipment needed to convey information (Junaidi, 2019). In this process, information is recalled which is then stored in memory and knowledge skills, then these skills are realized practically in the activeness of students. One of the learning activities related to students is biology (Burhan & Siregar, 2020).

Abstract concepts in biology learning require interactive media in a need. In line with this (Chaniago et al., 2023) states that interactive media is needed to explain abstract concepts in biology learning. In

reality, this is not in accordance with what happens in the field. There are still many biology educators who have not used interactive media in classroom learning (Astuti et al., 2020). Classroom learning should be able to support humans in global competition, namely with education that develops the potential of students. According to Cahyono, (2014), this development does not only lie in academic abilities, but also in the development of other skills.

In future biology learning, biology materials that are currently considered difficult by some students through the ease of use and sophistication of digital technology allow the use of interesting and multisensory representations so that it will help students imagine concepts that are considered abstract. The use of digital text, microcamera, videoblogs, and online learning methods will color future biology learning (Hikmawati & Taufik, 2017). The results of observations show that students choose the circulatory system material as material that is difficult to understand. The circulatory system material is considered difficult by students because the organs and processes that occur cannot be observed directly. The media commonly used by educators during learning are less able to explain the material. Abstract material on the circulatory system cannot be conveyed optimally if using conventional media such as printed books and modules. This abstract material can be visualized well if using interactive media (Mardiah & Yogica, 2023).

Interactive learning media has an important role in the sustainability of the teaching and learning process. The optimal use of learning media can make it easier for students to understand the subject matter. However, not all learning media can be used as the right solution to make the learning process effective. Therefore, an educator is required to be more creative in developing learning media, and more selective in choosing learning media (Susilo, 2015). Hartato & Saputri, (2024) One of the learning media is electronic teaching materials, the use of electronic teaching materials has an important role in improving the quality of learning, more interactive learning, and the learning process becomes flexible and productive. The development of science and technology has caused educators to switch from using printed teaching materials to electronic teaching materials, one of which is e-magazines (Hartato & Saputri, 2024).

E-Magazines or electronic magazines can be accessed by students via electronic media such as laptops, computers, smartphones, or other technologies so that students can learn online. The advantages of learning using electronic media according to (Handika et al., 2022). The advantages of e-magazines that will be developed are that they can be read anywhere and anytime because students only need to access them via laptops, smartphones, and other technologies they have (Ananda et al., 2023). E-Magazines have an attractive and colorful appearance. Magazines are well-known and widely circulated among students, but their form only displays a product and information about artists and developments in science and technology (Dani et al., 2017).

E-magazines or electronic magazines are learning resources that contain learning materials that are presented in an attractive manner with various supporting features such as images, videos, and audio (Fahaludin, 2014). According to Herman et al., (2021) electronic magazines are said to be interactive media because they are considered capable of facilitating two-way communication between users and the media. The advantages of electronic magazines are that they are easy to use, can be used anywhere and anytime, and can provide new learning experiences for students (Srikandi et al., 2019).

Dewi & Warso, (2014) as a learning media, biology e-magazines can support students' understanding of the material presented by educators and provide an interesting learning atmosphere. The design of e-magazine teaching materials makes learning more guided, supports students' understanding of the material presented, provides an interesting learning atmosphere and students can relate learning to everyday life (contextual) (Trissa et al., 2022).

The contextual approach (Contextual Teaching and Learning/CTL) is a learning approach that emphasizes the full involvement of students to be able to find the concepts learned and relate them to real-life situations in the classroom (Sudarisman, 2013) and encourages students to make connections between the knowledge they have with applications in their lives as family members and society (Sepriady, 2018). CTL is the linking of learning materials to the context of students' daily lives (personal, social and cultural contexts) so that students have knowledge/skills that can be flexibly applied from one problem/context to another problem/context (Sitepu et al., 2023). The contextual approach will be more effective in learning if combined with media that can attract students' motivation and interest in learning (Fitri et al., 2014).

Lack of connecting learning concepts with everyday life (contextual), makes it difficult for students to understand learning materials, and biology teaching materials such as narratives, difficult to understand language, and less attractive appearance (Rahmawati et al., 2024). Contextual learning can help educators in linking the material taught with real-world situations known to students and can encourage students to make connections between the knowledge they have and its application in their daily lives (Fuadi et al., 2013). Based on the background, the researcher is interested in developing a product and the researcher conducted a study entitled Development of a contextual-based e-magazine on circulatory system material for grade XI high school students.

Method

This type of research is research and development, which aims to produce a valid, practical, and effective contextual-based e-magazine. However, this article only contains the validity and practicality stages. The development model used in this study is the Plomp model. This model consists of three stages, namely the initial investigation stage, the development or prototype stage, and the assessment stage (Plomp., & Nieveen, 2013).
The validity analysis of contextual-based e-magazines is data that has been validated in advance by experts or experts and the practicality analysis obtained from sheets filled in by educators and students which are analyzed using descriptive statistics with the following stages. Giving answer scores with four alternative answers arranged according to a modified Likert scale from (Riduwan, 2012) to 4 = strongly agree (SS), 3 = agree (S), 2 = disagree (TS) and 1 = strongly disagree (STS).
Determine the highest score by looking at the highest score = number of validators x number of indicators x maximum score. Then determine the total score of each validator by adding up all the scores obtained from each indicator. Then determine the score obtained by adding up the scores from each validator. Determine the validation value by: Validation Value = (Total highest score) / (Total of all scores) X 100%. Then provide validity and practicality with the criteria from (Riduwan, 2012) which have been modified according to the following assessment (Table 1 and Table 2). Based on the validity and practicality assessment criteria in the table. It is known that the development product is declared valid and practical if it obtains a score of ≥ 61%.

Table 1. Validity Assessment Criteria

Percentage (%)	Category
81 - 100	Very valid
61 - 80	Valid
41 - 60	Quite valid
21 - 40	Less valid
0 - 20	Not valid

Table 2. Practicality Assessment Criteria

Percentage (%)	Category
81 - 100	Very practical
61 - 80	Practical
41 - 60	Quite practical
21 - 40	Less practical
0 - 20	Not practical

Results and Discussion

Preliminary Research Phase

This stage aims to analyze the problems and needs of schools, educators, students and see how the description of the learning media products developed. This initial investigation stage is carried out through several stages, namely analyzing problems, analyzing needs, analyzing curriculum, analyzing concepts, and analyzing students. The following is a description of the results of the analysis.
Problem and needs analysis, this study analyzes the problems and needs in biology learning at senior high school's state 3 Padang, which was chosen as the focus of the study because it has more complex problems than the other two schools, namely low collaborative skills and digital literacy at the same time. In addition, the most difficult material for students to understand is the circulatory system, due to the complexity of its sequence and type. Therefore, more interactive and relevant learning media are needed to improve students' understanding.
Curriculum analysis aims to be a guideline in compiling a contextual-based e-magazine. This curriculum analysis is carried out in order to see the reference for biology learning activities in schools and to find out the reference for learning outcomes that must be achieved by students. This curriculum analysis is carried out by reading and understanding the learning outcomes of the circulatory system material to formulate indicators of competency achievement that must be achieved by students and determine learning objectives.
Concept analysis aims to find out the concepts or materials presented in the circulatory system material. The results of this concept analysis are used as the basis for designing a contextual-based E-Magazine in accordance with learning achievements and learning objectives. The concepts that will be presented

in the contextual-based e-magazine on the circulatory system material are the heart, blood vessels, blood circulation, blood components, circulatory system disorders, and technology in the circulatory system.

Student analysis, the purpose is to determine the characteristics of the students. The results of this analysis are used as considerations for designing a contextual-based e-magazine that is developed. The subjects observed were students of class XI Phase F of senior high school state 3 Padang, which obtained a picture that students like and need teaching materials that are accompanied by pictures and contain additional materials related to everyday life. Based on these characteristics, an e-magazine is designed that can facilitate students in the contextual-based learning process of the circulatory system material.

Development or Prototyping Phase.

The results obtained in the preliminary research phase will be used as a guideline in developing a contextual-based e-magazine on the circulation system material. The results of the development or creation of the prototype carried out at this stage.

Prototype I Development Results

The results obtained in the initial investigation stage are used as guidelines in developing contextual-based e-magazines on the circulation system material. In prototype I, a contextual-based e-magazine storyboard was designed. At this stage, it begins with designing the systematics of the e-magazine, such as the cover, e-magazine operating guide, e-magazine usage instructions, learning outcomes and learning objectives, table of contents, list of images, introduction, circulation system material, components of the contextual approach contained in the e-magazine, practical activities, collection of learning videos, bibliography, and e-magazine author profiles.

The cover display presented is expected to be able to represent or show the characteristics that are to be highlighted, namely the circulation system, and the ornaments on the e-magazine cover are not too crowded so that anyone who sees it will be interested in reading the e-magazine that is made. The cover is made with 2 types of presentation, where the first cover only contains the title of the material in the e-magazine and the author's name, on the second cover the components that will be included in the e-magazine are described which contain the identity of the e-magazine consisting of a large title, namely the circulation system material, in addition to the image that represents the circulation system, the author's identity is also included, things that will be discussed in the e-magazine, and contextual components in the e-magazine (Figure 1).

Figure 1. Cover

This e-magazine operating guide aims to make it easier for readers to understand and use the available features using a professional PDF flipbook. The purpose of this guide is to provide easy access, improve user experience, reduce errors in use and increase user efficiency and satisfaction when reading e-magazines. This e-magazine operating guide is equipped with how to use the buttons and icons that exist when opening the e-magazine after the front cover or e-magazine cover and shows the e-magazine section when read in PC (Personal Computer) form, and in Smartphone form (Figure 2).

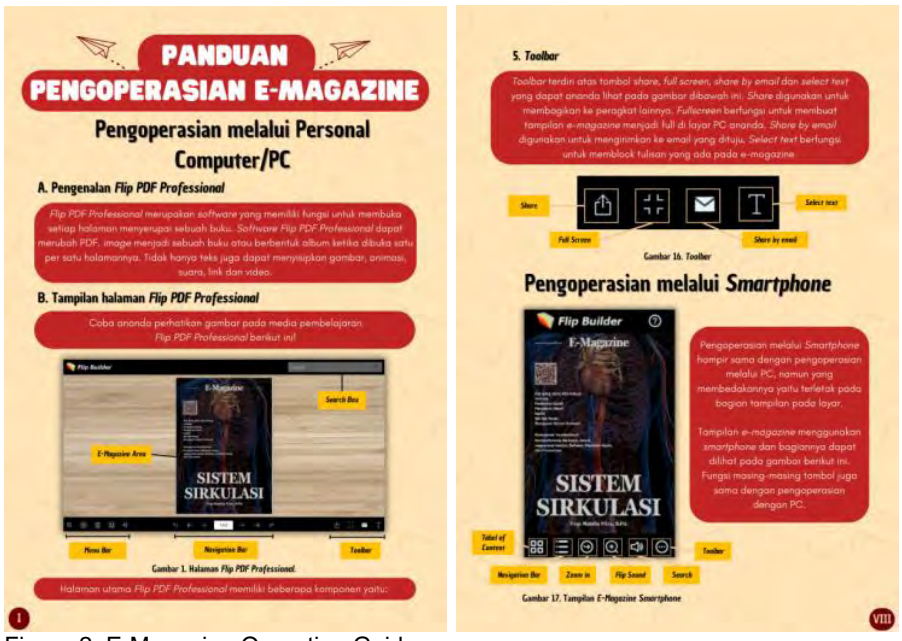

Figure 2. E-Magazine Operation Guide

Instructions for using e-magazine consist of instructions for educators and instructions for students. Instructions for using e-magazine are intended to make it easier for educators and students to understand the flow of the learning process. Instructions for educators are made to guide students in understanding the contents of the learning material and guide students in working on each instruction contained in the e-magazine. Instructions for students are made to understand the achievements and objectives of learning using e-magazine. If students experience difficulties during the learning process, students can ask for help from their deskmates or ask the educator directly regarding the matter in question (Figure 3).

Figure 3. E-Magazine Usage Instructions

Learning outcomes are created with the aim of making it easier for educators to determine the parts that will be taught to students in learning, providing long-term learning direction, and ensuring the sustainability of learning. Learning objectives are designed to adjust effective time in learning with a shorter time. These learning objectives are expected to focus daily learning, measure the success of learning that will be implemented, and help educators in designing learning activities so that students do not feel monotonous about the learning that will be implemented (Figure 4).

Figure 4. Learning Outcomes and Learning Objectives

The table of contents is made with the aim of making it easier for readers to see the sections of the learning material. The table of contents is made with an attractive appearance by adding images related to the material contained in the e-magazine so that it is not plain and uses HD (High Definition) images. The table of contents further explains what components are presented in the e-magazine (Figure 5).

Figure 5. List of contents

The image list section is made almost the same function as the table of contents, where the image list is made with a minimalist appearance and with a more attractive appearance with the addition of images related to the material contained in the e-magazine. In the image list, the description of all image elements in the e-magazine is more detailed and there are no dots or dashes between the description and the page number, this aims to make the page look less crowded and not make readers lazy to read any images contained in the e-magazine (Figure 6).

Figure 6. List of Figures

The introduction, the layout of the image is made very large so that it becomes a background so that the introduction looks better and for this introduction, two pages are made. The images used as backgrounds are adjusted and connected to each other so as to add a modern impression. The introduction serves to make it easier for readers to understand the context and prepare themselves to study the contents of the e-magazine to be more effective because it provides an overview and provides a framework for thinking and can connect initial knowledge. The numbering in this introduction is removed because it interferes with the aesthetics of the page (Figure 7).

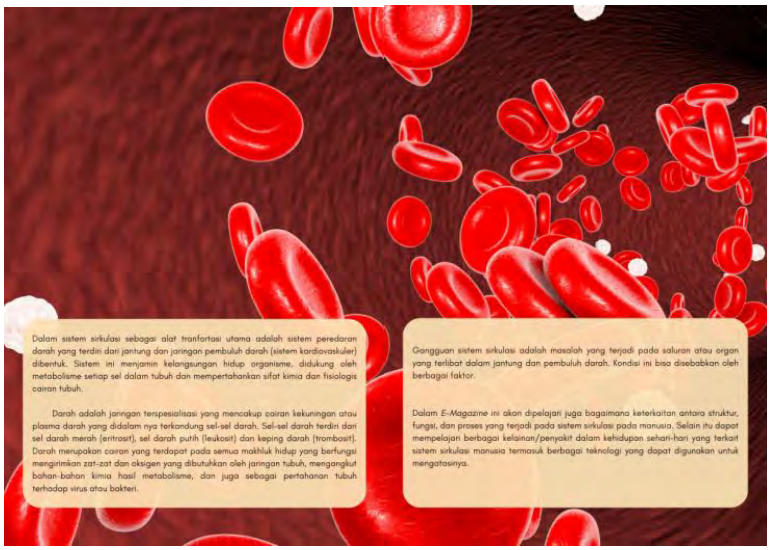

Figure 7. Introduction

In the material section, the explanation of the sections is more minimized and more clarified, because the concept of making this e-magazine is the delivery of information by following a flow that has been designed to support an optimal learning process, relevant to students, and able to achieve learning objectives. The material must also be relevant to the contextual component because it must meet clear and coherent objectives, systematic, structured, accommodate various interactive and participatory learning styles so that the material in the e-magazine is made interesting with the hope that readers will be comfortable learning using this e-magazine (Figure 8).

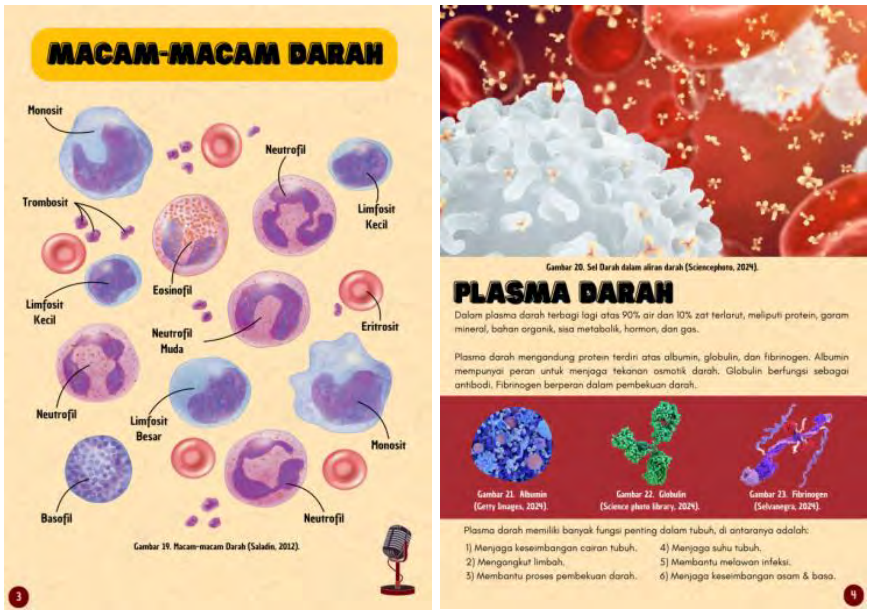

Figure 8. Learning materials

In this contextual approach section, it is a learning method that links subject matter to real-world situations. This approach involves direct experience and connects new knowledge to students' daily lives. This contextual approach is expected to provide real context, understanding concepts through experience rather than just memorizing information, student participation, social interactions that encourage collaboration between students, educators and the surrounding environment, learning can be centered on students and take control of their learning and the role of educators as facilitators can be realized. There are 7 contextual components contained in this e-magazine (Figure 9).

Figure 9. Components of a Contextual Approach

This practicum activity is a learning activity that involves the role of students directly in conducting experiments or experiments to understand the concept or theory of real experience. In this practicum activity section, the aim is to understand the concept in depth, develop practical skills by training students in using tools, materials, and techniques that are relevant to the lesson, practice problem solving, improve cooperation and connect theory with practice. This practicum activity consists of the planning, implementation, analysis and discussion process until the end of making a report on the results of the practicum process that has been carried out. Before starting the practicum activity, students can also watch the video that has been provided to facilitate the practicum process, after watching the video

students are welcome to continue the practicum activity (Figure 10).

This learning video is a visual media designed to be able to convey material or information interactively, interestingly and effectively. This learning video is usually used in various situations that are expected to help students in understanding the material optimally. The learning video contains a collection of all the materials available in the e-magazine. If students do not understand the learning material, they can rely on this learning video (Figure 11).

Figure 10. Practical Activities

Figure 11. Learning Videos

In this bibliography section, there are several lists of references added, both in terms of images, materials used as references in making e-magazines. In this section, it is also made by combining the evaluation section at the beginning of the page then continued with the bibliography, this aims to make efficiency in the e-magazine visible. E-Magazine with a free style model is made by differentiating the shape between the evaluation section and the bibliography so that readers understand that both are things that cannot be equated because the nature is very clearly different (Figure 12).

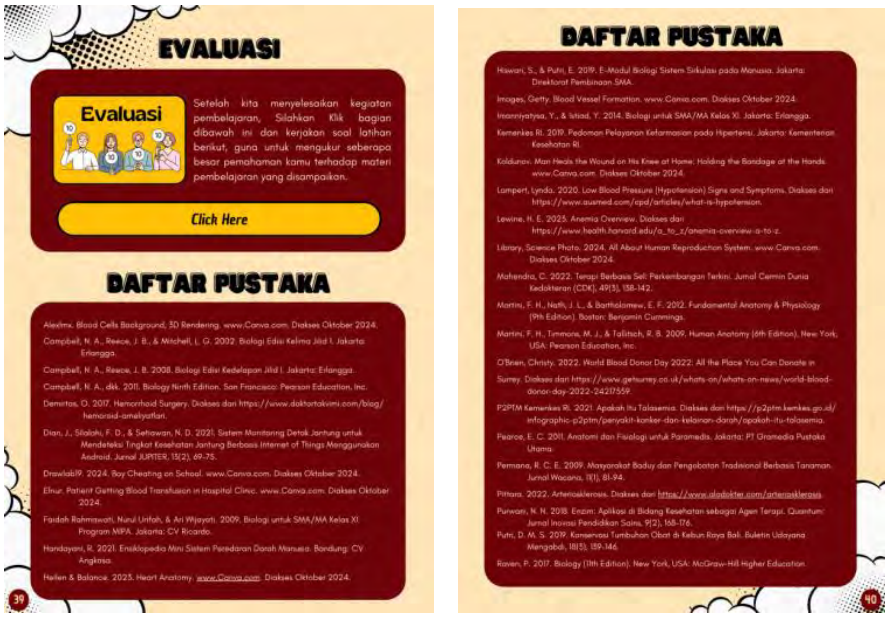

Figure 12. Bibliography

This author profile aims to explain information about the author's identity and to increase the trust and interest of readers. The main thing that must be highlighted in making this author profile is certainly aimed at increasing the credibility of the material, building personal relationships with readers, encouraging

inspiration and motivation, transparency and accountability, helping to introduce the author, and showing the relevance of learning media. The photo used is one of the things that must be considered, the selection of photos with formal elements is done because later this e-magazine media will be used as one of the learning media in schools and as educators we must also show neatness in dressing. In addition to the author's personal information, information is also added regarding the name of the supervisor and the name of the validator and the purpose of making contextual-based e-magazine media is explained (Figure 13).

Figure 13. Author Profile

After the contextual-based e-magazine was designed and the results of prototype I were obtained, a self-evaluation was conducted by the researcher using a self-evaluation instrument that had previously been validated by an expert lecturer. The results of the self-evaluation can be seen in Table 3.

Table 3. Self-evaluation results

No.	Repair	Follow-up
1.	There are several errors in writing and punctuation	Improve your writing and use of punctuation
2.	There are some images that are unclear or blurry	Replace the image with a good quality image

Prototype II Development Results

After conducting a self-evaluation on prototype, I on contextual-based e-magazine, the next step is to conduct an e-magazine validation test with experts (expert review) using an e-magazine validation instrument sheet that has previously been validated by an expert lecturer. The assessment by the expert lecturer includes aspects of the e-magazine's content, language, presentation, and media feasibility. The instrument analysis from each validator is summed up and the validation results from 4 validators are analyzed, which are summed up to obtain an average value of the overall e-magazine validity results, which can be seen in Table 4.

Table 4. Final Results of the Analysis of Contextual-Based E-Magazine Validity Instruments on Circulation System Material for Grade XI High School Students.

Aspect	Maximum Score	Total Score	Validity value (%)	Validity Criteria
Content Eligibility	160	157	98.13	Very Valid
Linguistics	80	79	98.75	Very Valid
Presentation	144	138	95.83	Very Valid
E-Magazine Media	192	185	96.35	Very Valid
Average			97.27	Very Valid

Based on Table 4, it can be seen that the average validity value is 97.27% with very valid criteria. This shows that the contextual-based e-magazine that was developed has been valid both in terms of the appropriateness of the content, language, presentation and e-magazine media so that it can be used in

learning at school. At the validation stage of this contextual-based e-magazine, there are suggestions from the validators which are the basis for consideration in revising this contextual-based e-magazine. The suggestions given by the validators can be seen in the following Table 5.

Table 5. Suggestions and Improvements from Validators for contextual-based e-magazines on Circulation System Material.

No.	Validators	Suggestions/input
1.	Prof. Dr. Darmansyah, S.T., M.Pd.	1. It is better to rearrange the top, right, left, and bottom margins so that they are not too close to the edge so that they appear dense. 2. It is better not to use excessive red because it will make the eyes get bored and watery too quickly. 3. Please fix the layout so that it does not appear too dense with information on each page.
2.	Dr. Abdurahman, M.Pd.	1. Check punctuation, foreign language writing.
3.	Dr. dr. Elsa Yuniarti, S.Ked., M.Biomed., AIFO-K.	1. Change the cover to be clearer and represent the material of the circulatory system 2. Highlight the e-magazine so that it is clearly different from other learning media. 3. Pay attention to the material contained in the e-magazine.
4.	Ahmad Saleh, S.Pd.	1. Pay attention to the layout and tidy it up. 2. Overall, the e-magazine product is good and in accordance with the rules for making e-magazines and in accordance with the Merdeka curriculum.

Prototype III Development Results

After the assessment by experts (expert review), continued to the development of prototype stage III, namely conducting a one-to-one evaluation. This stage is carried out by three students with different abilities, namely high, medium, and low abilities. Each student is asked to assess the e-magazine that has been developed. Based on the analysis of the results of the one-to-one evaluation questionnaire that has been given, it is known that the contextual-based e-magazine that has been developed has met the aspects of content feasibility, language, presentation and e-magazine media (Table 6).

Table 6. One to one evaluation test results

Aspect	Maximum Score	Total Score	Validity value (%)
Content Eligibility	36	34	94.44
Linguistics	30	29	96.67
Presentation	36	36	100
E-Magazine Media	30	30	100
	Average		97.77

Prototype IV Development Results

After the improvement process from the validation stage by expert lecturers and one-to-one evaluation, the contextual-based e-magazine produced prototype IV. Furthermore, a small group practicality test was conducted by six students with different abilities, namely high, medium, and low abilities. The practicality test conducted by the small group aims to see how practical the contextual-based e-magazine is by using the contextual-based e-magazine practicality test instrument sheet. The results of the small group practicality can be seen in the following Table 7.

Table 7. Results of Practical Test by Small Group

Aspect	Maximum Score	Total Score	Practicality Value (%)	Practicality Criteria
Ease of Use	192	189	98.43	Very Practical
Learning Time Efficiency	72	69	95.83	Very Practical
Benefit	120	118	98.33	Very Practical
Attractiveness	240	237	98.75	Very Practical
	Average		97.83	Very Practical

The results of the practicality test above, it was found that the ease of use aspect was 98.43% with very practical criteria, the efficiency aspect of learning time was 95.83% with very practical criteria, the benefit aspect was 98.33% with very practical criteria, and the attractiveness aspect was 98.75% with very

practical criteria. The overall average practicality value of the contextual-based e-magazine for the circulation system material by the small group was 97.83% with very practical criteria. This shows that the contextual-based e-magazine for the circulation system material that was developed is very practical so that it can be used in the assessment phase in the field trial or large group evaluation (field test).

Assessment Phase

The practicality test on a large group (field test) aims to see the practicality of contextual-based e-magazines used in the classroom learning process that takes place in real conditions. The practicality test of contextual-based e-magazines was conducted on an experimental class of 36 people. The aspects observed include ease of use, efficiency of learning time, benefits, and attractiveness. The analysis of the results of the practicality test from 4 educators and 36 students was then added up to obtain an average practicality value which can be seen in Table 8.

Table 8. Analysis of Final Results of Contextual-Based E-Magazine Practicality Test by Educators and Students.

Aspect	Assessor		Maximum Score	Total Score	Practicality Value (%)	Criteria Practicality
	Educator	Learners				
Ease of Use	141	1114	1296	1255	96.84	Very Practical
Learning Time Efficiency	32	412	464	444	95.69	Very Practical
Benefit	142	697	864	839	97.11	Very Practical
Attractiveness	158	1393	1600	1551	96.94	Very Practical
Average					96.64	Very Practical

From Table 8 of the final results of the practicality test of contextual-based e-magazines by 4 educators and 36 students above, it was found that the ease of use aspect with a result of 96.84% with very practical criteria, the efficiency aspect of learning time with a result of 95.69% with very practical criteria, the benefit aspect with a result of 97.11% with very practical criteria, and the attractiveness aspect with a result of 96.94% with very practical criteria. The average value of the practicality results of contextual-based e-magazines from 4 educators and 36 students is 96.64%. Based on these results, it can be concluded and shown that the contextual-based e-magazine that has been developed is included in the criteria of being very practical for use by educators and students in the learning process at school.

Conclusion

Based on the results of the development that has been implemented, the following conclusions are obtained (1) E-Magazine based on contextual material on the circulatory system has validity with very valid criteria based on the assessment by the validator, and (2) E-Magazine based on contextual material on the circulatory system has practicality with very practical criteria based on the assessment of educators and students.

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Author Contributions

Y. N. Fitra: writing original draft preparation, **A. Razak:** review and Enhancement of conceptual understanding. **Z. Zulyusri** and **E. Yuniarto:** Verifying analytical accuracy and sharpening concepts.

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