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THE DEVELOPMENT OF INTERACTIVE E-BOOK MEDIA ON PROTIST TOPIC TO IMPROVE LEARNING OUTCOMES FOR 10TH GRADE OF SENIOR HIGH SCHOOL

Pengembangan Media E-Book Interaktif Pada Materi Protista Untuk Meningkatkan Hasil Belajar Siswa Kelas X SMA

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Abstract

Transformation in learning conditions during the pandemics makes students experience decreased learning achievement and difficulty absorbing new material. The government's preventive efforts in tackling the learning process are by providing internet-based and technology-based learning. Therefore, interactive e-book media as a form of merging media in the form of the internet and technology is essential. This research aims to produce an interactive e-book media on protist topic to improve learning outcomes for 10th grade of senior high school that are valid, effective, and practical. This research is development research that refers to the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The parameters measured were the validity of the interactive e-book media which was assessed based on the presentation, content, and language aspects by expert lecturers and biology teachers. The effectiveness of the interactive e-book media was obtained from the pretest and the posttest was analyzed using N-gain. The practicality of the interactive e-book media was obtained from the responses of twenty students in 10th grade of SMA Muhammadiyah 10 Gresik. The data obtained were analyzed descriptively quantitatively. The result showed that the interactive e-book media has an average percentage of validity score of 94.93%, with a very valid category. The effectiveness of the interactive e-book media obtained an average N-gain of 59, which is included in the medium category with a pretty effective interpretation. The practicality of the interactive e-book media obtained an average of percentage positive responses of 84.83% in the practical category. Based on these data, it could be concluded that the interactive e-book media on protist topic to improve learning outcomes for 10th grade of senior high school is very valid, pretty effective, and practical. This research showed that interactive e-book media gives significant impact on learning outcomes.
Keywords: media, interactive E-book, Protist, learning outcomes

Abstrak

Kondisi pembelajaran selama pandemi yang berubah-ubah membuat siswa mengalami penurunan prestasi belajar dan mengalami kesulitan dalam menyerap materi baru. Langkah anjuran pemerintah dalam menanggulangi situasi proses belajar ini yakni dengan menyampaikan pembelajaran berbasis media internet dan teknologi. Oleh karena itu, kebutuhan media e-book interaktif sebagai wujud penggabungan media dalam bentuk internet dan teknologi sangat diperlukan. Tujuan penelitian ini yaitu menghasilkan media e-book interaktif pada materi protista untuk meningkatkan hasil belajar siswa kelas X SMA yang valid, efektif, dan praktis. Penelitian ini merupakan penelitian pengembangan yang mengacu pada model ADDIE (Analysis, Design, Development, Implementation, dan Evaluation). Parameter yang diukur adalah validitas media e-book interaktif dinilai berdasarkan aspek penyajian, isi, dan bahasa oleh ahli media, ahli materi, dan satu guru biologi, keefektifan media e-book interaktif diperoleh dari hasil pretest dan posttest yang dianalisis dengan menggunakan N-gain, dan kepraktisan media e-book interaktif diperoleh dari respon dua puluh siswa kelas X IPA SMA Muhammadiyah 10 Gresik. Data yang diperoleh dianalisis secara deskriptif kuantitatif. Hasil dari penelitian ini menunjukkan media e-book interaktif memperoleh persentase rata-rata skor validitas sebesar 94,93% dengan kategori sangat valid. Hasil keefektifan media e-book interaktif memperoleh rata-rata N-gain sebesar 59 yang termasuk kategori sedang dengan interpretasi cukup efektif. Hasil kepraktisan media e-book interaktif memperoleh rata-rata persentase respon positif sebesar 84,83% dengan kategori praktis. Berdasarkan data tersebut, maka dapat disimpulkan bahwa media e-book interaktif pada materi protista untuk meningkatkan hasil belajar kelas X SMA dinyatakan sangat valid, cukup efektif, dan praktis. Penelitian ini menunjukkan media e-book interaktif memberikan dampak signifikan terhadap hasil belajar.
***Kata Kunci**: Media, E-book interaktif, Protista, hasil belajar*

INTRODUCTION

The current educational situation is experiencing the impact of the pandemic conditions where learning is being carried out online (Syahmina, 2020). At the beginning of the first quarter of the 2021-2022 academic year, several schools in Indonesia implemented face-to-face learning as the new normal era. However, this situation did not last long because the cases of covid had increased, so it required students to do online learning again. Learning conditions that continue to change during this pandemic are difficult for students and teachers. Syafa'ati (2021) stated that students experience decreased learning achievement and have difficulty absorbing new material due to a lack of teaching during the pandemic.

Rikizaputra (2021) stated that the government's steps to ensure the ongoing learning process in the pandemic era are to convey learning through internet-based media and technology. The current conditions regarding the use of learning media are also minimal and occupy the second largest problem experienced by teachers in learning (Ariyanto, 2018). The existence and function of learning media in the learning process have been included in the Minister of Education and Culture Regulation 2016 No. 22 in chapter III that learning media is needed as a tool for delivering subject matter (Kemendikbud, 2016).

Wulandari (2020) stated that the current condition regarding learning media is still dominated by PowerPoint, which displays several images, separate videos, and no animation. It makes the concept of the material contained difficult to understand and is inversely proportional to the very high student response to learning media during learning activities which shows a percentage of 75.15% (Ariyanto, 2018). High student responses in learning are an achievement that must be maintained because it affects learning outcomes (Sari, 2018). Therefore, it is necessary to have various learning media variations to overcome this situation by adding something innovative and interactive.

Learning media has experienced a significant increase in its use as science technology advances. This development can be seen with the emergence of various kinds of learning media, one of them being e-books. The e-book is a technology that can contain various media features that computers, laptops, and smartphones can read. The benefits of e-books according to research by Febriati (2013), are that easy to process quickly by students. E-books can contain various media that can attract students to learn because they are presented with high quality and interactive dimensions.

The application of technology in the interactive aspect integrated into the learning process has been proven to benefit acquiring new concepts. Reinhold *et al.* (2020) stated that the implementation of interactive learning as a feature of educational technology could show developmental progress in obtaining new concepts for low achieving students. Using e-books in learning shows high effectiveness, as evidenced by student learning outcomes of 58.49% (Alwan, 2018).

Protist topic is one of the materials studied in 10th grade, including characteristics, reproduction, and role in life. In 2017 and 2019, the mastery protist topic in the national exam showed students could not master the indicators tested with percentage results of 54.82% and 35.62% (Kemendikbud, 2019). According to research by Riki's (2018) showed that 58% of students have learning difficulties in protist topics, which is classified as quite tricky. Agustina (2022) stated that students still experience misconceptions about protist topics by 32.44%. Based on the problem data in the protist topic above, this is common because the topic is dominated by microscopic objects that are not easily observed with the sense of sight and rarely found in daily life (Raharjo, 2018). In addition, the protist topic has many scientific terms that students need to understand to classify their organisms (Istikharah, 2017).

The e-book developed has the advantage of being used for online and hybrid learning because it is packaged with the support of various exciting features connected online and can be accessed via smartphones and computers/laptops. The advantages possessed by this e-book are supported according to research by Rosyidah's (2022), which stated that e-books packaged online could visualize abstract material to help students understand learning during the pandemic. Exciting features found in this e-book are pictures, videos, hyperlinks, current information and events, evaluations, linked icons on answer sheets, and student understanding activities in the form of exploration activities and making conclusions. Feature-packed with the help of Flip PDF Professional software to make features more interactive. Making features with the help of software is proven to create visual learning conditions that attract students' interest in understanding the material (Lestari, 2019).

Based on this description above, it is known that there are limitations to the use of various learning media that can increase the level of mastery material concepts, such as protist topics. Therefore, this development research aims to produce interactive e-book media on protist topic to improve learning outcomes for 10th grade of senior high school that are valid, effective, and practical.

METHODS

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This research is development research using the ADDIE model with five phases that were Analyze, Design, Development, Implementation, and Evaluation. Analyze stage including needs analysis, curriculum analysis, and student character analysis. Design stage including designing product concepts and content, defining content to be included in interactive e-books, and making a flow chart. Development stage including validation by expert lecturers and biology teachers. Implementation stage including a limited trial on students. Evaluation stage including giving suggestions and responses to the interactive e-book media.

This research was conducted at the Departement of Biology, Faculty of Mathematics and Natural Science, State University of Surabaya from December 2021 until March 2022. The Limited trials are conducted on 20 students X IPA 2 of SMA Muhammadiyah 10 Gresik in a heterogeneous way. The validity of the interactive e-book media is measured by validation expert lecturers and biology teachers using validation sheet instruments. The validity recognition used the Likert scale with criteria 1-4. The average percentage scores can be calculated with the following formula below.

$$\text{Score validation (\%)} = \frac{\Sigma \text{ score obtained}}{\Sigma \text{ maximum score}} \text{ x } 100\%$$

Furthermore, the results of the percentage of validation will provide interpretation according to the validity criteria determined in **Table 1**. The interactive e-book media are declared valid if it gets a percentage of ≥71% (Riduwan, 2013).

Table 1. Interpretation validation score criteria

Score (%)	Criteria
25 – 40	Invalid
41 – 55	Less valid
56 -70	Valid enough
71 – 85	Valid
86 - 100	Very valid

The results of learning can be known by executing pretest and posttest with instrument test sheets. Based on these tests, researchers would score N-gain to see cognitive learning comparisons using a formula by Archambault in Sitmorang (2015) below.

$$\text{N-Gain} = \frac{\text{Posttest score-Pretest score}}{\text{Maximum score-Pretest score}} \text{ x } 100$$

The results of the normalized gain score are divided into three categories which are interpreted in **Table 2**.

Table 2. Normalized gain criteria

Score	Criteria
N-gain > 70	High
30 ≤ N-gain ≤ 70	Medium
N-gain < 30	Low

The limited trial to determine student responses was conducted using a questionnaire instrument measured using the Guttman scale. Interactive e-book media is declared practical if it has a percentage of 71% with a score of 1 for the answer "Yes" and 0 for the answer "No" (Riduwan, 2012). Students' responses to interactive e-book media during learning activities can be calculated with the following formula below.

$$\text{Student respond percentage} = \frac{\text{Total score obtained}}{\text{Total score}} \text{ x } 100\%$$

Based on the results, the percentage of student responses will be interpreted in **Table 3**.

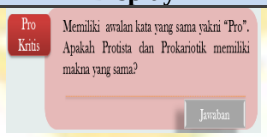
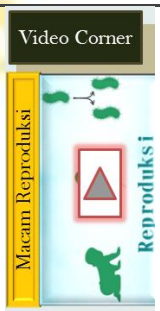
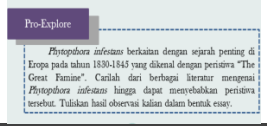
Table 3. Student response interpretation

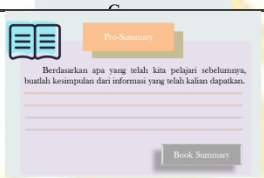
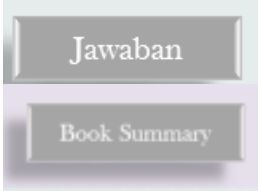
Percentage (%)	Criteria
25 – 40	Not practical
41 – 55	Less Practical
56 – 70	Practical enough
71 – 85	Practical
86 - 100	Very practical

RESULT AND DISCUSSION

This study succeeded in developing learning media with interactive e-book media on protist topic to improve learning outcomes for 10th grade of senior high school. The e-book has sub-materials consisting of the definition of protists, characteristics, reproduction, classification, and the role of protists. E-books have superior features to support students thinking processes in understanding the material and providing interactive evaluations (**Table 4**). The features that support interactive action in this e-book are **Pro-Kritis, Video Corner, Pro-Explore, Factual Phenomena, Flash Info, Pro-Summary, Pro-Eval, Pro-Link,** and **Answer icons.**

Table 4. Description features in e-book

Feature	Display	Description
Pro-Kritis		Presents critical questions to provoke students thinking processes before reading the material.
Video Corner		Presents online video shows using links to strengthen understanding.
Pro-Explore		Presents exploration activities as a form of linking

		previously studied material.
Factual Phenomena		Presents events related to the material based on the latest research progress.
Flash Info		Presents unique information about the material.
Pro-Summary		Presents concluding activities for students after learning e-books.
Pro-Eval		Presents evaluation activities to assess students' understanding after reading the material and using e-books
Pro-Link		Provides links to additional material for more detailed information on protists.
Answer Icons		An icon links to the answer sheet as a form of feedback for the *Pro-Kritis*, *Factual Phenomena*, *Pro-Summary*, and *Pro-Eval* features.

The validity of the interactive e-book media was obtained based on the results of the validator assessment by two Unesa lecturers and biology teachers at SMA Muhammadiyah 10 Gresik. The assessment is based on three aspects, presentation, content, and language. These three aspects are characteristics that can determine the quality of e-books in each academic unit (Rahmawati, 2015). The following recapitulation of the interactive e-book media validity test is shown in **Table 5**.

Table 5. Recapitulation of the validation results

No.	Assesses Aspect	Score V_1	Score V_2	Score V_3	Average
A. Presentation					
1	Presentation technique				
	a. Coherent presentation according to the concept	4	4	4	4
	b. Compatibility between available features and materials	4	4	4	4
	c. Pictures or layouts do not interfere with the presentation of the material	4	3	4	3.67
2	Material presentation support				
	a. The suitability and accuracy of the illustration with the material	4	4	4	4
	b. The features can improve student understanding	3	3	4	3.33
	c. The features can help students improve learning outcomes	4	3	4	3.67
3	Font selection				
	a. Font size easy to read	4	3	4	3.67
	b. Font easy to read	4	4	4	4
	Average presentation aspects				**3.79**
	Validity score (%)				**94.8%**
	Criteria				**Very valid**
B. Content					
1	Content				
	a. The material contains the correct concept	4	3	4	3.67
	b. The material is systematically	4	4	4	4

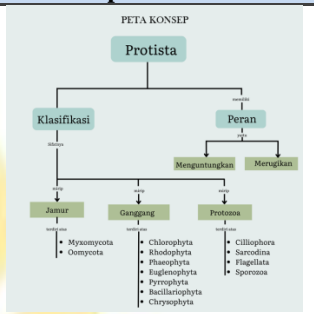
	arranged and easy to understand				
	c. The material follows the learning objectives to be achieved	4	4	4	4
	d. The material can improve students' understanding	4	4	4	4
	e. The material can improve student learning outcomes	4	3	4	3.67
2	Update				
	a. The material is following with the latest developments in biological science	4	4	4	4
	b. Has features that support learning	4	4	4	4
	c. Content updates	3	4	4	3.67
Average content aspect					**3.87**
Validity score (%)					**96.9%**
Criteria					**Very valid**
C. Language					
1	Language use				
	a. Using language according to EYD	4	3	4	3.67
	b. Sentences are easy to understand and communicative	4	3	4	3.67
	c. The language used following the level of development students	4	4	4	4
2	Use of the term				
	a. Using easy biological terms	4	4	4	4
	b. Using consistent biological terms	4	3	3	3.33
	c. Biological terms support concept delivery	4	3	4	3.67
Average language aspect					**3.72**
Validity score (%)					**93.08%**
Criteria					**Very valid**
Average validity score (%)					**94.93%**
Overall criteria					**Very valid**

Description

V_1 : 1st Validator
V_2 : 2nd Validator
V_3 : 3rd Validator

Based on the results of the interactive e-book media validation in **Table 5**, it is known that the e-book obtained an average validation score of 94.93%, with a very valid category. It indicates that a developed e-book is feasible based on presentation, content, and language. In addition, the e-book also needs little improvement according to the feedback from the validators that are presented in **Table 6**

Table 6. Improvements based on validator feedback

No.	Feedback	Improvement
1	The font size in the map section is too small	 (fixing the font size to make it easier to read)
2	The layout arrangement needs improvement so it will not disturb the presentation of the material	 a. Filum Chlorophyta Warna kehijauan pada air kolam, air danau, atau air sawah disebabkan oleh banyaknya populasi ganggang hijau atau Chlorophyta di dalamnya. Kelompok ini memiliki klorofil a dan b (pigmen hijau) sebagai pigmen dominan yang terkandung dalam kloroplas. Perbedaan kolorofil a dan b terletak pada struktur kimia, gugus pengikat, ragam cahaya yang diserap, dan kemampuan absorbsi maksimum. Hal termudah untuk membedakan antara klorofil a dan b yakni klorofil a berwarna hijau tua sedangkan klorofil b berwarna hijau muda (Ai dkk, 2011). Adanya klorofil membuat ganggang hijau dapat melakukan fotosintesis yang hasilnya disimpan sebagai cadangan makanan dalam bentuk amilum atau pati. Dinding sel ganggang hijau tersusun atas selulosa sehingga bentuk selnya selalu tetap. Reproduksi ganggang hijau dilakukan secara aseksual dengan cara pembelahan sel, fragmentasi talus, dan membentuk zoospora, sedangkan secara seksual dengan cara isogami, anisogami, oogami, dan konjugasi. Gambar 10. Ganggang hijau (a) *Micrasterias*, (b) *Ulva*, (c) *Volvox* 13 (improving the layout so not to disturb the presentation of the material and exceed the paper limit)
3	Sentence justification so that the desired meaning matches	Justify sentences with less clear meaning by replacing sentences that are easy to understand. "Ganggang memiliki kemiripan dengan tumbuhan, namun ganggang tidak memiliki daun, batang, dan akar yang sesungguhnya karena belum memiliki diferensiasi jaringan."

4	Scientific writing improvement	 (making improvements to the writing of the scientific name of the species)
5	The addition of examples of phenomena that reflect protist organisms is accompanied that provoke students thinking patterns	 (adding the latest cases and phenomena about protist organisms in each subchapter)
6	Write a bibliography by including all authors' names without using *et al.*	 "Barokah, G. R., Putri, A. K., dan Gunawan. 2016. Kelimpahan Fitoplankton Penyebab HAB (*Harmful Algal Bloom*) di Perairan Teluk Lampung pada Musim Barat dan Timur. JPB Kelautan dan Perikanan, 11(2): 115-126." (write down all authors' names)

Golongan	Spesies	Peranan
Rhodophyta	*Porphyra*	Pembungkus susi
Phaeophyta	*Sargassum*	Sumber alginat untuk bahan kosmetik, obat-obatan, dan makanan
	Macrocystis	Sebagai makanan dan pupuk
Euglenophyta	*Euglena viridis*	Menjaga keseimbangan ekosistem

Phenomena

"Harmful Algal Bloom"

Fenomena di perairan laut yang disebabkan oleh tingginya kadar unsur hara sehingga populasi fitoplankton bertambah dan menimbulkan kerugian bagi ekosistem disekitarnya. Fenomena ini bisa dikategorikan menjadi dua, yaitu *red tide maker* dan *toxin producer*. *Red tide maker* disebabkan oleh ledakan populasi berpigmen yang dapat menutupi permukaan perairan hingga menyebabkan deplesi oksigen serta gangguan fungsi mekanik maupun kimiawi pada insang ikan. *Toxin producer* disebabkan metabolit sekunder yang bersifat toksik dari suatu fitoplankton sehingga toksin dapat terakumulasi pada biota perairan.

Sumber: Barokah, G. R dkk. 2016. Kelimpahan Fitoplankton Penyebab HAB (*Harmful Algal Bloom*) di Perairan Teluk Lampung pada Musim Barat dan Timur. JPB Kelautan dan Perikanan, 11(2): 115-126.

Setelah kalian membaca deskripsi diatas, Cobalah menjawab pertanyaan dibawah ini.

PERTANYAAN

1. Apakah semua jenis alga/fitoplankton dapat mengakibatkan peristiva diatas? Berikan alasan!
2. Pada malam tahun baru, Intan harus dilarikan ke rumah sakit setelah memakan olahan seafood pinggir jalan. Setelah ditelusuri riwayat alergi yang dimiliki, dia tidak memiliki alergi terhadap produk pangan laut. Buatlah hipotesa yang terjadi pada intan dengan mengkaitkan peristiva *Harmful Algal Bloom*!

Jawaban

10

Barokah, G. R., Putri, A. K., dan Gunawan. 2016. Kelimpahan Fitoplankton Penyebab HAB (*Harmful Algal Bloom*) di Perairan Teluk Lampung pada Musim Barat dan Timur. JPB Kelautan dan Perikanan, 11(2): 115-126.

The interactive e-book media that has been developed is a media that can be accessed on the internet by laptops, computers, smartphones, and other portable devices that contain material, various media, and hyperlinks to access certain pages related to the material. It is a form of technology integration into the learning process in the digital era with space and time efficiency (Susantini, 2021). Using attractive, communicative, and interactive designs of e-book media are highly recommended for learning in the pandemic era (Wahyuni, 2021).

The aspect of presentation feasibility has an average score of 3.79 with a percentage of 94.81%, which was a very valid category. It shows that e-books are very feasible in presentation techniques, supporting material presentation, and selecting letters used. Component layout, illustrations, features, coherence and suitability of concepts, and appropriate letters can affect students' interest in using e-books. It is supported by Wulandari (2018) that systematically packaged learning media can increase students' interest in learning and understanding concepts. In addition, the appearance of the e-book also influences student interest, so an interactive design is needed (Putra, 2022). Based on feedback from validators, it is necessary to improve the layout and font settings in the concept map section to suit the development of e-book technology which focuses on readability and content accessibility (Turcic, 2018). The features on the e-book which have increased student understanding, supported by the feedback feature in the *Pro-Kritis*, *Factual phenomena*, and *Pro-Eval* sections with the help of icons linked to the answer sheet. In line with Kaplar *et al.* (2021), excellent interactive learning media is characterized by elements of interactivity and feedback during the learning process.

The aspect of content feasibility has an average score of 3.87 with a percentage of 96.9%, which was a very valid category. Based on the content and updates contained in the e-book, it has achieved learning objectives while keeping abreast of the latest developments in biological science. Learning topics and objectives are essential components in calculating the feasibility aspect of the content (Herianto, 2020). Wahyuni (2021) stated that providing information related to cases that follow the latest developments in biological science and phenomena that can be encountered daily makes students learn the material faster and easier. It shows that the content in the e-book can support the improvement of students' understanding and learning outcomes.

The feasibility of language has an average score of 3.72% with a percentage of 93,08%, which was a very valid category. According to research by Astashina (2019), selecting grammar, vocabulary, and terms in e-books can attract readers' interest in the learning process so that their use requires special attention. It is done to make it easier for readers to understand the information. The consistency of terms in books and learning media plays an essential role in forming the right concepts and making it easier for students to understand concepts in the learning process (Purnanto, 2016). Therefore, the selection of terms needs particular attention, especially for learning biology, which has many scientific terms. The consistency of using biological terms in e-books has the lowest score because there are obstacles in inputting them into the Flip PDF

application. It changes the scientific writing rules listed and requires a little revision, as shown in **Table 6**, point number 4.

The effectiveness of interactive e-book media is determined based on the increase in students' cognitive learning outcomes after using e-books. Learning outcomes are essential to determine the level of ability possessed by students and improve the ongoing learning process and diagnose the difficulties experienced by students (Sari, 2018). The data were obtained from tests given to students before (pretest) and after (posttest) using interactive e-book media by answering 5 essay questions. The data from students' pretest and posttest results are presented in **Table 7**.

Table 7. Student learning outcomes before and after using e-books (pretest and posttest)

No.	Score Pretest	UA/ A	Score Posttest	UA/ A	N-gain	Category
1	55	UA	95	A	89	High
2	48	UA	92	A	85	High
3	60	UA	82	A	55	Medium
4	55	UA	82	A	60	Medium
5	69	UA	88	A	61	Medium
6	70	UA	95	A	83	High
7	65	UA	88	A	66	Medium
8	58	UA	85	A	64	Medium
9	57	UA	85	A	65	Medium
10	40	UA	62	UA	37	Medium
11	67	UA	80	A	39	Medium
12	40	UA	88	A	80	High
13	62	UA	80	A	47	Medium
14	40	UA	85	A	75	High
15	63	UA	95	A	86	High
16	25	UA	60	UA	47	Medium
17	55	UA	60	UA	11	Low
18	55	UA	92	A	82	High
19	55	UA	95	A	89	High
20	55	UA	92	A	82	High
Average	**50**	**UA**	**76**	**A**	**59**	**Medium**
Completeness percentage (%)						**85%**

Description
UA : Unacheived
A : Achieved

Based on **Table 7**, it is known that the class completeness is 85%, with an average N-gain score of twenty students is 59, which is included in the medium category with quite effective interpretation (Nashiroh, 2020). The N-gain score obtained proves that the achievement of student learning outcomes using interactive e-book media in the cognitive aspect shows a significant difference (Devi, 2018). Therefore, interactive e-book media can be declared quite effective in improving student learning outcomes on protist material for 10th grade senior high school students. It is happened based on a review of students' abilities that are good at analyzing questions and understanding the material that has been given. According to research by Yudasmara (2015), interactive learning media can improve student learning outcomes with a completeness level of 95.83%. The interactive e-book media was also declared effective according to research by Rosyadi (2019), with the average student learning outcomes greater than the minimum completeness criteria.

The pretest results showed that all of the students did not achieve the test. It could happen because students have not studied and understood the entire material, so the students only integrate their already knowledge to answer questions (Fauziah, 2020). The posttest results showed that 17 students achieved and 3 students unachieved the test. Based on the 3 students who unachieved, it was seen that student number 16 experienced a significant increase in the results of the pretest and posttest. A significant increase occurred after using interactive e-book media, which showed that students were motivated to learn the material during the pretest. Students learning motivation to understand the material presented can arise because of dissatisfaction with the pretest results (Meylani, 2017). In addition, using appropriate learning media contributes to improving students' memory because it involves many senses in the learning process and leaves a memorable learning experience (Devi, 2018).

The practicality of interactive e-books is the ease of use for students in learning. This practicality is seen in student responses when they use interactive e-book media by filling out questionnaire sheets given to students. The recapitulation results of student responses to interactive e-book media are presented in **Table 8**.

Table 8. The results of student responses to interactive e-book media

No.	Criteria	Response (%)	
		Yes	No
DISPLAY			
1	Display images, colors, animations on interactive e-book media are interesting	60	40
2	The images presented are following the material described	100	0
3	Use the appropriate font type and size	100	0
Average positive response (%)		**86.67**	
Category		**Very practical**	
CONTENT			
1	Using language that easy to understand	100	0
2	Using communicative language	85	15
3	Using Indonesian based on EYD	100	0

4	Contents of interactive e-book media can explain the protist material so well	100	0
5	The evaluation questions can review the material that has been studied	100	0
Average positive response (%)		**97**	
Category		**Very practical**	
CHARACTERISTIC			
1	Interactive e-book media makes us interesting to participate in learning	100	0
2	Leaning activities using interactive e-book media can give high motivation in learning	75	25
3	Interactive e-book media help us understand the protist concept	100	0
4	Interactive e-book media makes us interesting study independently	45	55
5	The concept obtained can last long in memory	50	50
6	Interactive e-book media makes learning not boring	60	40
7	We are like to learn protist material using interactive e-book media	75	25
8	The feedback makes it easy to solidify protist material	100	0
Average positive response (%)		**75.62**	
Category		**Practical**	
Average overall positive response (%)		**84.38**	
Category		**Practical**	

Table 8 shows that interactive e-book media get a positive response from students. This is evidenced by acquiring the percentage of positive responses of 84.38% for "yes" answers which are included in the practical category. The highest percentage of positive responses was obtained in the content aspect of 97%, while the lowest percentage of positive responses was found in the characteristic aspect of 75.62%.

Students' responses cover 3 aspects which are display, content, and characteristic. The display aspect obtained a positive response percentage of 86.67% and 13.33% negative response. The negative response was in the statement, "Display images, colors, animations on interactive e-book media are interesting," which shows that some students still feel that the display of e-books is not attractive enough. A media appearance is needed by providing colors and images to stimulate students, especially in text-based material (Lestari, 2017). However, the comparison percentage of positive and negative responses still shows a largely positive. The feedback from students for e-books ae to use a more attractive background color or white and add animation.

The content aspect received the highest percentage of positive responses compared to other aspects, which was 97%. The lowest percentage of positive responses is contained in the statement "Using communicative language," which shows a percentage of 85%. The ratio of positive responses is still higher than negative responses. Students who gave negative responses to that statement believed that they needed assistance in understanding the sentences in the e-book so they could solve the problems they experienced. Using communicative language makes it easier for students to understand the information presented. According to research by Herminingsih (2014), communicative language can provide significant results in the teaching and learning process.

The characteristic aspect has the lowest percentage of positive responses compared to other aspects, with a percentage of 75.62%. The lowest positive response is shown in the statement, "Interactive e-book media makes us interesting study independently," with 45% positive and 55% negative responses. It shows the low willingness of students to use e-books without any learning demands. The causes of this condition can be caused by several factors, such as low learning motivation and environmental influences (Rikizaputra, 2021). Bungsu (2019) stated that in a pandemic situation that supports online and hybrid learning, it is important to have learning independence well embedded in students. Independence learning cannot be separated from students learning motivation to evaluate the activities they do (Jumaisyaroh, 2015).

The recapitulation of other statements that have not reached the maximum positive responses is shown in four statements. It is the statement related to motivation, long-term memory, impression, and experience students have. However, the percentage of positive responses was higher than the negative responses. According to research by Adnan (2019), the development of biology e-books can increase students learning motivation. Motivation is a driving force that comes from within and without affecting individual success. Learning activities will be achieved if students also have high motivation in themselves. Learning motivation has a positive relationship with students' cognitive abilities, so many ways have been done to create a learning community that can support this improvement (Yustini, 2021). Students' cognitive abilities are influenced by absorption and retention or long-term memory, which is not the same for each individual. It also affects the differences in the responses given to students in

the statement, "The concept obtained can last long in memory." The cause of individual retention differences is related to failure to encode information, weak memory resilience, and failure to transfer information from long-term memory to short-term memory (Sukmawati, 2015). Students' impressions and experiences when using e-book media will provide an output related to the impact felt by students in using media so that they will give different results. Students' variety of learning experiences can determine a variety of impressions in their learning experiences when using media. According to research by Devi (2018), students who have been treated using learning media have different experiences and learning outcomes than students who have not been treated.

The advantages presented in this interactive e-book media are proven to impact students. It can be shown in the statement "Interactive e-book media help us to understand the protist concept," which showed a positive responses score of 100%. Based on these data, the features as a characteristic in this e-book have been following their function to help students understand the material. According to research by Rosida (2017), it supports the results of this study that e-book features which have display phenomena, images, videos, hyperlinks, animations, linked icons on answer sheets and other interactive features can help students understand the material. Suggestions by students in this aspect are to add more innovative interactions and provide immediate feedback on the spot. It is based on the problem they face when they encounter difficulties in understanding information and require assistance if this interactive e-book media is used as learning media that can be used anytime and anywhere.

CLOSING

Conclusion

Based on the study results, it can be concluded that the development of interactive e-book media on protist topic to improve learning outcomes for 10th grade of senior high school is very valid, pretty effective, and practical. The validity of interactive e-book media has an average percentage score of 94.93%, with a very valid category. The effectiveness of the interactive e-book media obtained an average N-gain of 59, which is included in the medium category with a pretty effective interpretation. The practicality of the interactive e-book media obtained an average percentage of positive responses of 84.83% in the practical category.

Suggestion

Interactive e-book media that has been developed needs improvement on the increasing aspects of student motivation, interactive animation, and direct feedback when students encounter obstacles using and understanding the content of the e-books.

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REFERENCES

Adnan, Muharram, dan Jihadi, A. 2019. Pengembangan E-book Biologi Berbasis Konstruktivistik untukMeningkatkan Motivasi Belajar Siswa SMA Kelas XI. *Indonesian Journal of Educational Studies (IJES)*, 22(2): 112-119.

Agustina, L. dan Indana, S. 2022. Profil Miskonsepsi Siswa pada Materi Protista Menggunakan *Four Tier Test*. *BioEdu*, 11(1): 60-67.

Alwan, M. 2018. Pengembangan Multimedia E-book 3D Berbasis *Mobile Learning* untuk Mata Pelajaran Geografi SMA Guna Mendukung Pembelajaran Jarak Jauh. *Jurnal At-Tabir STAI Darul Kamal*, 1(2): 26-40.

Ariyanto, A., Priyayi, D. F., dan Dewi, L. 2018. Penggunaan Media Pembelajaran Biologi. *Bioedukasi Jurnal Pendidikan Biologi*, 9(1):1-13.

Astashina, M. S. 2019. The Language Course is Not Just a Book. It is Complex Set of Educational Components. *Language and Text*, 6(4): 64-69.

Bungsu, T. K., Vilardi, M., Akbar, P., dan Bernard, M. 2019. Pengaruh Kemandirian Belajar terhadap Hasil Belajar Matematka di SMKN 1 Ciahampelas. *Jurnal Sosial Humaniora*, 1(2): 382-389.

Devi, C., Uatri, T. S. G., dan Nurkanti, M. 2018. Penggunaan Media Pembelajaran MIVI (Media Interaktif Visual) untuk Meningkatkan Hasil Belajar Siswa pada Topik Sistem Gerak Manusia. *Jurnal Bioedukatika*, 6(1): 1-7.

Fauziah, O. dan Ambarwati, R. 2020. Penerapan Buku Ajar berbasis Pemaknaan Materi Invertebrata Kelas X untuk Meningkatkan Hasil Belajar dan Melatihkan Kepekaan Sikap Peserta Didik. *BioEdu*, 9(1): 41-48.

Febriati, Fani N., Budiono, J. D., dan Isnawati. 2013. Pengembangan Buku Ajar Elektronik pada Materi Struktur dan Fungsi Jaringan Tumbuhan untuk Kelas XI SMA. *BioEdu*, 2(2).

Herianto, I. Z. dan Indana, S. 2020. Validitas dan Keefektifan Lembar Kegiatan Siswa (LKS) Berbasis *Contextual Teaching and Learning* (CTL)

pada Materi Psikotropika untuk Melatihkan Kemampuan Literasi Sains Siswa SMA. *BioEdu*, 9(1): 26-32.

Herminingsih, D. I. 2014. Toward The Charazterization of The Effective Structural Features and Language Function of English Used by The Biology Teachers of The Junior High Schools to Conduct Various Instructions. *Jurnal Universitas Tulungagung BONOROWO*, 1(2): 1-12.

Istikharah, Ria dan Zulkifli, Simatupang. 2017. Pengembangan Lembar Kegiatan Peserta Didik (LKPD) Kelas X SMA/MA pada Materi Pokok Protista Berbasis Pendekatan Ilmiah. *Jurnal Pendidikan Matematika dan Sains*, 12(1): 1-6.

Jumaisyaroh, T., Napitipulu, E. E., dan Hasratuddin, H. 2015. Peningkatan Kemampuan Berpikir Kritis Matematis dan Kemandirian Belajar Siswa SMP Melalui Pembelajaran Berbasis Masalah. *Kreano, Jurnal Matemaika Kreatif-Inovatif*, 5(2): 157-169.

Kaplar, M., Radovic, S., Veljkovic, K., Simic-Muller, K., and Maric, M. 2021. The Influence of Interactive Learning Materials on Solving Task that Require Different Types of Mathematical Reasoning. *International Journal of Science and Mathemaics Education*, 1-23.

Kemendikbud. 2016. Permendikbud Nomor 22 Tahun 2016 Tentang Standar Proses Pendidikan dan Menengah. URL: http://bsnp-indonesia.org, diiakses tanggal 10 Oktober 2020.

Kemendikbud. 2019. Laporan Hasil Ujian Nasional. URL: http://pusmenjar.kemdikbud.go.id/hasil-un/, diakses tanggal 19 Oktober 2020.

Lestari, Y. D., dan Winarsih. 2017. Pengembangan Lembar Kegiatan Siswa (LKS) Berbasis *Contextual Teaching and Learning* (CTL) pada Materi Perubahan Lingkungan untuk Kelas X SMA. *Skripsi tidak diterbitkan*. Surabaya: Universitas Negeri Surabaya.

Lestari, T. L., Adi, E. P., dan Soeprayitno, Y. 2019. *E-book* Interaktif. *JKTP*, 1(1): 71-76.

Meylani, V., dan Suharsono. 2017. Pengaruh Pre Test terhadap Tingkat Pemahaman Mahasiswa Calon Guru Biologi pada Materi Praktikum Pewarnaan Gram Mata Kuliah Mikrobiologi. *Bioedusiana*, 2: 103-108.

Nashiroh, P. K., Ekarini, F., dan Ristanto, R. D. 2020. Efektivitas Penerapan Model Pembelajaran Koopeatif Tipe JIGSAW berbantuan *Mind Map* tehadap Kemampuan Pedagogik Mahasiswa Mata Kuliah Pengembangan Program Diklat. *Jurnal Pendidikan Teknologi dan Kejuruan*, 17(1): 43-52.

Purnanto, Arif W. dan Mustadi, A. 2016. Analisis Kelayakan Bahasa dalam Buku Teks Tema 1 Kelas 1 Sekolah Dasar Kurikulum 2013. *Profesi Pendidikan Dasar*, 3(2): 101-109.

Putra, R. R. dan Fitrihidajati, H. 2022. Validitas *E-book* Terintegrasi *Hands On Minds On* (HOMO) pada Materi Ekologi untuk Melatih Keterampilan Berpikir Kritis Siswa Kelas X SMA. *BioEdu*, 11(1): 116-126.

Raharjo, D., Ramili, M., and Rinanto, Y. 2018. Misconception protist in high school biology textbooks. *International Conference on Mathemaics and Science Education*, 3: 85-90.

Rahmawati, G. 2015. Buku Teks Pelajaran sebagai Sumber Belajar Siswa di Perpustakaan Sekolah di SMAN 3 Bandung. *Jurnal EduliB* ISSN: 2089-6549 Tahun 5, 5(1): 130-135.

Reinhold, Frank *et al*. 2020 Learning Fractions with and without Educational Technology: What Matters for High-Achieving and Low-Achieving Students?. *Learning and Instruction*, 65: 101264.

Riki, Ajustus, Ningsih, K., dan Yeni, L. F. 2018. *Deskripsi Kesulitan Belajar Siswa pada Materi Protista Kelas X SMA Negeri 1 Kembayan.* Pontianak: Universitas Tanjungpura.

Riduwan. 2012. *Metode & Teknik Menyusun Proposal Penelitian*. Bandung: Alfabeta.

Riduwan. 2013. *Pengantar Statistika untuk Penelitian Pendidikan, Sosial, Ekonomi, Komunikasi, dan Bisnis*. Bandung: Alfabeta.

Rikizaputra, Sembiring, Al K., Dianata, M., Azhar, M., dan Yohandri. 2021. Kemandirian dan Motivasi Belajar Biologi Siswa Menggunakan *Google Classroom* pada Masa Pandemi Covid-19. *Bio-Lectura: Jurnal Pendidikan Bologi*, 8(2): 158-166.

Rosida, Fadiawati, N., dan Jalm, T. 2017. Efektivitas Penggunaan Bahan Ajar *E-book* Interaktif dalam Menumbuhkan Keterampilan Berpikir Kritis Siswa. *Jurnal Pembelajaran Fisika*, 5(1): 35-45.

Rosyadi, I. dan Santosa, A. B. 2019. Pengembangan *E-book* sebagai Media Pembelajaran Interaktif Berbasis 3D Flipbook pada Mata Pelajaran Perekayasaan Sistem Radio dan Televisi Kelas XI TAV di SMK Negeri 2 Surabaya. *Jurnal Pendidikan Teknik Elektro*, 8(1): 97-104.

Rosyidah, I. dan Rahayu, Y. S. 2022. Pengembangan *E-book* Inteaktif berorientasi *Contextual Teaching and Learning* untuk Melatihkan Keterampilan Berpikir Kreatif pada Materi Pertumbuhan dan Perkembangan Tumbuhan. *BioEdu*, 11(1): 49-59.

Sari, Debby V., Budijastuti, W., dan Purnama, E. R. 2018. Keefektifan Kartu *Make a Match* pada Materi Sistem Rangka terhadap Hasil Belajar Siswa Kelas XI SMA. *BioEdu*, 7(2): 379-387.

Situmorang, Rosdiana M., dkk. 2015. Penerapan Model Pembelajaran *Problem Based Learning* untuk Meningkatkan Hasil Belajar Siswa pada Materi Sistem Ekskresi Manusia. *Jurnal EduBio Tropika*, 3(2): 51-97.

Sukmawati, I., Ramadani, S. D., Fauzi, A., D. dan Corebima, A. D. Perbedaan Pemberdayaan Retensi antara Siswa SMA Akademik Rendah dan Tinggi Melalui Pembelajaran Cooperative Script dalam Pembelajaran Biologi. *Prosiding Seminar Nasional Biologi/IPA dan Pembelajarannya*, 662-667.

Susantini, E., Puspitawati, R., Raharjo, dan Suadiah, H., 2021. E-book of Metacognitive Learning Strategies: Design and Implementation to Activate Srudent's Self-Regulation. *Research and Practice in Technology Enhanced Learning*, 16(13): 1-17.

Syafa'ati, J. S. N., Sucipto, dan Roysa, M. 2021. Analisis Prestasi Belajar Siswa pada Pembelajaran Daring di Masa Pandemi COVID-19. *Jurnal Educatio*, 7(1): 122-128.

Syahmina, I., Tanjung, I. F., dan Ohani. Efektivitas Pembelajaran Biologi pada Masa Pandemi Covid-19 di Madrasah Negeri Medan. *Jurnal Biolokus: Jurnal Penelitian Pendidikan Biologi dan Biologi*, 3(2): 320-327.

Turcic, M., and Pap, K. 2018. Dynamic Mathematical Layout in E-books. *Tehnicki vjesnik*, 25(2): 573-581.

Wahyuni, L. dan Rahayu, Y. S. 2021. Pengembangan *E-book* Berbasis *Project Based Learning* (PjBL) untuk Melatihkan Kemampuan Berpikir Kreatif pada Materi Pertumbuhan dan Perkembangan Tumbuhan Kelas XII SMA. *BioEdu*, 102: 314-325.

Wulandari, E., and Azwir, A. 2020. The Validity of Interactive Learning Multimedia on Protista and Fungi Materials for Senior High School. *International Journal of Progressive Sciences and Technologies*, 13(1): 98-102.

Wulandari, T., Sibuea, A. M., dan Siagian, S. 2018. Pengembangan Media Pembelajaran Berbasis Multimedia Interaktif pada Mata Pelajaran Biologi. *Jurnal Teknologi Informasi & Komunikasi Dalam Pendidikan*, 5(1): 75-86.

Yudasmara, G. A. dan Purnami, D. 2015. Pengembangan Media Pembelajaran Interaktif Biologi untuk Meningkatkan Hasil Belajar Siswa SMP. *Jurnal Pendidikan dan Pengajaran*, 48(1-3): 1-8.

Yustini, S., Rahmayumita, R., dan Hidayati, N. 2021. Video dan Google Clasroom: Sebuah cara untuk Menignkatakan Motivasi Belajar Biologi Siswa SMAN 1 Pagaran Tapah, Riau. *Bioedusiana*, 6(2): 121-132.