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# THE VALIDITY OF INTERACTIVE E-BOOK ON HUMAN HEREDITY MATERIAL TO IMPROVE CRITICAL THINKING SKILLS OF 12TH GRADE HIGH SCHOOL STUDENTS

## *Validitas E-Book Interaktif Pada Materi Hereditas Pada Manusia Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa Kelas XII SMA*

**Diva Reftiyana**
Biology Education, Fakulty Matematics and Natural Sciences, Universitas Negeri Surabaya
*E-mail:divareftiyana.20045@mhs.unesa.ac.id*

**Endang Susantini**
Biology Education, Fakulty Matematics and Natural Sciences, Universitas Negeri Surabaya
*E-mail:endangsusantini@unesa.ac.id*

**Abstract**

One of the learning outcomes in the independent curriculum is to be able to establish students' critical thinking skills. The ability to think critically is still low from year to year because students lack opportunities to practice critical thinking skills. Teaching materials that can be used to improve students' critical thinking skills are interactive e-books. The purpose of this research is to describe the validity of interactive e-books on human heredity subject to improve the critical thinking skills of 12th grade high school students. This type of research is development research with the ADDIE model. At the development stage, the validity of the interactive e-book was measured from the results of validation by three validators. At the implementation stage, the research was conducted on 31 students of class XII at SMAN 1 Sugihwaras, Bojonegoro. Data collection techniques were carried out by validation methods and analyzed descriptively quantitatively. The validation results were declared highly valid with an average percentage of content eligibility of 90.5%, presentation eligibility of 92.5%, and linguistic eligibility of 100%. Based on the three eligibility criteria, the overall average percentage of 90% was obtained, indicating a highly valid category. The interactive e-book has four main features accompanied by several tasks and contains four critical thinking indicators (interpretation, analysis, explanation, and evaluation) that must be answered by students, so that this interactive e-book on human heredity material can improve students' critical thinking skills. The results of the study recommend that every school and biology teacher use interactive e-books as teaching materials to deliver heredity material as well as improve critical thinking skills.

**Keywords:** E-book, Critical thinking, Human heredity, High school

***Abstrak***

*Salah satu capaian pembelajaran yang ada pada kurikulum merdeka adalah mampu mengembangkan kemampuan berpikir kritis peserta didik. Kemampuan berpikir kritis yang masih rendah dari tahun ke tahun disebabkan peserta didik kurang mendapat kesempatan untuk berlatih kemampuan berpikir kritis. Bahan ajar yang dapat digunakan untuk meningkatkan kemampuan berpikir kritis peserta didik adalah e-book interaktif. Tujuan penelitan ini adalah mendeskripsikan validitas e-book interaktif pada materi hereditas pada manusia untuk meningkatkan kemampuan berpikir kritis siswa kelas XII SMA. Jenis penelitian merupakan penelitian pengembanagn dengan model ADDIE. Pada tahap development, validitas e-book interaktif diukur dari hasil validasi oleh tiga validator. Pada tahap implementation, penelitian dilaksanakan pada 31 peserta didik kelas XII di SMAN 1 Sugihwaras, Bojonegoro. Teknik pengumpulan data dilakukan dengan metode validasi dan dianalisis secara deskriptif kuantitatif. Hasil validasi dinyatakan sangat valid dengan persentase rata-rata kelayakan isi 90,5%, kelayakan penyajian 92,5%, dan kelayakan kebahasaan 90%. Berdasarkan tiga kriteria kelayakan tersebut diperoleh rata-rata persentase keseluruhan 91% menunjukkan kategori sangat valid. Pada e-book interaktif terdapat empat fitur utama yang disertai dengan beberapa tugas dan memuat empat indikator berpikir kritis (interpretation, analysis, explanation, dan evaluation) yang harus dijawab oleh siswa, sehingga e-book interaktif pada materi hereditas pada manusia ini dapat meningkatkan kemampuan berpikir kritis siswa. Hasil penelitian merekomendasikan pada setiap sekolah maupun guru biologi untuk menggunakan e-book interaktif sebagai bahan ajar untuk menyampaikan materi hereditas sekaligus dapat meningkatkan kemampuan berpikir kritis.*

***Kata Kunci:*** *E-book, Berpikir kritis, Hereditas manusia, SMA.*

## INTRODUCTION

According to the Ministry of Education, Culture (2022), the Independent Curriculum is a curriculum that offers various types of intracurricular learning, where the content is organized in such a way that allows students to gain an optimal understanding of certain concepts and can develop their personal competencies or talents efficiently. One of the learning outcomes in the independent curriculum is being able to embolden the improvement of students' critical thinking skills, which in turn becomes a challenge for teachers and students. Thus, a real understanding of the concept of critical thinking must be possessed by both teachers and students at the primary level (Witono, 2022).

These skills include problem solving, creative thinking, as well as critical thinking (Kalelioğlu & Gülbahar, 2013). Based on a study by Agnafia (2019), say that the lack of student training and teaching materials, especially on critical thinking indicators, is the cause of the low level of students' critical thinking skills from year by year. Facione (2015) said that there are 6 indicators of critical thinking skills which include *Interpretation, Analysis, Explanation, Inference, Evaluation* dan *Self regulation*.

Several studies in the field of education provide evidence that the interactive e-books created are very valid and practical to provide training related to critical thinking skills (Febriarti & Rahayu, 2022). However, the current reality is that the critical thinking skills of students at the High School or equivalent level are considered moderate based on the results of the achievement of the AKM value nationally in 2023, which is around 49.26%, this value has decreased from the AKM value in the previous year. The achievement of this value is the result of the value of student literacy nationally, the value of student literacy shows the literacy skills possessed by each student. This ability must be present in students because it is needed when students are in the school environment and when students are in the surrounding community as a basis for critical thinking skills (Kemdikbud, 2023).

The national curriculum requires learning biology to overcome many problems that occur in the 21st century era. Many of the issues that are being discussed at personal, local and global levels are related to biology. So that the ability of students to make critical decisions based on biology is needed. High critical thinking skills are needed, one of which is in biological material, namely material on human heredity in the independent curriculum listed at the end of phase F. The learning outcomes are that students are capable to apply the concepts of heredity, growth and development, and evaluate the latest ideas related to evolution, as well as technological innovations in biology, while the Learning Outcomes for students in process skills include the ability to observe, question and predict, plan and carry out investigations, process, analyze data and information, evaluate and reflect, and communicate results. Of the several Learning Outcomes for process skills, there are several skills that require critical thinking skills.

The results of observations at SMAN 1 Sugihwaras, found that the learning activities carried out, both media and teaching materials are still lacking in developing and improving students' critical thinking skills, as well as in efforts to improve the level of understanding and application of biological concepts. Human heredity material is one of the biological materials whose have content that very abstract so that it is hard for students to catch the meaning (Hasanah, 2017). At SMAN 1 Sugihwaras, human heredity material is delivered and explained through the help of textbook teaching materials and also power point. The content of the textbooks mostly explains the material without providing practice questions or case studies to students that are useful in honing their critical thinking skills. Questions that students can work on are only those that have similarities to the examples given by the educator.

The learning process really needs interactive teaching materials to provide training for students related to critical thinking skills and increase the attractiveness and effectiveness of teaching and learning activities in the classroom. The development of various features in interactive e-books can improve students' critical thinking skills (Syuryani and Rachmadiarti, 2020). Kong's (2015) statement supports the idea related to the ability of interactive e-books to help train students' critical thinking skills, because this e-book is strongly related to various issues in the surrounding environment. For this reason, an example of teaching material that can be utilized as a solution to overcome the above problems is an interactive e-book.

The use of teaching materials in the classroom is very helpful for teachers and educators when teaching so that many are developed to be more interactive to attract students' attention (Hasan, 2021). Soulissa, et al. (2020) stated that there is a very important relationship between teaching materials in the form of e-books and critical thinking skills on learning results for the concept of the human respiratory system. Faradiba (2020) stated that in learning biology, interactive e-books are very feasible to implement. Some of these studies show how effective

interactive e-books are used as teaching materials in learning biology.

The explanation of the background above underlies the author's view that in learning the material of heredity in humans, an interactive teaching material is needed that emphasizes critical thinking skills. Understanding can be obtained by students and can digest learning material with the help of teaching materials that have been well designed. The purpose of the research is to describe the validity of interactive e-books on human heredity material to improve the critical thinking skills of class XII students at SMAN 1 Sugihwaras.

## METHOD

The type of research conducted is research and development. The product developed and tested in this study is an interactive e-book on human heredity material to improve the critical thinking skills of 12$^{th}$ grade high school students. This product development uses the ADDIE model which consists of analysis, design, development, implementation, and evaluation.

This research was conducted at Surabaya State University and SMA Negeri 1 Sugihwaras, Bojonegoro. The implementation time was carried out for 2 weeks in August 2024. The target of this interactive e-book development research is class XII students of SMA Negeri 1 Sugihwaras, Bojonegoro in the 2024/2025 school year. The selected sample is students of class XII SMA Negeri 1 Sugihwaras in the 2024/2025 school year with a total of 31 students from class XII-7.

The first research stage, namely anlysis, is carried out by analyzing the curriculum which includes analysis of learning outcomes (CP), subject matter, learning objectives (TP) and indicators of achievement of learning objectives (IKTP). In addition, the analysis is also carried out on teaching materials, students, concept maps, and task analysis. The second stage, design, is carried out by selecting media, selecting formats, and designing products by paying attention to content, presentation and language components. The third stage, development, is carried out by making draft 1 of the interactive e-book, reviewing by the supervisor to produce draft 2, then at this stage also validation by expert lecturers to produce draft 3. The fourth stage, impelementation, was carried out by limited testing of e-book products to thirty-one students in class XII-7 at SMA Negeri 1 Sugihwaras. The last stage, evaluation, was carried out by looking at the input suggestions from the validation analysis of expert lecturers and biology teachers, as well as students' responses.

Assessment instruments are tools used to obtain data. The parameter measured is the validity of the interactive e-book. Data collection uses a validation sheet instrument. Validity was carried out by several experts including, an expert lecturer on Heredity material in humans, an expert lecturer on learning media, and a biology teacher at SMAN 1 Sugihwaras. The data collection technique used was validation technique. The type of method for analyzing data is descriptive quantitative. Quantitative descriptive is a method of analyzing data by describing the data obtained through several calculations or accumulated scores.

Theoretically, the interactive e-book was validated based on presentation aspects, content aspects and language validity. Likert scale criteria of 1-4 were applied as a validation assessment with categories 1= Not good enough, 2= Good enough, 3= Good, and 4= Very good. The scores obtained were then averaged by validators 1, 2, and 3 using the formula:

$$\text{Score } \overline{X} = \frac{\sum Scores\ for\ each\ criterion\ from\ all\ validators}{\sum validators} \ldots (1)$$

After obtaining the average score, the percentage of the validation score is then calculated, using the formula:

$$\text{P skor validasi (\%)} = \frac{\sum score\ obtained}{\sum maximum\ score} \text{ x } 100\% \ldots (2)$$

The percentage of the results obtained is then interpreted by applying the validity criteria according to Riduwan (2012):

Table 1. Criteria for validity

| Percentage range | Criteria |
|---|---|
| 86 – 100% | Highly valid |
| 71 – 85 % | Valid |
| 60 – 70 % | Valid enough |
| 41 – 59 % | Not valid enough |
| 25 – 40 % | Not valid |

## FINDING AND DISCUSION

Interactive e-book display profile of heredity in humans

Interactive e-books on human heredity are developed teaching materials that can be utilized to improve the critical thinking skills of 12$^{th}$ grade high school students. There are three sub-materials in the developed e-book, including sex determination, hereditary diseases and blood type. The interactive e-book developed is an electronic teaching material so that it can only be accessed through electronic devices such as smartphones and laptops connected to the internet. Some of the

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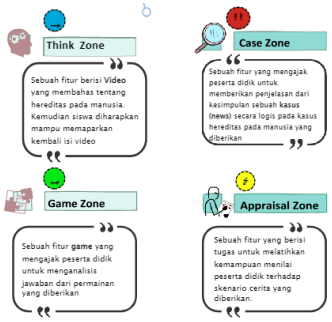
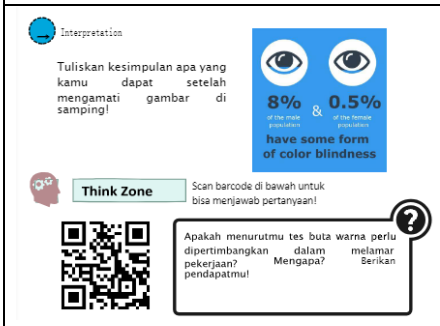
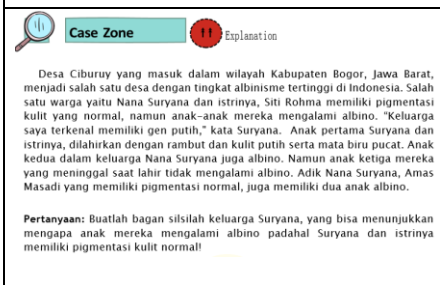
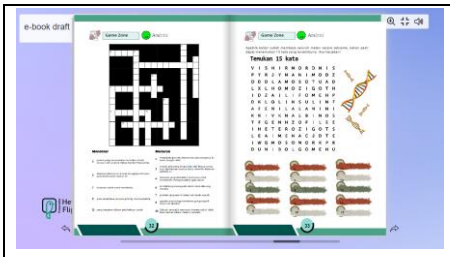
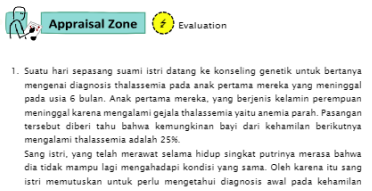
components in the developed interactive e-book of heredity in humans are the front cover, preface, table of contents, list of tables, list of images, Learning Outcomes (CP), instructions for use, e-book features, concept maps, material content, and Bibliography.

The interactive e-book in this study has features that can be utilized in efforts to improve the critical thinking skills of 12th grade high school students related to heredity material in humans. Therefore, the interactive e-book developed is adjusted and linked to its various features with indicators of critical thinking skills, which include interpretation, analysis, explanation, and evaluation. The e-book is designed interactively by providing images, videos, Barcodes containing YouTube videos and interactive games, as well as hyperlinks so that students can directly access the planned page. Nurharunnisah (2018) is in accordance with this, which suggests that teaching materials are called interactive if the activity is fully controlled by students both navigation and in reading a material, this allows students to pause video playback directly and can also move from one mteri to the next material through hyperlinks. In addition, interactive means being able to build two-way communication between students and teaching materials because it is designed to make commands to students. Each sub-chapter in the e-book has interactive e-book features that can provide facilities to students so as to improve critical thinking skills. According to Rosita, et al. (2017) interactive e-books are electronic books that have been accompanied by various features of moving animation or interactive multimedia, which are designed to make it simple and efforthless for students to gain an understanding of the subject matter.

The interactive e-book features consist of think zone, case zone, game zone and appraisal zone. The following is an explanation of each feature of the interactive e-book on human heredity. The four features train different critical thinking indicators. First, there is the "Think Zone" feature, which is a feature containing videos that discuss heredity in humans, in this first feature, the critical thinking indicator that is trained is interpretation. Second, there is the "Case Zone" feature, which is a feature that invites students to provide an explanation of the logical conclusion in a case, in this feature the critical thinking indicator that is trained is explanation. Third, there is a "Game Zone" feature, which is a game feature that invites students to analyze the answers to the games given, the critical thinking indicator that is trained is analysis. Fourth, there is the "Appraisal Zone" feature, which is a feature that contains tasks to train the ability to assess students on the story scenario given. In this feature, the critical thinking indicator trained is evaluation.

Table 2. Display and features contained in the e-book

| The display of *e-book* interactive | Caption |
|---|---|
|  | Cover Page |
|  | Interactive Features |
|  | Material Content |
|  | *Think Zone* Feature Previously students practiced *interpretation* indicators |
|  | *Case Zone* Feature train *explanation* indicators |

| | |
|---|---|
|  | *Game Zone* Feature train *analysis* indicators |
|  | *Appraisal Zone* Feature train *evaluation* indicators |

There are three sub-materials in the developed E-book, including sex determination, disease decline and blood type. Some of the components in the developed interactive E-book of heredity in humans are the front cover, preface, table of contents, list of tables, list of images, learning outcomes (CP), instructions for use, e-book features, concept maps, material content, Bibliography. Table 3 below is the characteristics of the developed e-book.

Table 3. Characteristics of Interactive E-books on Heredity in Humans

| No. | Aspects | Characteristics |
|---|---|---|
| 1. | Structure | a. Presented in electronic form<br>b. Has a page transition effect in the form of a flip so that it can be flipped through<br>c. There is a barcode facility that can be scanned to watch videos and play games<br>d. There is content in the form of images, videos and games that support student understanding<br>e. Interactive by inviting students to actively answer and discuss through the features presented |
| 2. | Usage | a. Accessible using laptops and smartphones<br>b. Can be opened online via the link: *https://heyzine.com/flip-book/f3e2144234.html*<br>c. Can be used to improve students' critical thinking skills |
| 3. | Content | a. Contains material that is in accordance with the demands of the Learning Outcomes in the Merdeka Curriculum<br>b. Contains material concepts about heredity in humans in detail<br>c. There are various features that can make students actively involved in learning to improve their critical thinking skills |
| 4. | Features | Contains supporting features namely: *think zone, case zone, game zone,* and *appraisal zone.* |

Validity of Interactive E-book on Human Heredity

The theoretical feasibility of interactive e-books on human heredity material developed was tested in terms of presentation, content, and language. The validation results obtained are presented in Table 4.

Table 4. Rekapitulasi hasil validitas *e-book* interaktif

| No. | Assessed Aspects | Validator | | | Avreage Score |
|---|---|---|---|---|---|
| | | V1 | V2 | V3 | |
| Content Eligibility | | | | | |
| 1. | Suitability of material with CP | 3,6 | 4 | 3 | 3,5 |
| 2. | Accuracy of the material | 3,6 | 3,3 | 3 | 3,3 |
| 3. | Learning support materials | 4 | 3,8 | 3 | 3,6 |
| 4. | Suitability for practicing critical thinking skills | 4 | 3,9 | 3,4 | 3,8 |
| Average of content eligibility | | | | 3,62 | |
| Average percentage | | | | 90,5% | |
| Category | | | | Highly valid | |
| Persentation Eligibility | | | | | |
| 1. | Systematization of interactive e-books | 3,7 | 4 | 3,3 | 3,6 |
| 2. | Interctive features | 4 | 4 | 3 | 3,6 |
| 3. | Balance between subchapters | 4 | 3,9 | 3 | 3,6 |
| 4. | Presentation of material | 4 | 3 | 3 | 3,4 |
| 5. | Display quality | 4 | 4 | 3 | 3,6 |
| 6. | Suitability of typeface | 4 | 4 | 3 | 3,6 |
| 7. | Color quality | 4 | 4 | 3 | 3,6 |
| 8. | Picture quality | 3,9 | 3,4 | 3 | 3,4 |
| 9. | Video quality | 3,9 | 4 | 3 | 3,6 |
| 10. | Completeness of presentation | 3,9 | 4 | 3 | 3,6 |
| Average of persentation eligibility | | | | 3,7 | |
| Average percentage | | | | 92,5% | |
| Category | | | | Highly valid | |
| Linguistic Eligibility | | | | | |
| 1. | Language usage | 4 | 4 | 3 | 3,6 |
| 2. | Use of the term | 3,9 | 4 | 3 | 3,6 |
| Average of linguistic eligibility | | | | 3,6 | |
| Average percentage | | | | 90% | |
| Category | | | | Highly Valid | |
| Overall Average of Aspects | | | | 91% | |
| Category | | | | Highly Valid | |

The results of validation by two experts in the field of development and experts in the field of material as well as a Biology teacher, obtained validity with an average percentage of 91% with a highly valid category, so that it is feasible to be applied as teaching material during lessons in class. The data on the acquisition of each aspect of validation is also shown in the following figure.

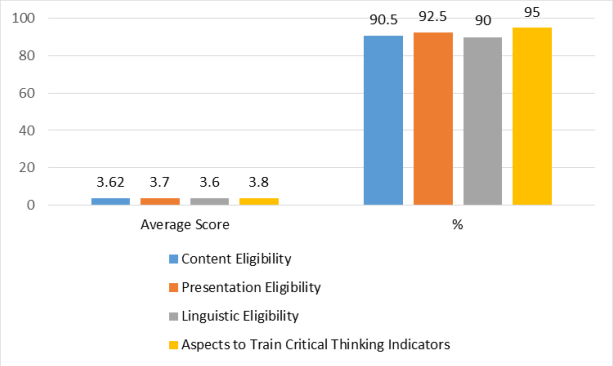



Figure 1. Validity results based on four aspects

The feasibility of content in interactive e-books on human heredity material gets a percentage of 90.5% with a highly valid category. Four criteria in the content feasibility component include the accuracy of the material, suitability as learning support material, appropriateness of the material with the Learning Outcomes, and the last is the suitability of interactive e-books that are useful in improving critical thinking skills. In the criteria for the appropriatenessof the material with the learning outcomes, the average score is highly valid because the material contains concepts that are appropriate and exist in the learning outcomes of the independent curriculum. The material is arranged coherently from simple to complex. Indicators of achievement of learning objectives are also adjusted to the CP in phase F as well as indicators of critical thinking, so that CP and are well achieved in accordance with the independent curriculum as well as being able to improve the critical thinking skills of each student. This opinion is in line with the views of Sungkono et al. (2003), which emphasizes that teaching materials need to be arranged systematically, that is, arranged in a logical order to facilitate the learning process for students.

In the material accuracy criteria, an assessment of the sources of data and information used during the interactive e-book preparation process is obtained. This criterion gets a pretty good score, because the sources used come from trusted sources. Sources of information and data are obtained from reading books, textbooks compiled by experts in the field of heredity in humans, as well as using several trusted articles to obtain correct data. In addition to the material, the interactive e-book also presents examples of real cases obtained from trusted sources such as online news that can be checked directly for the truth. As Hartono (2006), states that case study learning is very important to develop in lessons, this is because by raising real cases in everyday life will systematically and logically support students in developing their thinking power.

The next criterion is the suitability of the material to support learning. The material and various features included in the interactive e-book are supportive of learning. Because it includes development research, interactive e-books are made and adapted to teaching materials commonly used by students but are more interactive and in the form of electronic teaching materials. The materials help students to be more active and objective so that students are accustomed to completing assignments through independent literature study.

The last criterion is the suitability of interactive e-books to train critical thinking skills, scoring 3.6 with a percentage of 90% in the highly valid category. Facione (2015) presents six indicators of critical thinking, which include interpretation, inference, analysis, explanation, evaluation, and self-regulation. Four of them, including interpretation, analysis, explanation, and evaluation become the foundation and basis for researchers to develop features in interactive e-books. In this criterion, a very satisfactory score was obtained. The author tries to develop features that are suitable for teaching human heredity material as well as improving students' critical thinking skills.

The feasibility of presentation gets a percentage value of 92.5% with a very valid category. In the systematic component of the assessment, a very good score was obtained, the appearance of the e-book cover received a perfect score with an average of 4. Similarly, in the assessment of the preface and table of contents, in the table of contents there are hyperlinks allowing students to directly access relevant pages by simply clicking on the topic they want to learn more about. The use of hyperlinks creates shortcuts that can direct users to other parts of the e-book, or open documents stored on network servers or on the Internet. The instructions for using the e-book and interactive features also scored well. The instructions for using the e-book contain information for students to use in using the e-book, so that students can access it easily.

Interactive features contain an explanation of the various features in the interactive e-book. each feature is equipped with a different logo, color, and icon so that

when the feature exists or appears after discussing the material students can immediately recognize and know what indicators are trained on that feature. Widodo's (2016) research is in line with these findings, that e-books generally have unique features, such as search features or distinctive features that differentiate them from other e-books.

The next criterion is the balance between sub-chapters, the sub-chapters included are adjusted to the level of student education, namely class XII SMA. The material in each sub-chapter also uses terms that students have learned or heard when studying biology in class XI before.

The presentation component of the material received a fairly good score, with an average of 3.4. The material contains learning activities that are student centered so that students can play an interactive role in learning. In the criteria for the quality of the interactive e-book display, it is also assessed that the quality of the display, fonts, colors, images, and videos are made as good and sophisticated as possible to support the characteristics of e-books in the form of electronic and interactive teaching materials. The combination of types and colors of letters is also appropriate and makes it easier for students as readers to distinguish between sub-chapters and topics in each discussion. The images presented are also good and clear with sources that can be checked. The video provided on the barcode is also easy to access and scan, so that students can play an active role in interacting with the e-book so that students' understanding increases. This opinion is consistent with the view of Nguyen (2015), e-books are software products whose access can be obtained either with an internet connection or without a connection. E-books also allow users to include elements such as videos, animations, images, and others, which aim to deepen the understanding of learning.

The last criterion in the aspect of content feasibility is the completeness of presentation. The presentation is good and coherent starting from the introduction or preface, table of contents and bibliography. The subject matter is also presented from simple discussion to complex discussion.

Linguistic feasibility or language feasibility obtained highly valid assessment results with an average percentage of 90% from the three validators. The language feasibility component consists of two criteria, which include the use of language and the use of terms. In this language feasibility assessment, the results were very good, with an average of 3.7. In the language use component, there is an assessment for official or standard language because in delivering subject matter, it is better to use official language, easy to understand, and informative so that it can improve student understanding properly. The study by Revita et al. (2023) is in line with this which explains that the use of effective and accurate language can facilitate a person's understanding of the issues discussed and the processing of information obtained. The integration between language and individual knowledge can be seen through the way they speak and write the information they master in written form.

The second component is the use of terms, the terms used and included in interactive e-books are always written using italics. There are many foreign terms in human heredity material such as rhesus, foreign gene names, carrier and many more. However, some terms are still not consistent in their writing such as italicized writing for e-books.

## CONCLUSION

Based on the results and research obtained, it can be concluded that the interactive e-book on human heredity material developed is declared very feasible. This interactive e-book can train and improve critical thinking skills through the features that have been developed. This is shown from the results of the review by two expert lecturers and one biology teacher including content feasibility of 90.5%, presentation feasibility of 92.5%, and linguistic feasibility of 90%. So that the overall average percentage of the results of the validity of interactive e-books on human heredity material to improve the critical thinking skills of XII grade high school students is 91% with the category very feasible to use in learning.

### Suggestions

Some suggestions for the implementation of the teaching and learning process using interactive e-book teaching materials on human heredity material, namely the first interactive e-book on human heredity material can be utilized in other schools in class XII learning activities on similar material, secondly, it is necessary to check in advance the internet network owned by each student, and finally, it is necessary to conduct broader research on the use of e-book teaching materials to improve other skills needed in the 21st century.

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## REFERENCES

Agnafia, D. N. (2019). Analisis Kemampuan Berpikir Kritis Siswa Dalam Pembelajaran Biologi. *Biologi Dan Pembelajarannya*, *6*(1), 45–53.

El-Haddad, dkk (2016). Readability and content analysis of lifestyle education resources for weight management in Australian general practice. *BMC Obesity*. 3. 10.1186/s40608-016-0097-1.

Facione, P. a. (2015). Critical Thinking: What It is and Why it Counts. Erlangga.

Facione, P. A., Sánchez, C. A., Facione, N. C., & Gainen, J. (2010). The Disposition Toward Critical Thinking. *Journal of General Education*, Vol. 44 (1), 1-25.

Febriarti, F. D., & Rahayu, Y. S. (2022). Pengembangan E-Book Interaktif pada Materi Pertumbuhan dan Perkembangan Tumbuhan untuk Melatihkan Keterampilan Berpikir Kritis Siswa Kelas XII SMA. *Berkala Ilmiah Pendidikan Biologi (BioEdu)*, *11*(3), 775–784. https://doi.org/10.26740/bioedu.v11n3.p775-784

Hartono, Jogiyanto. 2006. Filosifi, Pendekatan dan Penerapan Pembelajaran Metode Kasus. Jogjakarta: CV Andi offset.

Hasanah, H. (2017). Upaya Meningkatkan Prestasi Belajar Siswa Pada Kompetensi Dasar Prinsip-Prinsip Hereditas Melalui Pendekatan Analogi Di Kelas Xii Ipa 1 Sekolah Menengah Atas Negeri 1 Ciamis. *4*(1), 122–131.

Kalelioğlu, F., & Gülbahar, Y. (2013). The effect of instructional techniques on critical thinking and critical thinking dispositions in online discussion. *Educational Technology and Society*, *17*(1), 248–258.

Kementerian Pendidikan, Kebudayaan, R. dan teknologi. (2022). Buku Saku Tanya Jawab Kurikulum Merdeka.

Kementerian Pendidikan, Kebudayaan, R. dan teknologi. (2023). Rapor Pendidikan Indonesia 2023.

Khasanah, B. A. and A. I. D. (2017). Kemampuan Berpikir Kritis Siswa Melalui Penerapan Model Pembelajaran Brain Based Learning. *Pp*, *7*(2), 46–53.

Kong, Siu Cheung. 2015. An experience of a three-year study on the development of critical thinking skills in flipped secondary classrooms with pedagogical and technological support. *ScienceDirect*.

McConnell, J. (2008). An educational strategy to improve graduate nurses critical thinking skills during the hospital orientation program. *The journal of continuing education in neursing*, *3*, 193. https://doi.org/10.3928/00220124-20080301-12.

Meltzer. (2002). Metode Penelitian Pendidikan (Pendekatan Kuantitatif, Kualitatif dan R&D). Bandung: Alfabeta.

Nguyen, N. G. 2015. *Designing and Using interactive e-book in Vietnam*. International Journal of Learning, Teaching and Educational Research, 11(1): 75-98.

Nurhairunnisah, S. (2018). Bahan Ajar Untuk Meningkatkan Pemahaman Konsep Matematika pada Siswa Kelas X. Jurnal Inovasi Teknologi Pendidikan volume 5, 192-203.

Revita, dkk. 2023. Peran Bahasa dalam Penerapan Ilmu Pengetahuan. *Kournal on Education*, 05(2): 2981-2987.

Riduwan. (2012). Skala Pengukuran Variabel-Variabel Penelitian. Alfabeta.

Rosita, Fadiawati, N., & Jalmo, T. (2017). Efektivitas E-Book Interaktif Sistem Pencernaan Manusia Untuk Menumbuhkembangkan Keterampilan Berpikir Kritis Siswa. *Bioterdidik Wahana Ekspresi Ilmiah*, *5*(2).

Sungkono, dkk. (2003). Pengembangan Bahan Ajar. Yogyakarta: FIP UNY

Susantini, E., Thamrin, M., Isnawati, H., & Lisdiana, L. (2012). Pengembangan petunjuk praktikum genetika untuk melatih keterampilan berpikir kritis. *Jurnal Pendidikan IPA Indonesia*, *1*(2), 102–108.

Susantini, Endang, Puspitawati, R. P., Raharjo, & Suaidah, H. L. (2021). E-book of metacognitive learning strategies: design and implementation to activate student's self-regulation. *Research and Practice in Technology Enhanced Learning*, *16*(1). https://doi.org/10.1186/s41039-021-00161-z

Syuryani dan Rachmadiarti. (2020). Validitas E-book Interaktif Pada Materi Keanekaragaman Hayati untuk Melatihkan Keterampilan Berpikir Kritis Siswa Kelas X SMA. *Berkala Ilmiah Penidikan Biologi (BioEdu)*, 9(2). 140-149.

Widodo. 2016. Pengantar E-Book. *Disampaikan dalam Bimbingan Teknik bagi Petugas Pengelola Perpustakaan Sekolah, yang diselenggarakan oleh Kantor Perpustakaan dan Kearsipan kabupaten Madiun, di Graha Eka Kapti Lantai II Pusat Pemerintahan Kabupaten Madiun di Mejayan*.

Wijayanti, T. E. 2019. Pengembangan Flipbook Berbasis Multiple Intelligence pada Materi Substansi Genetika untuk Melatihkan Keterampilan Berpikir Kritis Peserta didik Kelas XII SMA. *BioEdu: Berkala Ilmiah Pendidikan Biologi*, *2*(8), 253-259.