

Web-based teaching media innovation to improve understanding of science learning

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ABSTRAK

Penelitian ini berfokus pada rendahnya minat siswa di salah satu sekolah menengah pertama di Kota Malang dalam mempelajari sains, terutama kesulitan dalam memahami istilah-istilah ilmiah dalam materi sains yang diberikan. Keterbatasan sumber belajar dan kurangnya perubahan dalam strategi pengajaran diidentifikasi sebagai penyebab rendahnya minat tersebut. Minimnya penggunaan media pembelajaran oleh guru yang hanya monoton menggunakan ppt dan buku teks membuat pembelajaran menjadi kurang variatif dan membuat siswa kurang tertarik untuk mengikuti pembelajaran. Penelitian ini mengevaluasi dampak penggunaan media pembelajaran berbasis web pada materi perkembangan hewan dan tumbuhan terhadap hasil belajar siswa kelas IX. Dengan menggunakan metode kuantitatif dan uji ANOVA, media web yang menyajikan konten melalui video, teks, dan gambar dibandingkan dengan PPT dan buku pelajaran konvensional di dua kelas. Hasil analisis data menunjukkan adanya perbedaan yang signifikan antara kedua kelompok (F hitung = 7,691, signifikansi = 0,008). Respons positif siswa terhadap media web menegaskan keefektifannya dalam meningkatkan minat dan pemahaman sains.

ABSTRACT

This research focuses on the low interest of students in one of the junior high schools in Malang City in learning science, especially the difficulty in understanding scientific terms in the given science material. Limited learning resources and lack of change in teaching strategies were identified as the causes of low interest. The lack of use of teaching media by teachers, who only monotonously use PPTs and textbooks, makes learning less varied and makes students less interested in participating in learning. This study evaluates the impact of web-based learning media on animal and plant development material on the learning outcomes of Grade IX students. Using quantitative methods and the ANOVA test, web media presenting content through video, text, and images were compared with PPT and conventional textbooks in two classes. The results of the data analysis showed a significant difference between the two groups (F count = 7.691, significance = 0.008). The students' positive response to the web media confirmed its effectiveness in increasing interest and understanding of science.



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INTRODUCTION

Natural science, or IPA, is a science that discusses the natural phenomena around us, which are explained in detail from the results of human observations and experiments. From this, science is expected to be a guide for students to study themselves and their environment and requires students to develop aspects of science in everyday life. This is in line with the statement [Inan et al. \(2010\)](#) that science learning is learning that emphasises direct understanding of recognizing the natural environment around directly. In addition, according to [Januarisman & Ghufron \(2016\)](#) science learning in schools serves as the mastery of knowledge and scientific attitudes, as well as process skills. Through the learning of IPA, students are expected to know the natural events and things about natural science around them.

Based on the elaboration, it can be said that science learning in secondary school plays a vital role in helping students understand the world around them. In other words, after students learn science, they can apply what they have learned from their surroundings ([Khusnul et al., 2022](#)). However, obstacles are in the provision of science materials related to students' interest in learning science and their understanding of scientific terms or languages that make it difficult for them to understand it. From these problems, this research aims to create an appealing and effective approach to science learning. This is supported by the statement [Darmuki et al. \(2022\)](#) that the strategy in learning greatly affects the results of what students learn in understanding learning materials. Besides, according to [Degeng et al. \(2017\)](#) learning strategies to produce people who can live in the current era must start from the appropriate theoretical basis, those that provide more opportunities for students to experience growth in learning. Methods or strategies to be used in learning in teaching materials include a suitable strategy, easy-to-understand materials, and student accompaniment so they do not experience difficulties in understanding the materials.

The strategy used in learning can be done by using a media-based approach. In this case, teaching media is a learning resource emphasizing media as the core of the learning process. This is supported by a statement by the statement [Ilahiyah et al. \(2019\)](#) that teaching media is all forms of materials used by teachers in the learning process in class that can determine the achievement of student competencies. Besides, according to [Awaluddin \(2017\)](#), teaching materials are systematically arranged subject matter used by teachers and students in the learning process. In addition, teaching media that can be applied to increase the success of learning are a reference in providing information related to the lessons ([Akbar, 2017](#)). From this statement, teaching media can be interpreted as a tool or intermediary for teachers to provide learning materials to help students understand information in the learning process.

The use of educational media in learning must adapt to the times. This is supported by [Nurninawati et al. \(2022\)](#) that good education is education evolving with the times. In this century, digital technology is one of the most preferred aspects of the present era, which is easy to do and does not require high costs. This statement supports the trend of using digital technology in learning, which not only provides easy access but also minimises costs. Therefore, the approach to the use of instructional materials must utilise digital technology as an effective means of improving the quality of learning ([Marlina et al., 2023](#)). Through digital teaching materials, students have acquired skills and learned the necessary information for each lesson ([Alzahrani, 2022](#)). In this way, education can be more responsive to the demands of the times, provide relevant learning experiences, and support the development of learners following the dynamics of changing times. The diversity of learning resources, ranging from digital texts to interactive multimedia, provides a variety that enriches the learning experience ([Afifah, 2020](#)).

The educational media developed in this study is a web for learning IPA materials on the development of animal and plant breeding. The use of the web itself as a means of learning, according to [Marlina et al. \(2023\)](#), is very relevant to current developments. In this era, bold learning provides global access to students, allowing them to access learning materials flexibly without the constraints of time and location. Technology in learning makes the delivery of materials more stimulating, easier, and cost-and-time efficient ([Subramani & Iyappan, 2018](#)). The

technology in learning methods at this time can use internet technology in the form of a web that can be accessed anytime, anywhere.

According to [Karuppan \(2001\)](#), many academics are now actively involved in web design and the development of web-based educational materials, and this trend is expected to continuously accelerate. The Internet and web technologies have changed how we access information and learn. The web-based open media opens up new possibilities in learning materials delivery, particularly in the context of plant and animal reproductive development. This approach presents the material more interestingly and interactively by combining multimedia elements such as images, videos, and simulations. This statement is supported by [Ilin \(2021\)](#) that digital educational media can support online learning through soft media in the form of a web or application that helps students learn. This can create a more dynamic learning experience and motivate students to become more involved in the learning process. Through web-based open media, students can access more complete and up-to-date information about the evolution of plant and animal mating. Interactive multimedia allows them to understand these concepts through visual and auditory experiences that can enrich their understanding. Thus, web-based learning media in the context of plant and animal reproductive development not only increases the accessibility of information but also stimulates students' interest and involvement in learning, thus creating a more enjoyable and productive learning environment.

From the above statement, the use of the web in learning is also reinforced by previous research statements that support the effectiveness of the web as a teaching medium in learning IPA at the junior high school (SMP) level. According to research from [Eliyarti et al. \(2020\)](#), the use of the web states that significant differences in learning outcomes occur, indicating that physics teaching materials with different forms of web-based assignments influence students' learning outcomes. During learning, students seem to be actively involved and more motivated to complete the assigned missions. In learning activities, changing and varying the form of tasks encourages students to be more creative. In addition, research by [Dwipa et al. \(2023\)](#) claimed that the effectiveness of web-based science learning media can be seen in the student learning outcomes test that obtained a percentage of student learning completeness of 92.8%. Then, according to research by [Berlian et al. \(2023\)](#), web-based media as learning media and learning resources have a wide scope, thus enabling students to learn independently and improve their digital literacy skills on the concept of biotechnology. [Januarisman & Ghufro \(2016\)](#) stated that the application of web-based learning media in science subjects for seventh-grade students before the research was conducted based on the survey results showed that junior high schools in Depok Sleman District had not yet applied web-based science learning media in the teaching and learning process. In addition, according to [Chen & Wang \(2020\)](#), the results of the assessment of the practicality of web-based science learning media on pollution material by students in small group tests with an achievement level of 93%; a very practical criterion. In the field test, the achievement level was 94%; a very practical criterion. In the trial use with an achievement level of 100%, the criteria are very practical. However, there are still obstacles to the use of digital learning media in the form of limited teachers in the use of digital learning media. These problems can be found in several previous research. Learning Natural Sciences (IPA) still tends to rely on conventional media such as blackboards and printed books. Besides, the use of digital learning media is still limited and monotonous. Another statement was also presented by [Imran & Sulviana \(2022\)](#) who explained that students' interest in learning IPA still seems to be low due to teachers' lack of use of educational media and limited use of educational media in the form of books and only using PPT.

The results of observations at junior high schools in Malang City in class 9 revealed obstacles in the form of a learning process where the student's interest in the learning process of IPA was still low, based on the student's attention to the learning provided, so the teacher found it difficult to deliver the subject matter. The teaching methods tended to be lectures and discussions. The teaching aids were limited to package books and PPTs. In addition, the results of the interview with the IPA learning teachers indicate some obstacles in the delivery of the material by the teacher because the students were not enthusiastic and focused and did not understand the materials being discussed. In addition, sometimes only a short time was allotted for one material,

namely 2-3 sessions. Teachers also had problems with technology-based teaching media; they tended to use PPTs, which present materials only in text. Teachers wanted to explain the materials in detail using multimedia such as text, video, and images that were easily accessible to the students.

From the above elaboration, the web for science learning is very good and effective for teaching. This fascinated the researchers to use web teaching media for grade 9 junior high school students on animal and plant breeding materials. In addition, the results of the observations at junior high schools in Malang City grade 9 found that the teaching materials were limited to textbooks with minimal explanation of the material and colours as it uses only 2 colours. In addition, the results of interviews with biology teachers inform that the teaching media was limited to PPT and student books. In response to these problems, the researchers want to create a web about animal and plant breeding accessible to students via mobile phones anytime and anywhere. This is based on the observation that junior high school students in Malang City tend to use mobile phones only for entertainment during breaks. It is hoped that the existence of a web that can be accessed via mobile phones will help provide students with learning media options and make it easier for students to study at home and in class.

METHOD

The testing of web-based educational materials on animal and plant breeding used quantitative methods with inferential statistics, using ANOVA (analysis of variance) as an analysis technique to determine whether differences in scores on the dependent variable can be explained by differences in scores on the independent variable. This method statistically measures whether the variation between test groups is greater than that in the control group (Setiawan, 2019). The results of the variance analysis can provide a deeper understanding of the effectiveness of web-based animal and plant breeding materials. If there is a significant difference between the groups, it can indicate that the learning method has a different impact on the student's learning outcomes described in Table 1. Therefore, through the application of ANOVA, this study can provide significant information on the effectiveness of web-based teaching materials in improving students' understanding of animal and plant breeding development materials (Darmaji et al., 2022).

Table 1. Acquisition of raw data comparing learning outcomes

Use of teaching materials	
Experimental class	Control class
X1	X2

The web for learning science material on animal and plant development was made using sites.google.com This method is used so that in the future, teachers can create their own web as a variety of learning for the classroom, adapted to the conditions of students. Figure 1 is the form of the web used in learning science.

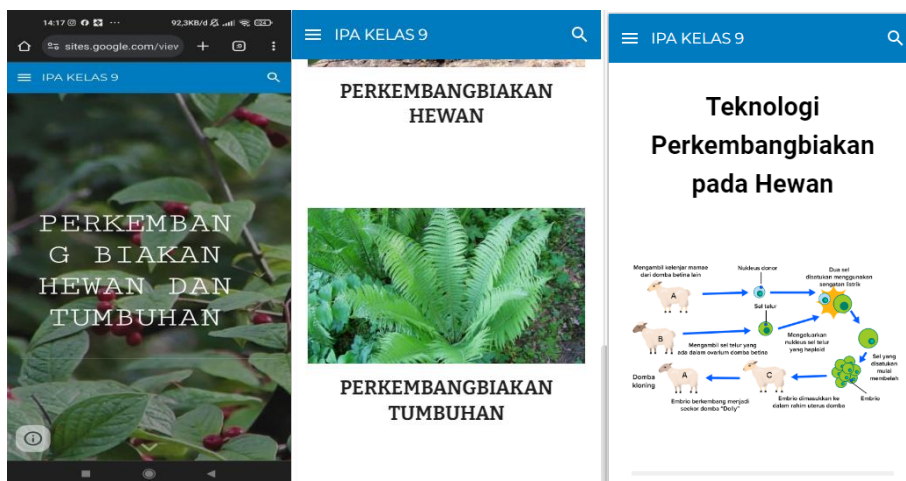


Figure 1. Web view of teaching media for animal and plant reproduction

This study focused on grade 9 students in one of the junior high schools in Malang, specifically grades F and G, who were studying animal and plant reproduction. The web-based teaching method was implemented in the experimental class, while the control class used the conventional method with PPT presentations and textbooks. The sample size was determined according to Sugiyono, (2018) theory and lasted for one month. This study used a qualitative experimental method with statistical analysis using ANOVA. The procedures of this study included the preparation of the proposal and instrument, media validation, and obtaining permission from the school. Observations and interviews with teachers and students were conducted to identify barriers to learning scientific terms related to animal and plant reproduction.

The research subjects, including the control class and the experimental class, were identified based on the willingness of the teachers and students. The control class used traditional teaching methods, while the experimental class used web-based teaching with mobile phones, supervised by teachers and researchers. The evaluation was done using a 20-question quiz app for both classes. Data collection included post-test scores and interviews to gain insight into the learning process. The data underwent normality testing to ensure normality of distribution, followed by ANOVA to assess significant differences between the test and control groups (Setiawan, 2019). Interpretation of the results and discussion focused on the potential impact of web-based learning on student understanding compared to traditional methods. The study concludes by summarising the findings and answering the research questions regarding the effect of the independent variable (learning method) on student learning outcomes. The conclusions form the basis for recommendations for the development of future learning methods.

The technique in the data analysis was to manage the data obtained through qualitative methods using formula (1) and the Likert scale in Table 2 by following the Scale Rating Category according to Sugiyono (2017). The average percentage results obtained are calculated using the Formula 1.

$$P = \frac{\sum X}{N} \times 100\% \tag{1}$$

- P = Percentage of student response results
- $\sum X$ = Number of scores selected by students (yes or no)
- N = Maximum number of scores

Table 2. Likert scale rating categories

Skor	Description
Skor 1	Very good in use
Skor 2	Good in use
Skor 3	Good enough to use
Skor 4	Less for use

Skor 5 Not good at use

Source: Sugiyono, (2015:135)

Once the score value had been obtained, the data were analysed using the normality test and hypothesis testing using SPSS. The normality test aims to determine whether or not the data are normally distributed, where this test has conditions that Sig. < 0.05 indicates that the data are normally distributed and, conversely, the data are not normally distributed if Sig. > 0.05 (Lelisho et al., 2023). After performing the normalisation test, we proceeded to the one-way ANOVA test, which aims to test the dependent variable by comparing it to a group of observed independent samples. Analysis of variance is currently widely used in the survey and experimental research (Devianto et al., 2014). The basis for determining the ANOVA test is as follows:

If significant or probability > 0.05 then H0 is accepted

If significant or probability <0.05 then H0 is rejected

RESULT

The results of this study were carried out using the previously described research, where the results of the learning variables were tabulated in a work table. Table 3 shows the statistical worksheet.

Table 3. Pre-test and post-test results

Use of teaching materials				
Experimental class		Control class		
Pre-test	Post-test	Pre-test	Post-test	
85	84	72	80	
77	100	67	84	
85	96	75	56	
95	64	72	80	
70	100	82	84	
60	84	70	52	
87	100	77	64	
75	100	70,	52	
67	96	60	92	
85	92	70	96	
85	96	90	64	
85	92	77	96	
85	92	80	44	
87	92	77	96	
72	80	72	76	
85	64	77	84	
70	92	65	84	
82	84	80	68	
72	88	85	0	
92	100	82	76	
67	100	60	72	

70	96	60	84
82	100	67	64
65	100	45	60
80	80	65	88
85	100	80	96
82	88	37	92
85	92	77	60
87	84	77	84
79,44	90.89	71,31	73.37

Table 3 implies that the highest score obtained by the students in the test class was 100, and the lowest score in the test class was 64, with an average score of 90.89. In addition, the highest score of the highest control class was 96, and the lowest score of the high class was 0, with an average score of 73.37. Table 3 indicates that the average of the test class is higher than that of the Sample class.

After obtaining the data, the normality of the above data was first calculated using SPSS. The results of the normality calculation are in Table 4.

Table 4. Normality test result

	Class	Shapiro-Wilk		
		Statistic	df	Sig.
ipa test results	Experimental class	.588	29	.000
	sample class	.856	29	.001

The normality test shows that the data was not normally distributed. Since H_0 is rejected as $0.000 < 0.05$, this test suggests that the data is not normally distributed. The Kolmogorov-Smirnov test indicates that the data are not normally distributed. Since H_0 is rejected as $0.001 < 0.05$, this test signifies that the data is not normally distributed. Even if the normality results are not met in one or both data groups, the ANOVA test can still be performed in certain situations. If the abnormality is not too significant and the data distribution is relatively symmetric, ANOVA can still provide reliable results. With a large sample size, the importance of the normality test can be reduced because, in this case, the t-test and ANOVA can still give fairly robust results even if the data do not follow a normal distribution, as shown in Table 5.

Table 5. Anova Test Results

	ANOVA				
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3099.586	1	3099.586	7.691	.008
Within Groups	22568.828	56	403.015		
Total	25668.414	57			

Table 5 shows the results of the data analysis using the ANOVA test, which showed significant differences in student learning outcomes between the groups using web-based learning methods and the control groups using traditional book-based learning methods. The F-statistic value is 7.691 with a significance level of $0.008 > 0.05$, so the null hypothesis (H_0) can be accepted. These results strongly indicate that the developed web-based learning has a significantly different

impact on student learning outcomes compared to traditional methods. In other words, statistical evidence of a significant difference in student learning outcomes between the two groups was present. In addition, students validated the web-based learning media. The data obtained from the student user response questionnaire were then analysed using qualitative data to test the results of student responses and the feasibility of the developed learning media described in Table 6.

Table 6. Student validation results

NO	Statement	1	2	3	4	5	TES	TMS	Average = $\frac{\sum \text{score overall}}{\sum \text{All items}}$	percentage
1.	I know the learning objectives that have been presented	7	2	6	9	5	90	145	3.10	62%
2.	The material taught by the teacher is related to my daily observations	6	3	7	7	5	90	145	3.10	62%
3.	The material taught by the teacher was in line with what I expected about animal breeding.	4	6	2	13	4	94	145	3.24	64.8%
4	The material taught by the teacher is appropriate for my material needs.	7	3	6	9	4	87	145	3	60%
5	The material taught by the teacher helps to improve my learning ability.	4	7	5	8	5	90	145	3.10	62%
6	I am happy with the material taught by the teacher.	4	6	8	7	4	88	145	3.03	60.6
7	I understand the learning model applied in this lesson.	4	4	9	7	4	92	145	3.17	63%
8	The use of media makes the material more interesting.	4	6	5	8	6	93	145	3.20	64%
9	The media used motivates me to learn.	4	2	10	7	5	92	145	3.17	63.4%
10	The teaching materials used are quite modern.	4	4	10	6	5	91	145	3.10	62%
Average									3.12	62%

TES : Total empiric score

TMS : Total maximum score

From the table above it can be seen that the students' responses to the web teaching media for instruments 1 to 10 were achieved by 62% with an average score of 3.12, which is in the

category of good enough to be used in the process of learning about the development of animals and plants.

DISCUSSION

Teaching media made in this study is in the form of a web through the use of web-based teaching materials on animal and plant breeding materials using sites.google.com. Web media is used by students in the test class on animal and plant breeding material to make it easier for them to learn science, especially in animal and plant breeding material, so it is hoped that the use of the web can improve learning outcomes and the ability of students to remember the terms in the material. Teaching media in the form of this application has several menus that are by what is being learned on that day, consisting of Animal Breeding, Plant Breeding, and Modern Breeding Technology, which is equipped with videos that can be accessed directly through the web. In addition, these web media have been equipped with explanations adapted to the material provided and additional videos that enhance the student's ability to learn. On the other hand, the control class employed PPT and textbooks with the same content as the web.

Based on the results, the web teaching media using sites.google.com can affect the learning outcomes and interest of junior high school students in learning IPA, especially animal breeding material. This is due to the use of web teaching media that can be accessed via mobile phones (Android), and in this study was designed by considering the area of science literacy, which includes three components, namely knowledge, application, and reasoning. The third element is presented through some educational media in the form of this learning web. Here, students are asked to read and write the important things related to the explanation on the web and repeat the content of the discussion. According to [Aripin \(2018\)](#), mobile-based teaching materials, in this case the web, are very helpful for students to learn the materials and understand the meaning of the IPA learning. In addition, the videos associated with each explanation provide students with a visual image of the process of animal and plant breeding in detail, which is easy to understand.

In addition, the interviews with 9th grade F students or test classes unveiled that the use of teaching media using the web is considered new to their school; usually, the teaching media was only in the form of PPT and textbooks, so teaching using the web is very fascinating and the delivery of material provided is by the material to be taught. The results of other interviews stated that the web exposure, in addition to using words, also attached a video, where the video was very helpful in delivering material, especially in the process of metamorphosis and the process of plant reproduction. The results of the interview showed that learning via the web had several advantages over the other media used, so there was a significant difference in the average scores of the two groups. However, some students could not use these web-based learning media and were too cool on their own and had to be corrected by the teacher. Behind all this is the fact that the use of the web also makes it easier for the students to access the media and that it can be used anywhere via Android or laptop. This is supported by the statement of [Kuswanto & Radiansah \(2018\)](#) that web teaching media via Android has several advantages: it is easily accessible anytime and anywhere and is simple, attractive, and easy to use. Furthermore, according to [Sari & Setiawan \(2021\)](#), web-based learning approaches are considered beneficial because they can provide information to students without being limited by space and time.

Educational media in this study is an interactive multimedia that positively impacts students' literacy. According to [Risma & Nurhikmah \(2023\)](#) the use of the Web in science learning has enormous benefits, especially in the context of learning activities at school and at home, by using video, text, sound, and image features that support students' learning process. The web-based approach to science learning allows students to access science learning materials anytime, anywhere. In addition, according to [Rohmani et al. \(2021\)](#), the primary purpose is to present information comprehensively to students to achieve the desired results in the learning process. The integration of different types of media aims to improve student understanding through a more holistic approach, using the strengths of each element to present learning material interestingly and effectively. In addition, research that supports the results of web-based learning in learning in terms of student learning outcomes was done by [Fadilah \(2019\)](#), who stated that web-based learning media create an intriguing and non-monotonous atmosphere by using

different media approaches in the form of text, video, and images, which make the instructional media provided interesting and improve student learning outcomes. Other studies also state that the effectiveness of learning using web teaching media in education can improve student performance due to its advantages in motivating students to understand material quickly and improve learning outcomes (Istighfarini et al., 2022). Januarisman & Ghufro (2016) showed that the use of web teaching media makes it easier for students to access material, so it can increase the intensity of student learning and increase student knowledge.

The results of exposure to the results of research and discussion shows that web teaching media can have a significant impact on student learning outcomes, although the results of the student questionnaire stated that it was quite good, the results of the acquisition of the scores of test students and control students were very influential in making the web learning of science materials of the evolution of animals and plants very effective in using and helping students in learning.

CONCLUSION

The current study only focuses on increasing student understanding of animal and plant breeding material in grade 9. Therefore, we suggest teachers provide time for operation and initial explanation related to web teaching media before learning. Besides, teachers can develop web teaching materials in the future as an option in learning to increase student interest in the lessons being carried out. We also suggest that future researchers add a column regarding student interest in using the web and develop the web by adding elements of other methods or media so that the web developed becomes appealing and can be better understood by students.

Author contributions

The authors made substantial contributions to the conception and design of this study. The authors are responsible for the analysis, interpretation and discussion of the results. The final manuscript was read and approved by the authors.

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The authors declare no conflicts of interest with regard to the preparation and publication of this article. This article is the result of the author's originality and complete thoughts, supported by relevant references to strengthen the argument. Therefore, the data and content of this article are guaranteed to be free from plagiarism.

Data availability statement

All data are available from the authors.

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