

Development of a website-based biology learning resource on environmental change for 10th-grade students

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ABSTRACT

This study aims to develop a web-based biology learning resource on environmental change for 10th-grade high school students and determine its feasibility, practicality, and classroom implementability. The development addressed limitations of existing learning media in visualizing abstract and contextual environmental change concepts. The resource was developed using the Research and Development method based on the ADDIE model, consisting of analysis, design, development, implementation, and evaluation. Designed using Google Sites and Canva, the resource integrates content, images, videos, learning objectives, and assessments aligned with learning needs and the Merdeka Curriculum. A limited pilot test involved 18 10th-grade students at South Konawe State High School 10. Evaluation included validation by subject matter and media experts, assessments by biology teachers, and student feedback through questionnaires. Data were analyzed using quantitative descriptive methods. Results showed average validation scores of 4.00 from subject matter experts ("very good"), 3.18 from media experts ("good"), 3.05 from biology teachers ("good"), and 3.23 from students ("good"). Learning implementation reached 91% in the first session and 100% in the second. Limited device access and compatibility were obstacles, overcome through shared or parental devices. Thus, the resource is suitable and practical as supplementary learning material, although accessibility depends on device conditions. Further research should involve larger samples and examine learning outcomes.



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INTRODUCTION

The progression of digital technology has transformed human experience into every aspect of existence, notably in education and learning. The role of technology in learning is significant within the processes of teaching and acquiring knowledge (Akram et al., 2022; Said, 2023). Developments in the domain of information and communication technology (ICT) have occurred swiftly and have facilitated numerous human endeavors. The application of ICT enables individuals to transcend constraints of both time and location, particularly in education, where technology is crucial (Wahyuni & Sudarma, 2018). In line with the research by Zou et al., (2025), which states that digital learning, characterized by the integration of information and communication technology (ICT) into educational practices, has become a cornerstone of modern education.

The evolution of learning technology is guided by four primary traits, which include: (1) employing a systematic approach; (2) leveraging a wide range of educational resources; (3) striving to enhance the quality of human learning; and (4) focusing on personalized instructional methods (Warsita, 2017). In the age of digitalization, technology has become integral to education due to its significant impact on knowledge, as students learn about natural occurrences and facts, leveraging technology to apply this information (Maritsa et al., 2021). In the current digital age, the study of biology can be effectively conducted by making use of technological innovations and the internet.

Science, particularly biology, makes a significant contribution to technological development, serving as the foundational science underpinning such advancements (Sudarisman, 2015). In today's digital age, the use of digital devices and the internet is a primary necessity that must be met in the world of education; consequently, teachers are required to innovate in delivering instruction, particularly in biology, by leveraging digital platforms and the internet to embrace the Fourth Industrial Revolution (Jayawardana & Gita, 2020).

Technological advances in today's digital age demand changes in teaching methods to keep pace with developments in the Industry 4.0 era. This is in line with research by Efendi et al., (2026), who state that the rapid development of Industry 4.0 is driving positive transformation in the sustainability of technology-based learning, enabling students to learn and utilize technology. Students at South Konawe State High School 10 are also experiencing this, as they still rely on teaching aids that are ineffective in explaining biological concepts, particularly those related to environmental change. The learning medium currently used is PowerPoint, which makes it difficult for students to understand the material covered in class. Therefore, technology-based learning media are needed to explain material on environmental change, so that students can better understand the subject. Understanding of environmental issues or changes is expected to shape students' character so that they become caring and capable of preserving the environment (Nurwendah et al., 2023). Integrated learning via the internet can help teachers deliver instructional content (Ferdiansyah & Irfan, 2021).

The website served as a digital resource for biology education in the 4.0 era, enabling teachers to use it to facilitate the teaching and learning process. The use of web-based learning tools can provide students with new experiences in their education, thereby enabling a more diverse, engaging, and innovative learning process that improves student achievement (Soussi, 2020; Salsabila & Aslam, 2022). In line with the research by Yanto et al., (2023), web-based teaching media have been proven to be valid, practical, and effective when applied to support learning, as well as efficient in improving the quality of student learning outcomes.

Online education has experienced rapid growth in recent years, leveraging web technology to facilitate the learning experience (Kuswanto, 2018). In line with Najjar et al., (2025), online learning utilizes digital platforms and the internet to facilitate students' access to learning. In the world of education, websites play a vital role in learning by providing information, facilitating communication, fostering creativity, and delivering instructional content (Dinc, 2017). Websites represent a creative advancement that greatly influences the transformation of the educational experience (Nanda & Agustini, 2023). Often referred to as online education or e-learning, web-based learning encompasses course materials accessible via the internet (Purba et al., 2020). In addition, websites can be described as audiovisual learning tools capable of presenting images, audio, video, and learning materials, thereby supporting more effective learning interactions (Yuda et al., 2019). The use of these various components can facilitate students' understanding of biological concepts, particularly those related to environmental change, while also encouraging active participation and independent learning.

The website-based learning media was developed using Google Sites to integrate attractive and accessible text, images, videos, and learning materials. Based on the Cognitive Theory of Multimedia Learning, particularly the signaling and coherence principles, these multimedia components were selected to focus students' attention on essential information and facilitate understanding of abstract biological concepts (Mayer, 2024). Google Sites is a Google product introduced as a website-building tool; users can take advantage of Google Sites because it is easy to create and manage, making it accessible even to inexperienced individuals (Hidayat et al., 2023; Laili et al., 2025; Saputra et al., 2022). Web-based learning tools are highly beneficial in this digital

age for both students and teachers, including: 1) helping students delve deeper into and explore lessons; 2) enabling students to learn independently without relying on others or being tied to a specific location; 3) supporting teachers in implementing interactive teaching methods; and 4) contributing to the improvement of teaching quality in schools (Tambunan & Siagian, 2022).

The use of online platforms as educational tools is likely to be more appropriate for individuals from Generation Z when compared to traditional media like textbooks and other resources (Irnawati & Rahmawan, 2024; Zulaiha et al., 2025). Utilizing websites for educational purposes comes with numerous benefits, including: 1) the ability for students to engage in independent study to enhance and broaden their understanding, 2) increased participation in learning activities, as students not only listen to their instructor's explanation but also partake in various tasks like observing and experimenting, and 3) internet-based educational tools offer supplementary learning materials that can further enrich the content being studied (Setyadi & Qohar, 2017).

Based on the above discussion, research on web-based learning media has demonstrated its potential to support interactive and flexible learning and to enable students to learn independently. However, much of the previous research reviewed in this study still focuses on the development of web-based media in general; therefore, there is a need for media specifically tailored to the characteristics of environmental change content and the learning needs of high school biology students. Therefore, this study developed web-based biology learning media for 10th-grade environmental change material by integrating learning content, videos, user guides, learning objectives, assessments, and reference sources into a single digital platform. The novelty of this study lies in the integration of these various components into Google Sites-based media, which was systematically developed using the ADDIE model while taking into account the needs of teachers, students, the curriculum, and the characteristics of the environmental change material. This study contributes to providing an alternative digital learning resource that can support flexible and self-directed biology learning, while also providing empirical evidence regarding the feasibility, practicality, and implementability of the developed media. Based on this, this study aims to develop web-based learning media on environmental change for 10th-grade high school students so that students can better understand the subject matter and concepts related to environmental change.

METHOD

The research method utilized in this investigation is research and development. The creation of this website involved performing a needs assessment and examining existing studies. Implemented the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) to create educational materials (Fitrianingsih et al., 2023).

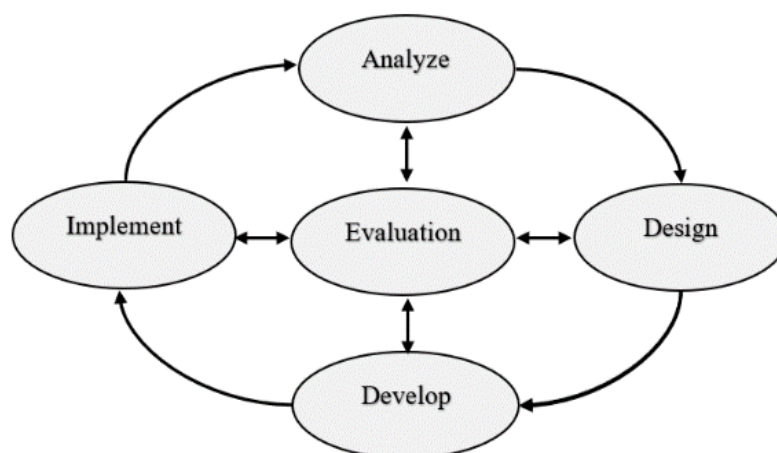


Figure 1. ADDIE Development Model

This stage consists of needs analysis and competency and content analysis. The needs analysis stage starts with conducting interviews with biology teachers using interview sheets and analyzing the needs of students using questionnaire sheets. The design stage consists of activities to create initial media concepts and design media. The next stage is development. This stage consists of product development, development of assessment instruments, expert validation, and first-stage revision. Website media that has been revised in the first stage is carried out with limited implementation to students of class XI South Konawe Senior High School 10, totaling 18 people, as well as an assessment by a biology teacher. Evaluation is applied at each stage of the ADDIE model, namely the analysis, design, development, and implementation stages.

Quantitative data analysis refers to the questionnaire that uses the Likert scale shown in Table 1 below.

Table 1. Likert Scale Categories in the Product Feasibility and Practicality Questionnaire

No.	Scale	Category
1	4	Very Good
2	3	Good
3	2	Less Good
4	1	Very Less

The survey data, in the form of average scores for each aspect, were then interpreted using the criteria for assessing the suitability and practicality of web-based instructional media, as shown in Table 2 below.

Table 2. Criteria for Assessing the Feasibility and Practicality of the Product

No.	Score Interval	Score Interval	Category
1	$M_i + 1.5 SD_i \leq M \leq M_i + 3.0 SD_i$	$3.25 \leq x \leq 4$	Very Good
2	$M_i + 0 SD_i \leq M \leq M_i + 1.5 SD_i$	$2.5 \leq x < 3.24$	Good
3	$M_i - 1.5 SD_i \leq M \leq M_i + 0 SD_i$	$1.75 \leq x < 2.5$	Less Good
4	$M_i - 0 SD_i \leq M \leq M_i + 1.5 SD_i$	$1 \leq x < 1.75$	Very Less

RESULTS AND DISCUSSION

Results

The results of research on website media on environmental change material carried out using the ADDIE model will be explained as follows:

Analyze

During the analysis phase, it became evident that current teaching materials are ineffective in presenting abstract and contextual concepts related to environmental change. Teachers need more engaging and interactive learning materials, while students require materials that integrate text, images, videos, and supporting resources to facilitate conceptual understanding. In addition, the learning content must align with the Merdeka Curriculum, particularly the Learning Outcomes and Learning Objectives, which are then integrated into the website design. These findings serve as the foundation for the next phase (the design phase), which involves the creation of web-based teaching materials on the topic of environmental change.

Design

The design phase translates the characteristics of environmental change—which take the form of abstract and complex biological concepts—into visual and interactive learning components. This design is guided by Cognitive Theory of Multimedia Learning, specifically the principles of signaling, coherence, and segmentation. Written explanations are combined with relevant images and videos to illustrate environmental phenomena and clarify the relationships between causes, processes, and effects. Key information is visually highlighted to direct students'

attention to essential concepts, while irrelevant visual and verbal elements are minimized to reduce unnecessary cognitive processing. The content is also organized into structured sections and supported by an interactive menu to facilitate navigation and step-by-step understanding. These design principles were implemented using Canva to develop visual elements and Google Sites to organize learning content, multimedia resources, and assessment activities. The design outcome is presented in the storyboard shown in Figure 2.

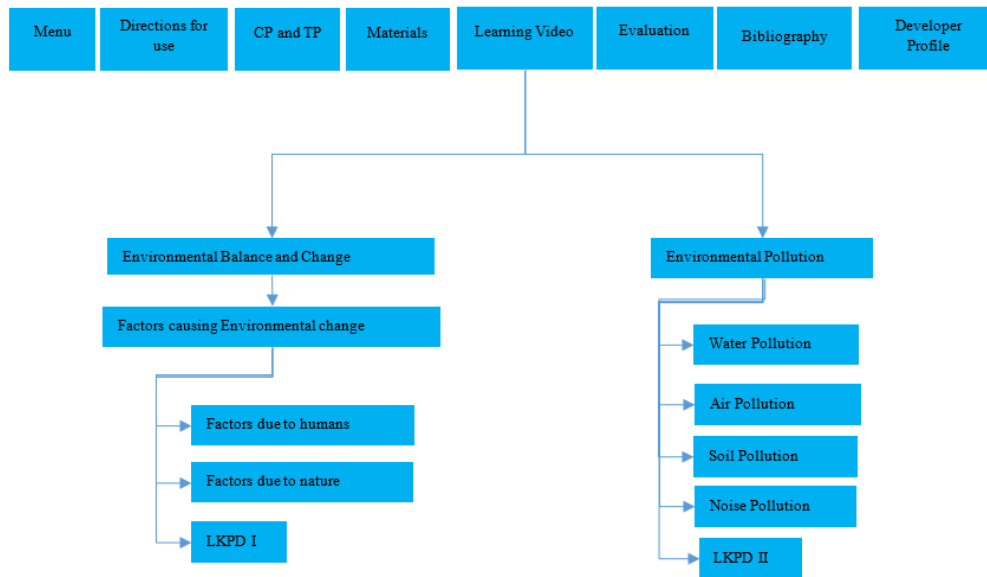


Figure 2. Storyboard of Web-based Learning Media

Development

This development phase was successfully completed by creating the first version of the web-based learning materials and conducting an evaluation or validation of those materials (which involved assessments by subject matter experts, media specialists, and biology teachers, as well as feedback from students).

1. Results of Making Website-Based Learning Media

Making website-based learning media products using 2 software programs, including Google Sites and Canva.



Figure 3. Website-Based Learning Media

2. Results of Feasibility and Practicality of Website-Based Learning Media Products

The feasibility of website-based learning media products was assessed by material expert lecturers and media experts. Material experts are faculty lecturers of the Faculty of Mathematics and Natural Sciences, Yogyakarta State University, with expertise in environmental change who are mandated to assess the feasibility of products in the realm of material. Aspects of the material assessed by material experts include the feasibility of material and language (Table 3), as follows:

Table 3. Results of Validation of the Feasibility of Website-Based Learning Media by Material Experts

No.	Assessment Aspect	Score	Criteria
1	Material feasibility	4	Very Good
2	Language	4	Very Good
Average score		4	Very Good

The presentation of the website-based instructional media product, as evaluated from all perspectives—including the appropriateness of content and language—falls into the “very good” category. The total scores for each aspect indicate that the website-based instructional media product is suitable for pilot testing with a “very good” rating. In addition to the score assessment, subject matter experts also provided suggestions for improvements to several elements of the website-based educational media materials so that the identified shortcomings can be addressed before the product is tested (Table 4), as follows:

Table 4. Input from Material Experts and Follow-up Improvements

No.	Enter	Corrective Follow-up
1	Fonts are not the same	Corrected as per feedback
2	Font size needs to be enlarged	Corrected as per feedback
3	Some links cannot be opened (instructions for use)	Corrected as per feedback
4	There is a link that does not open directly to the PDF file (landslide)	Corrected as per feedback

Media experts are faculty lecturers of the Faculty of Mathematics and Natural Sciences, Yogyakarta State University with expertise in Technology Science (IT) who are mandated to assess product feasibility in the media domain. Media aspects assessed by experts include aspects of screen design appearance, ease of use, consistency, usefulness, and graphics (Table 5), as follows:

Table 5. Results of Validation of Feasibility of Website-Based Learning Media by Media Experts

No.	Assessment Aspect	Score	Criteria
1	Display screen design	3	Good
2	Ease of use	3.5	Very Good
3	Consistency	3	Good
4	Expediency	3.4	Very Good
5	Graphics	3	Good
Average score		3.18	Good

Table 6. Input from Media Expert and Follow-up Improvement

No.	Enter	Corrective Follow-up
1	Less color contrast	Corrected as per feedback
2	The letters are not thick enough, or the font is enlarged	Corrected as per feedback
3	There are spaces between paragraphs in the material	Corrected as per feedback
4	Articles related to the impact of development	Corrected as per feedback
5	What are the causes of environmental change (video 1)	Corrected as per feedback
6	Impact of environmental change (video 1)	Corrected as per feedback
7	Efforts to minimize impact (video 1)	Corrected as per feedback
8	Learning objectives adjusted to CP and evaluation questions adjusted to TP	Corrected as per feedback

There is one biology teacher from South Konawe State High School 10. The teacher teaches in class X Merdeka I and validates the practicality of the product based on their expertise as learning practitioners at the high school level. The aspects assessed by the biology teacher include aspects of content, language, usefulness, and graphics (Table 7), as follows:

Table 7. Results of Validation of the Feasibility of Website-Based Learning Media by Biology Teacher Experts

No.	Assessment Aspect	Score	Criteria
1	Contents	3	Good
2	Language	3.2	Good
3	Expediency	3	Good
4	Graphics	3	Good
Average score		3.05	Good

The presentation of this web-based instructional media product across all aspects—including content, language, functionality, images, and learning methods—falls into the “good” category. The total score for each aspect indicates that this web-based instructional media product is worthy of being evaluated in the “good” category. Biology teachers believe that this web-based instructional medium can be used with some improvements.

Based on the improvements suggested by the teacher, the educational website can be used with several improvements in the areas of content, language, usability, and graphics. In terms of content, improvements were made by clarifying the presentation of the material, aligning the material with learning objectives, and supplementing the material with supporting media and assessment exercises. In terms of language, improvements were made by simplifying sentences, correcting spelling and scientific terminology, and using language that is communicative and appropriate for the students’ level of understanding.

In terms of usability, improvements were made by clarifying the menu structure and navigation, ensuring that all links and features function properly, and optimizing the website’s display to make it easily accessible across various devices. Meanwhile, regarding the graphic design, improvements were made by refining the layout, adjusting the size of images and videos, standardizing font types and sizes, and improving color combinations and the quality of visual elements to make the website more appealing, user-friendly, and conducive to the readability of the content.

There were 18 students in class XI of South Konawe State High School 10 who had studied environmental change material in the previous year. Each learner responded to the practicality of web-based learning media products in the limited trial. The aspects assessed by students include aspects of content, language, usefulness, and graphics (Table 8), as follows:

Table 8. Results of Assessment of Practicality of Website-Based Learning Media by Students

No.	Assessment Aspect	Score	Criteria
1	Contents	3.22	Good
2	Language	3.22	Good
3	Expediency	3.24	Very Good
4	Graphics	3.24	Very Good
Average score		3.23	Good

The evaluation results for the web-based educational media product indicate that the content elements are rated as good, the linguistic elements are rated as good, the usability elements are rated as very good, and the graphic elements are rated as very good. The total score for each element also indicates that this web-based educational media product is worthy of consideration in the “good” category. Unlike the evaluations by experts and biology teachers, students did not provide suggestions for improving the media or content of the web-based educational media product.

Implementation

The implementation stage is obtained from the implementation of learning. The results of learning implementation were obtained from observations made by observers at each meeting. Observations were made in both experimental classes, and the results can be seen in [Table 9](#) below:

Table 9. Recapitulation of Learning Implementation in Experimental

No.	Class	Meeting	Activities	Total	Percentage
1	Experiment	Ke-1	10	11	91%
		Ke-2	11	11	100%

From the information contained in Table 10 regarding the results of learning implementation, it can be concluded that the implementation of learning has gone very well and follows the contents of the learning module that has been prepared. It's just that during the first meeting, the researcher did not convey the learning activities at the next meeting, because the time had run out, so the learning activities at the next meeting were conveyed through the WhatsApp group. Learning that has been carried out faces obstacles, such as students who do not have cellphones or cellphones of students who do not support using website-based learning media. Obstacles encountered in the implementation of learning can be overcome by giving instructions to students to join their classmates who have mobile phones or have supported using website media. This website media can also be used when students want to study environmental change material, so that students who do not have a cellphone or support can use their parents' cellphones to open learning materials on the website. Through web-based learning media, learning materials can be accessed anytime and from anywhere ([Akpen et al., 2024](#); [Amelia & Asikin, 2018](#); [Songkram, 2015](#)). In addition, this web-based media serves as a learning platform that allows both teachers and students to engage in learning activities without being limited by time or place ([Indriani et al., 2023](#)). E-learning resources can be more comprehended as an educational method that incorporates information technology through computers that have telecommunications capabilities (internet, intranet, extranet) and multimedia elements (graphics, audio, video) as the primary tools for delivering content and facilitating communication between teachers and learners ([Suryaningrat et al., 2023](#)).

Evaluation

The evaluation stage is applied to the 4 stages of the development model, namely the analysis, design, development, and implementation stages. The evaluation process is carried out at the end of each of these stages to assess the suitability of the product specifications carried out and the suitability of the results obtained as a reference and consideration for the research process at the next stage ([Table 10](#)), below:

Table 10. Evaluation Results at the Analysis, Design, Development, and Implementation Stages

No.	Stage	Evaluation Results
1	Analysis	- Each step in the analysis stage was carried out according to the established procedure. - The analysis stage included interviews with biology teachers, student needs analysis, and curriculum and content analysis. The results showed that the existing learning media were less effective in presenting abstract and contextual concepts of environmental change. Teachers needed more engaging and interactive learning materials, while students needed materials integrating text, images, videos, and supporting resources. The learning content was also aligned with the Merdeka Curriculum, particularly the Learning Outcomes and Learning Objectives. - The results of the analysis stage served as the basis for the design stage, particularly in determining the characteristics of the website-based learning media and the environmental change content to be developed.

No.	Stage	Evaluation Results
2	Design	- Each step in the design stage was carried out according to the established procedure. - The design stage focused on translating the abstract and complex characteristics of environmental change concepts into visual and interactive learning components. The design incorporated the signaling, coherence, and segmentation principles of the Cognitive Theory of Multimedia Learning. - The design results included the organization of learning materials, images, videos, interactive menus, and assessment activities using Canva and Google Sites. The resulting storyboard and media design served as the basis for the development stage.
3	Development	- Each step in the development stage was carried out according to the established procedure. - The development stage resulted in the initial website-based learning media developed using Google Sites and Canva, followed by evaluation through material expert validation, media expert validation, biology teacher assessment, and student assessment. - Material experts rated the product 4.00 (Very Good) for material feasibility and language. Media experts gave an average score of 3.18 (Good), while the biology teacher gave an average score of 3.05 (Good). Student assessment produced an average score of 3.23 (Good). - The development stage also included revisions based on expert and biology teacher feedback, including improvements to font size, links, color contrast, paragraph spacing, video content, learning objectives, navigation, and visual elements. - The revised product was subsequently used in the implementation stage.
4	Implementation	- Each step in the implementation stage was carried out according to the established procedure. - The implementation stage involved the use of the website-based learning media in learning activities. Learning implementation reached 91% in the first meeting and 100% in the second meeting, indicating that the learning activities were implemented very well and followed the prepared learning module. - Several technical obstacles were identified, including students who did not have mobile phones or whose devices were incompatible with the website-based learning media. These obstacles were addressed by having students work with classmates who had compatible devices or use parents' devices to access the learning materials. - The implementation results can serve as a reference for further research, particularly through trials on a broader scale, as the current implementation was conducted on a limited scale.

In Table 10, each step in the process of researching and developing web-based learning media has been carried out and implemented in accordance with the established guidelines. The evaluation of each step indicates that the results of each phase from analysis, design, and development to implementation can serve as a guide for proceeding to the next phase or as a foundation for further investigation. The results of the analysis regarding the needs of teachers, students, and the curriculum were used as the basis for the design process to create more effective web-based learning media. The design of media features, materials, and learning tools is adjusted to the needs that exist in learning; novelty in references is needed to support learner literacy to better understand the material studied. After the website-based learning media is designed

according to the needs in learning or school, followed by product validation by experts, the results of validation or revision are used as a reference for implementation. The implementation of learning can be used as a reference for further research or repetition on a different scale.

Discussion

This study aims to develop a web-based biology learning tool on environmental change and to evaluate the extent to which the tool is appropriate, practical, and easy to use in the learning process. The results show that the web-based learning tool developed using the ADDIE model is appropriate and easy to use in high school biology education, particularly regarding the topic of environmental change. However, these findings must be considered in light of the small sample size, as the pilot study involved only 18 students. The relatively small sample size limits the generalizability of the research results; thus, the findings regarding the practicality and feasibility of the media cannot yet be fully generalized to a broader population of high school students. Therefore, future research needs to involve a larger number of students and a more diverse range of school characteristics to obtain stronger evidence regarding the practicality, feasibility, and application of web-based learning media in a broader learning context. During the analysis phase, the results of interviews with teachers and the analysis of student needs indicated that the biology learning process still relies on traditional media, which are less effective in fostering understanding of abstract and contextual concepts, such as environmental change. This finding aligns with the views of [Wahyuni & Sudarma \(2018\)](#), who state that the application of information and communication technology in the learning process can overcome barriers related to space, time, and the types of learning media used. Therefore, the development of web-based learning media is an appropriate solution to meet learning needs in this digital age.

Evaluations by experts in this field indicate that the content and language are of very high quality. This suggests that the material on environmental change provided on the website aligns with learning objectives, is well-structured, and uses terminology that is easily understood by students. Improvements made based on expert recommendations, such as standardizing font type and size and strengthening hyperlinks, have also contributed to enhancing content quality. These findings align with [Sudarisman \(2015\)](#) perspective, which emphasizes the importance of presenting biology instruction in a structured and contextual manner so that students can understand the connection between concepts and real-world environmental phenomena.

Assessments by media experts indicate that the website-based learning tool falls into the “good” category, with “very good” ratings for ease of use and benefits. This suggests that the developed website features intuitive navigation, an appealing design, and supports effective learning processes. Improvements have been made to color contrast, font weight, and the completeness of video content to enhance the visual quality and readability of the media. Web-based learning media can provide a more interactive learning experience and increase student participation ([Harahap et al., 2024](#)).

Evaluations by biology teachers indicate that the web-based learning media performed well across all assessed aspects. Teachers found the media easy to use, well-suited to students’ characteristics, and capable of supporting both independent and in-class learning. This suggests that the developed learning media have the potential for sustained implementation in biology instruction. These findings align with the results of [Tambunan & Siagian \(2022\)](#) study, which revealed that digital learning media can assist teachers in designing more interactive and efficient lessons.

Students’ responses to the web-based learning media received ratings ranging from good to very good, particularly regarding usability and graphic design. Students found the media engaging, easy to understand, and helpful in grasping material on environmental change. The absence of improvement suggestions from students indicates that the learning media meets the needs and characteristics of Generation Z, who are generally already accustomed to digital technology ([Irnawati & Rahmawan, 2024](#)). This reinforces the finding that using a website as a learning medium can enhance students’ motivation and independence in the learning process.

During the implementation stage, observations showed that learning using website-based learning media went very well. The percentage of learning implementation reached 91% in the first

meeting and 100% in the second meeting. Although there were technical obstacles such as limitations in the ownership and specifications of students' devices, these obstacles could be overcome through cooperation among students. These findings are in line with Amelia & Asikin (2018), who state that web-based learning allows students to access materials anytime and anywhere, thus providing flexibility in supporting the learning process.

Overall, the findings of this study make an important contribution to the field of educational technology, particularly in the creation of website-based digital learning media for biology lessons. The media created not only helps achieve learning objectives but also enhances digital literacy, self-directed learning, and students' awareness of environmental change issues. However, this study has limitations because its implementation is still on a limited scale. Therefore, it is recommended to conduct further studies with pilot tests on a broader scale and to evaluate the quantitative impact of web-based learning media on academic achievement.

CONCLUSION

This study developed a website-based biology learning resource on environmental change for 10th-grade students using the ADDIE model. The development process was conducted systematically through analysis of teacher and student needs, curriculum and content analysis, design, development, implementation, and evaluation. The findings indicate that the developed learning resource is feasible and practical for supporting biology learning, as reflected in the assessments of subject matter experts, media experts, biology teachers, and students, particularly in terms of content, language, usability, and visual presentation. The implementation of the learning resource also showed that the learning activities could be conducted in accordance with the prepared learning procedures and supported more interactive and flexible learning. However, its use was influenced by contextual constraints, particularly the availability and compatibility of students' digital devices, which were addressed through shared access to compatible devices or parents' devices. Therefore, the developed website-based learning resources can serve as an alternative digital resource for teaching environmental change in high school biology, particularly as a complementary resource for classroom and independent learning. Further research is recommended to conduct broader-scale implementation and examine its effects on students' learning outcomes and other relevant educational variables.

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