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Development of electronic handouts for class X high school ecosystem materials for online learning

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Abstract: Students' low interest is the most common problem in online learning. As a solution, we need media that is attractive and easy to use. This study aims to (1) develop electronic handouts on the Ecosystem topic for class 10th-grade senior high school for online learning, (2) determine the feasibility of handouts, (3) determine teacher perceptions of handouts, and (4) determine student perceptions after using handouts in learning. This study uses a 4D development model. The subjects of this study were 10th-grade high school students consisting of small groups (6 students) and large groups (26 students). The results of this study indicate that the validity of the material reaches a percentage of 90% in the "very good" category, the validity of the media reaches a percentage of 95% in the " very good " category, the teacher's perception results in the percentage of 90.83% in the "very good" category, the percentage of satisfaction is average. The small group average was 89.72% in the "very satisfied" category, and the average satisfaction percentage for the large group was 90.12% in the "very satisfied" category. So it can be concluded that electronic handouts can be used in online learning. This research handout can be used as an alternative learning resource to increase students' interest in learning.

Keywords: Electronic handout, Ecosystem, Online learning

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INTRODUCTION

Online learning utilizes the internet network and digital technology in the learning process to be implemented virtually (Yuliani, 2020). Nevertheless, online learning must still focus on learning outcomes and student competencies. However, in reality, the online learning process is still far from expectations. Arora & Srinivasan (2020) found that teachers and students often disturb the learning process. The main thing is the unstable internet network, so students will be limited when accessing online learning resources, especially those that cannot be downloaded, such as web pages. In addition, the lack of teacher training in using online platforms and providing interesting online learning resources for students is a crucial aspect that must be overcome. The reason is the lack of available learning resources that students can access and the lack of exciting learning media, resulting in low student interest in learning. This problem has become a cliché because the transformation of the learning environment into the digital era is not balanced with the readiness of teachers and supporting learning resources.

The observations in the field indicate that students' low interest in online learning is genuine, even in excellent schools. This finding is reinforced by the number of students who submit assignments on time through the platform provided by the school, which is less than 70%. On the other hand, the level of student participation in the learning process is only at 30%. Kemit (2021) also found the same case, who stated that students' interest in online learning was meager due to the lack of synchronization of learning resources, media, and treatment with the learning process. Most teachers carry out online learning activities, such as face-to-face learning, where students tend to be easier to be conditioned and supervised. For this reason, learning media is needed to support online learning to increase students' interest in learning.

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Learning media that can increase student interest are media that have an attractive appearance and follow learning indicators and objectives. One of these media is electronic handouts that combine a summary of the material with exciting visualizations such as interesting and relevant images, videos, and animations. Studies conducted at the research object schools confirmed that students had never used electronic handouts, so the researchers developed electronic handouts to increase students' interest in learning.

The handout is a learning media that contains material briefly (Astra et al., 2019). The handouts are compiled from relevant literature per the subject's essential competencies, indicators, and learning objectives (Supriyati et al., 2019). The development of electronic handouts is based on presenting handouts in an electronic format (Najuah, 2020). Moreover, the potential for embedding multimedia as a source of further information is of added value compared to printed handouts. In addition, the electronic handout developed in this study also follows the 21st-century learning era because this electronic handout was developed by focusing on the student center. Electronic handouts contain material on the ecosystem around students so that students will think more critically about the ecosystem in their environment. Besides, electronic handouts are easy for students to learn (Fitriani, 2021).

The electronic handout in this study contains the topic of ecosystems. The selection of ecosystem topics is based on characteristics that tend to be contextual and easy to observe without coming to the laboratory (Susilawati et al., 2016). In addition, the ecosystem material contains ecosystems in Jambi province, so it can add insight and knowledge for students about the natural wealth around them and foster a sense of love for the natural wealth in their province. The natural wealth of Jambi Province that relates to this topic includes natural forests, mangrove forests, mountainous ecosystems located in Kerinci Regency, and coastal areas in Tanjung Jabung Barat and Tanjung Jabung Timur Regencies (Nursanti et al., 2021). The presence of electronic handouts with potential local content is expected to increase the knowledge of students and the general public about the natural wealth that exists in the surrounding environment and is expected to make students more aware of environmental sustainability and natural wealth.

The development of electronic handouts in this study was designed with the Canva design application. Canva's design app is an easy-to-use design app. The Canva app can be used both offline and online. Canva's design app offers many features, including posters, resumes, graphics, presentations, flyers, banners, bookmarks, and more (Garris, 2020). The advantages of the Canva application are the short time for making learning media due to the use of practical applications, the designs contained in the Canva application are varied and exciting, and the design process is very flexible and can be done via laptops and cellphones. This study was carried out to answer the following research questions: (1) what is the characteristic of the electronic handout material for class X Senior High School Ecosystem for online learning, (2) how is the feasibility of electronic handouts on the Ecosystem material for class X Senior High School for online learning, (3) how is the teacher's perception of electronic handouts on Ecosystem material for class X Senior High School for online learning, and (4) how are students' perceptions of electronic handouts on Ecosystem material for class X Senior High School for online learning.

METODE

The development of electronic handouts in this study uses a type of development research with a 4D development model. There are four stages of development: Define, Design, Develop and Disseminate (Trianto, 2010). The 4D model was chosen in this study because this model is systematic and very appropriate to be used to develop simple learning media (Arywiantari et al., 2015).

Research Subjects

Field trials were carried out in one of the high schools in Jambi City. Learning trials were carried out on small groups of 6 students and 26 large groups. This number has met the testing criteria suggested by Setyosari (2016), which for small group trials, it is sufficient to involve 5-8 subjects, while large group trials can involve more significant class subjects, namely 15-30 subjects. The selection of subject groups is based on school readiness, namely schools that are accredited A and schools that have a vision of carrying out the learning process by utilizing teaching materials in the form of Information and Communication Technology (ICT). In addition, the media is also validated by experts to obtain

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information about the feasibility of handouts on media and materials aspects. In addition, biology teachers, as school practitioners, are also research subjects to provide perceptions about the media developed by filling out teacher perceptions questionnaires.

Research Procedure

The research has four main stages as described in the 4D development model, which stages define, design, develop, and disseminate. The define stage is the stage of establishing and defining the problems and needs of students based on problems in the learning process. This stage is the initial stage of research to produce a research background. At this stage, researchers conducted interviews with Biology teachers to find the problems in online learning, especially in Biology subjects, with problem analysis including student needs, concept analysis, and analysis of learning objectives.

The next stage is finding efficient and effective ways to develop product designs based on the data from the defined stage. Activities carried out at the design stage include the selection of teaching materials, the selection of formats, and the initial design. The selected teaching materials are electronic handouts because electronic handouts are media that contain concise material and are equipped with animations, pictures, and videos. The design stage is to collect reference materials, images, and videos related to ecosystem materials, especially ecosystems in the province. After the reference material, images and videos have been collected. The researcher begins to design electronic handouts using the Canva application. The developed electronic handouts are made in electronic form that can be accessed on mobile phones or laptops that suit the needs of online learning.

The Develop stage is the implementation stage of the product planning designed in the previous stage. The Develop stage is designing the product and inserting the collected materials, images, animations, and videos into the developed media. Then the product that has been developed will be validated based on aspects of media validation and material validation. The product will be revised according to the experts until declared feasible to be implemented. After that, the product was implemented, and teachers' and students' perceptions were collected. The Disseminate stage is the final part of the development, which is carried out to disseminate products developed via web links.

Data Analysis

Product Fesialibility

The data was obtained through the assessment score of the validation questionnaire on the material and media aspects conducted by expert lecturers, the teacher's perception assessment, and the student's perception assessment. The rating scale uses a Likert scale with intervals of 1 to 4, and the average score will be calculated for each item of the questionnaire statement with a weight of very good (4), good (3), fair (2), and poor (1). Furthermore, to determine the level of validity of the material and media aspects, as well as the assessment of teacher perceptions and student perceptions, the data that has been obtained from respondents is tabulated to determine the feasibility level of the electronic handout media developed using the following eligibility percentages:

$$\%\,\text{fesiability} = \frac{T}{T_{\max} \times n \times N} \times 100\%$$

Where T is the assessment score, Tmax is the maximum assessment score, n is the number of item descriptors, and N is the number of respondents. Furthermore, the scores that have been obtained are grouped into several categories based on intervals using the following equation:

$$I = \frac{T_{\max} - T_{\min}}{C}$$

with C being the rating category (4-Likert scale). After obtaining the results of the percentage of answers to specific criteria, determining the category of scores given to a category as in Table 1 (Arikunto, 2009).

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Table 1. Product Qualification Rating Scale

No	Score (%)	Category
1	< 21%	Poor
2	21 – 40%	Fair
4	41 – 60%	Good
5	61 – 80%	Very Good
6	81 – 100%	Excellent

Inferential Statistical Analysis

The following analysis is student learning outcomes. The analysis carried out for student learning outcomes is inferential statistical analysis. The inferential analysis has several stages: prerequisite tests for pre-test and post-test data and different tests. Statistical analysis was performed using analytical software with a significance level of 0.05.

RESULTS AND DISCUSSION

The results of this study consist of: (1) the characteristics of the electronic handout, (2) the feasibility of the handout in terms of media and materials, (3) the results of measuring student abilities, (4) the perception of the biology subject teacher, and (5) the perception of students in small groups and large groups. However, before discussing learning media products, we would like to present an analysis of product development needs. The results of the needs analysis for online learning media define the characteristics of the media needed: media that can attract creative and innovative students and media that lead to student centers. In addition, we also analyze the basic concepts that students must learn and master. The basic concepts in one basic competency are linked with other essential competencies, becoming a concept map.

Product Development

The product made in this research is an electronic handout learning media for Ecosystem material for class X Senior High School. Electronic handouts consist of several main components, namely (1) cover, (2) instructions for use, (3) handout identity, (4) learning objectives, (5) concept maps, (6) content of the material, (7) exercises, (8) summary, and (9) bibliography. On the cover, the expected media criteria are not monotonous so that they can attract students' interest to use them in learning. Therefore, on the cover page, a moving image is attached to the background.

The user manual display is provided with a download button to access the electronic handout on the cellphone/laptop and a fullscreen button to display electronic handout media in full view. An essential part of this page is to provide a complete explanation of how to use the media. It should be noted that this media is designed to be used independently by students. Thus, students must get precise directions to get an optimal learning experience.

The next part is a concept map of Ecosystem material. Characteristics of students who tend to be dynamic require selecting more eye-catching writing. Researchers, developers, and teachers must pay close attention to this aspect because the combination of writing, color, and animation will make students more comfortable paying attention to the media. On the other hand, the aspect of content and media focus is also inseparable part. The concept map display is shown in Figure 1.

The presentation of the contents of the handout is designed to make students feel at home in learning. The goal is, of course, to increase interest in learning during a pandemic. Efforts are being made to present an attractive environment, such as by creating an attractive and moving animated background. In addition, various combinations of writing are believed to maintain student focus during learning. This follows the research by Setya & Zakwandi (2019), which states that learning media innovations also need to seek multimedia factors that make students feel at home when using them.

Furthermore, Colliot & Jamet (2018) explained that this phenomenon is related to the social-cue theory in which the presence of a teacher (face and gestures) positively influences learners' motivation and engagement in their learning. Thus, the use of multimedia can increase the focus on student learning independently. Like playing games, well-designed multimedia can increase students' interest in using applications.

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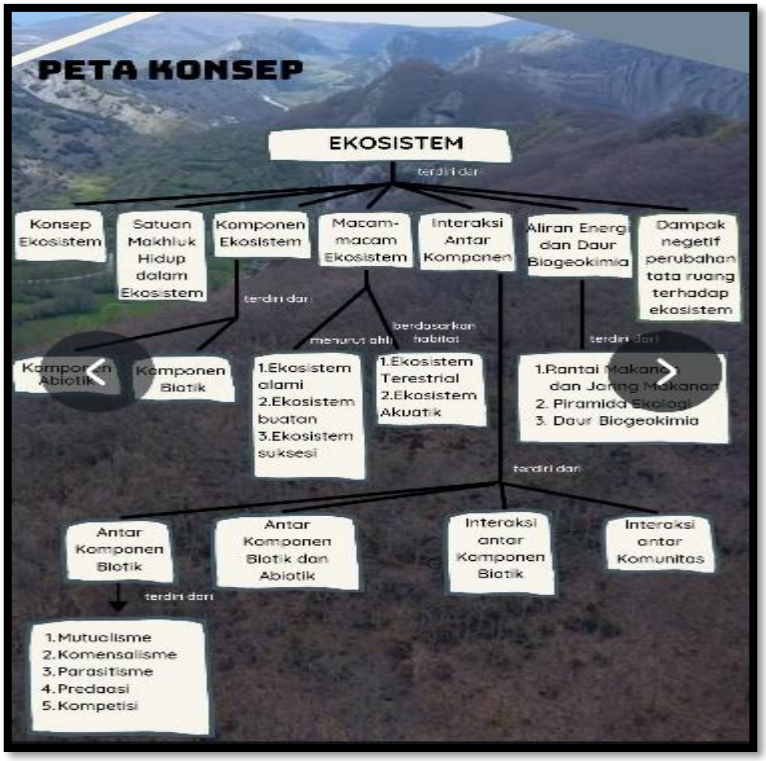

Figure 1. Mind Map

Material Aspect Product Validation

The validation of the electronic handout for the material aspect was carried out twice. The assessment aspect consisted of 3 indicators, namely the presentation of the material, the presentation of language, and the suitability of the material with the scientific and cognitive framework of students. In the first stage, the validation results for the presentation of the material were obtained by 70% with the "good" category. Some notes that need to be considered in further development are additional supporting and complementary information. Supporting and complementary information becomes the focus because it is closely related to regional characteristics that make unique electronic handouts.

Furthermore, the language presentation indicator scored 85% in the "very good" category. This indicator assesses the sentence structure and the language used in the handout. Language is a means for students to understand context is very feasible. For groups of elementary and middle school students, the use of general terms is still a priority, in addition to still using popular science terms.

The indicator of the suitability of the material with the student's cognitive structure has also shown promising results, with a percentage score of 62.5%. This indicator has a significant role for a learning resource because it is useless if the development of learning resources produces the same work as before. On the other hand, a researcher's ability to develop learning content is also represented in this context. However, some signs must be considered to determine the suitability of the material. The characteristics of students are, of course, the main thing to consider.

The final material validation results in stage I obtained a reasonably significant result, 68.33%, with the "very good" category to be tested in the field. However, we decided to make some improvements as input from the validator. Improvements made are then re-assessed by the validator for the same rating points. In the material presentation indicator, the developed handout has obtained a percentage score of 95% in the "excellent" category. In the indicator of language presentation, it gets a percentage score of 87.5% in the "excellent" category. The material suitability indicator obtained a percentage score of 87.5% in the "excellent" category, and the final material validation result obtained a percentage of 90% with the "excellent" category being tested in the field.

Media Aspect Validation

Media experts carried out three times (three cycles) validation of the media aspect, which assessed two indicators, appearance and design. In the first stage, the media display indicator obtained a

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percentage score of 40% in the "good" category. The results of this initial validation indicate that the media is still lacking in appearance. The test results on several devices show that the media is not fully ready because some images and videos are not clear due to the low resolution. Therefore, this is a note for developers of learning media, especially smartphone-based. Insufficient image quality causes the user experience to deteriorate. Researchers certainly need to consider technical things like this. The same thing was also found in the design indicators, which only obtained a percentage score of 47.5% in the "good" category. Comments and suggestions from media experts on learning media design are unattractive media design, unclear images and writing, less attractive presentation of material, and monotonous design variations, so innovation and creativity in more exciting designs are needed. The final result of media validation in stage I obtained a percentage result of 45% in the "good" category, and revision was needed.

In the second phase, the media display indicator by obtaining a percentage of 70% in the "very good" category. The comments and suggestions of media experts on the media display are that the media display is quite attractive, but the color selection is too monotonous. The instructional media design indicator got a score of 30 and a percentage of 75% in the "good" category. The comments and suggestions of media experts on the design of learning media are attractive media design, the use of media is quite simple, the media is quite flexible and efficient, has an innovative design. The final result of media validation in stage II obtained a percentage of 73.33% with the "very good" category, but media experts suggested revising again to produce better media.

In the third stage, the media display indicator obtained a percentage of 95% in the "excellent" category. The comments and suggestions of media experts on the appearance of the media are that the media display is very attractive and has animation, exciting pictures, and backgrounds. The size and type of letters are apparent and can be read. The addition of animation makes the media not monotonous. The instructional media design indicator obtained a score of 38 and a percentage of 95% in the "very good" category. The comments and suggestions of media experts on the design of learning media are that the media design is very attractive, the use of the media is easy to operate, the media is very flexible and efficient, has innovative and creative designs. The preparation of materials and designs is neat. The final result of media validation in stage III obtained a percentage of 95%, with the "excellent" category being tested in the field. Based on the three stages of media validation, it can be concluded that the percentage of product feasibility increases at each stage of the media validation process until the product is feasible to be tested in the field.

Implementation

After the product is declared feasible on the material and media aspects, the product is then tested on learning. The implementation was conducted in small groups and optimized in large-group. During the implementation, the questionnaires were distributed to obtain teachers' and students' perceptions. The two indicators' perceptions of students and teachers are provided in Table 2. Overall, all subjects gave a good category rating on the use of handouts. Visually, the evidence of group satisfaction is shown in Figure 2.

Table 2. Perception

No	Indikator	Groups	Score	Percentages (%)	Category
1	Material Presentation	Small	150	89.28	Excellent (Very Satisfied)
		Large	648	89.01	Excellent (Very Satisfied)
		Teacher	58	90.63	Excellent
2	Media Presentation	Small	173	90.10	Excellent (Very Satisfied)
		Large	758	91.10	Excellent (Very Satisfied)
		Teacher	51	91.07	Excellent

Based on the results of the trials conducted, it is known that the electronic handout material can be used as an additional source of teaching materials for teachers and students. This can be seen through the graphic image which shows that the results of the questionnaire on the assessment of Biology teachers' perceptions of the product reached a percentage of 90.83% with the "excellent" category. The results of the small group student perception questionnaire assessment reached a percentage of 89.72% in the "excellent" category, and in the large group, it reached a percentage of 90.12% in the "excellent" category.

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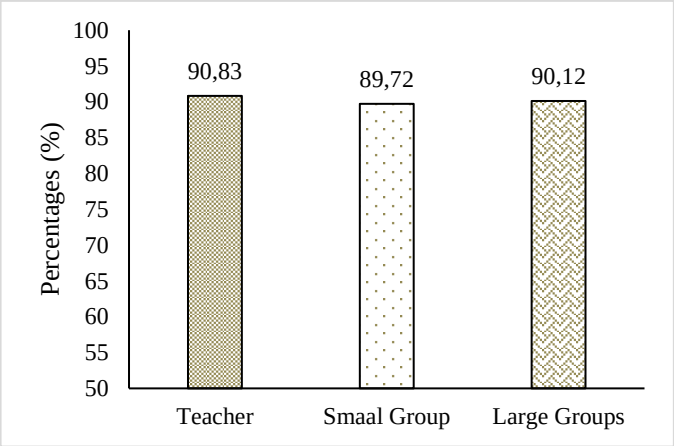

Figure 2. The Results of The Teacher's Perception Assessment Test, Small Groups, and Large Groups

Based on the results, it was concluded that electronic handouts were appropriate to be used as learning resources during online learning. The electronic handouts were engaging learning media and contained material in an ecosystem following essential competencies, learning objectives, and indicators that matched student needs and increased student learning resources to increase student interest in learning.

The last stage is the dissemination stage. This stage is carried out after the product is declared suitable for teachers and students for online learning. The product is disseminated through a website the researcher has created so teachers and students can access it. Based on the results of teacher and student assessments, electronic handouts are appropriate to be used as exciting learning resources for students and make it easier for students to understand the material being taught.

Inferential Statistical Analysis

Prerequisite Test

The inferential analysis begins with a prerequisite test for the pre-test and post-test, namely the normality test. The normality test was carried out to determine whether the data were normally distributed or not (Jepri et al., 2022). Student learning outcomes data were not normally distributed before and after treatment. Table 3 shows the results of the normality test.

Table 3. Normality Test

	Statistik	Df	Sig.
Pre-Test	0.175	33	0.012
PostTest	0.175	33	0.110

The results of the pre-test analysis showed a significant difference, indicating that the pre-test data were not normally distributed, while the post-test data were normally distributed. This requires that hypothesis testing must be carried out using a non-parametric approach.

Hypothesis test

Hypothesis testing is done by comparing the pre-test and post-test results of students during the learning process. This test is carried out with the help of statistical analysis software. The main criteria of this analysis expect students to meet the minimum passing criteria after carrying out learning using media. Table 4 shows the results of hypothesis testing with a non-parametric approach.

Table 4. Hypothesis Testing

t	Df	Sig. (2-tailed)
74.87	65	0.000

Table 4 shows a significance of 0.00, so it can be concluded that the electronic handout of ecosystem materials is effectively used in online learning. Putria et al. (2020) explained that the

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optimization of online learning could be done by maximizing the function of digital technology as a facility that supports learning.

Discussion

This study proves that electronic handouts can meet the criteria as a suitable learning medium for online learning. Electronic handouts are very practical and flexible for use by students and teachers. Based on teacher and student questionnaires on media presentation indicators, the statement "The use of electronic handouts is flexible and easy to operate" obtained a positive response of 92.85% in the "excellent" category. In addition, electronic handouts contain short and explicit ecosystem materials accompanied by pictures, animations, and videos to support the material. This electronic handout is very helpful for students in online learning as a teaching resource that can increase student interest in learning digital-based handouts can increase student interest in learning (Putri, 2020).

Students can use electronic handouts in online learning as independent learning because electronic handout media is a flexible and efficient medium (Santhalia & Sampebatu, 2020). This is following the needs of students in the analysis of student needs where students need student-centered media. In addition to the efficient and flexible use of electronic handouts, the material in the electronic handouts also invites students to think critically about the Ecosystem around them. Thus, electronic handouts are very practical for use in online learning.

Media that is interesting for students is media that is not monotonous and has an attractive appearance. The display of electronic media handouts containing animations, videos, and images that support ecosystem materials is well laid out. It obtains a media presentation percentage of 91.10% in the "Excellent (Very Satisfied)" category for small group students and 90.10% in the "Excellent (Very Satisfied)" category for large group students. It can be concluded that the electronic handout media is exciting. Mukti & Nurcahyo (2017) believe the excellent placement of media elements, such as layout, animation, images, video, and audio, will have an attractive impression on the media. Learning media that has an attractive appearance will increase student interest in learning.

The material contained in the electronic handout is Ecosystem for learning biology in grade 10 Senior High School. Examples of ecosystems observed are the Ecosystems in Jambi province and are different from other handouts. The examples presented make students more interested in reading electronic handouts and getting to know the region's diversity of ecosystems. Furthermore, the presence of this media can create a sense of love for the natural wealth in Jambi province. In addition, electronic handouts accompanied by moving pictures and animations make electronic handouts more exciting, not monotonous, and not dull and can increase students' interest in learning. This follows Wuryanti & Kartowagiran's (2016) opinion regarding the presentation of exciting and varied media that can foster student interest in learning.

Damayanti & Ishafit (2020) and Putri (2020) mention that electronic handouts are very suitable to be used as a source of teaching materials in the online and offline learning process. Furthermore, multimedia learning media had a positive effect on students and helped students understand the concept of learning materials (Damayanti & Ishafit, 2020). This follows the criteria for electronic handouts developed with multimedia and presentation of exciting and easy-to-understand concepts. The availability of concept maps will significantly help students to do apperception and connect the learning of topics that have been discussed with the topics to be discussed (Fazlina & Sumarmin, 2019; Pratama & Sakti, 2020). According to the media, electronic handouts support the online learning process, so the learning process is maximized.

Electronic handouts with material coverage oriented to local potential also have many advantages. Putri (2020) explained that students could use electronic handouts as an alternative to understanding the material because the content is different and can be accessed online. This fact reinforces electronic handouts as an alternative in online learning to providing printed teaching materials.

Teaching materials are essential to achieve a good learning process. Learning can take place effectively with the use of learning media that positively impacts student learning outcomes. The existence of learning media can enable the learning process to take place effectively so that it has a positive impact on student learning outcomes. Faradilla, S & Aimah (2018) state that the learning process that is not optimal/ineffective will make the learning outcomes not optimal. Electronic handout learning media will make the learning process not dull so that the learning process that takes place can be maximized.

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CONCLUSION

The conclusions obtained from the results of this study are as follows. (1) The developed electronic handout meets the criteria as an alternative learning media in online learning. Presentation of topics that are relatively easy to find can make it easier for students to understand concepts about ecosystems, especially in Jambi Province. (2) The feasibility of electronic handouts based on expert assessments shows that the media is very feasible both in content and media. (3) The teacher's response regarding electronic handouts showed a positive response, with a percentage reaching 90.83% in the "excellent" category. (4) Student responses to the use of electronic handouts also showed a positive trend, with the percentage of satisfaction reaching 89.72% in the small group in the "excellent (very satisfied)" category and 90.12% in the large group in the "excellent (very satisfied)" category. (5) The results of non-parametric statistical tests on students' abilities show that learning using electronic handouts can improve student learning outcomes, confirmed by the number of students who pass the minimum passing criteria.

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