# Development Of Interactive E-Book Based On Multiple Intelligences Ecosystem Topic To Train Creative Thinking Skills

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| Article Info | Abstract |
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| | Education in 21st century, students have creative thinking skills according to various intelligence. Basic competencies used are to train students to analyze ecosystem topics. This shows that basic competence is not enough to explain the concept. Therefore, it is necessary to developed interactive teaching materials that can facilitate the material delivered easily understood by students, one of which is e-book. The research objective is to produce interactive e-books based on multiple intelligences ecosystem topics to train creative thinking skills that are feasible theoretically and empirically. The study used the ADDIE model. Feasibility is theoretical in the form of validity, and empirical feasibility is readability tests and student response questionnaires. This research involved 15 students of class X MIPA 8 SMAN 2 Lamongan. Data analyzed descriptive quantitative. The results showed that e-book was feasible theoretically with a percentage of 97.16% and empirically feasible with a readability level of 10th and student responses with a percentage of 98.48%. That is, the e-book is theoretically and empirically feasible to implement in learning. |

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**INTRODUCTION**

The education system in the 21st century is required to improve the quality of students to be able to compete globally. In addition, the development of science and technology can also create interactive teaching materials that help students understand the material easily. The conditions of the COVID-19 pandemic in Indonesia required the government to implement a learning system to minimize its spread. Therefore, in the circular letter minister of education and culture No. 23425/A5/Ak.O1.04/2021, in a copy of the joint decree decision four ministers, the government implements blended learning systems between face-to-face learning and distance learning (Kemendikbud,2021).

The 2013 curriculum requires learning to include 21st century skills, including 4C (Critical thinking, Collaborative, Communicative, and Creative) and integrating HOTS (High Order Thinking Skills) (Kemendikbud, 2017). In addition, learning will maximize if presented in a comprehensive, engaging, and interactive. The teacher's role is significant in producing quality students according to the qualifications of the times, one of which is by practicing creative thinking skills based on multiple intelligences they have (Widiana & Jampel 2016).

Creative thinking is a skill with many perspectives that can bring up many ideas in a broad scope. There are four components, including fluency, flexibility, originality, and elaboration (Handayani *et al.*, 2021). The 2013 curriculum supports creative thinking skills for class X SMA ecosystem materials in basic competencies 3.10 "Analyzing ecosystem components and interactions between these components" and basic competencies 4.10 "Presenting works showing interactions between ecosystem components (food webs, biogeochemical cycles)" (Kemendikbud, 2016). The two basic competencies in ecosystem topics are factual and concrete, so learning, not enough memorizes concepts but also requires creative thinking skills (Toyyibah & Rachmadiarti, 2019). Ecosystem topics cannot describe using textbooks that only include text, images, and descriptive explanations. However, teaching materials are needed to cover these deficiencies by increasing students understanding that they can train creative thinking skills in integrating biological characteristics into ecosystem topics.

The low creative thinking skills and the lack of public education related to multiple intelligences concepts cause the lack of quality in the Indonesian education system. In Gardner's theory, multiple intelligences focus on and value each student's uniqueness based on varying intelligence (Gohar & Sadeghi, 2018). Gardner argues that everyone has varying intelligence, so there is a need for a multiple intelligence approach in learning, especially teaching materials to maximize students' potential (Fransiska *et al.,* 2016).

Several data support the low quality of education in Indonesia. Including based on the results of Programme International for Student Assessment (PISA) showing Indonesia's rank is in 71st position out of 79 countries with a score of 396 even though the standard science score that must be gets is 489 points (OECD, 2018). In addition, students are still often trained with lower cognitive levels at levels 1-4 in learning even though what needs in the 21st century is levels 5-6. The creativity index of Indonesian students based on The Global Creativity Index (GCI) 2015 is ranked 115 out of 139 countries with a score of 0.202 (Patmawati *et al.*, 2019). The ecosystem is a broad topic supported by the 2019 Biology National Examination ecosystem topic results for senior high school students in Lamongan Regency. The indicator predicts the impact of an environmental balance with an absorption value of 44.83%. Whereas for the standard of minimum completeness, the results of the National Examination are in the proportion of 55% (Kemendikbud, 2019). It shows that proficiency in ecosystem topics is still relatively low and includes complex learning materials.

In optimizing the quality of education, needed better management. Minister of Education and Culture Regulation Number 22 of 2016 states that the implementation of education must focus on student intelligence by developing teaching materials as learning resources, one of which is interactive e-books (Toyyibah & Rachmadiarti, 2019). Based on Negara & Wiyono's (2018) research, integrating multiple intelligences in ecosystem topics has significantly influenced learning activities. E-books facilitate various intelligence and are integrated into ecosystem topics because student intelligence is measured through evaluation tests and used to overcome environmental problems.

Developed e-book based on multiple intelligences on ecosystem topics with nine intelligence: logical-mathematical, linguistic, musical, visual-spatial, kinesthetic, intrapersonal, interpersonal, naturalist, and the last existential spiritual. The nine intelligences are integrated into various activities on the features in the e-book. E-books affect students' mastery in learning and understanding material and can train creative thinking skills through activities to formulate problems, provide ideas and solutions, and evaluate existing problems (Gaol *et al.,* 2019). In addition, e-books that train creative thinking can make students generate new ideas, think divergently, connect many concepts, and produce original ideas (Adawiyah *et al.*, 2019).

In the COVID-19 pandemic, teachers and students often discover it difficult to find reading sources and teaching materials during distance learning. Therefore, e-books are a solution to overcome these problems, namely with practicality such as being easy to download on the internet, easy to access, environmentally friendly, including audio-visual media so that they are effective in helping students' understanding (Santoso *et al.,* 2018).

Based on the description above, a modification was made as well as an innovation to facilitate learning in the use of teaching materials, namely by integrating components of multiple intelligences into ecosystem topics through interactive e-books to train learners to have creative thinking skills by the demands of the 2013 curriculum in the 21st century. Therefore, the objective of this study is to produce an interactive e-book based on multiple intelligences on ecosystem topics to train creative thinking skills that are theoretically and empirically feasible.

## RESEARCH METHOD

This research is a type of developmental research. Researched from September to December 2021 at the Department of Biology, Faculty of Mathematics and Natural Sciences, State University of Surabaya and SMAN 2 Lamongan. Research development using the ADDIE model has five stages, namely: Analysis, Design, Development, Implementation, and Evaluation.

The analysis stage (A) includes several steps, namely the analysis of curriculum, concepts, assignments, and students. Curriculum analysis refers to basic competencies 3.10 and 4.10, which formulates learning indicators and learning objectives that train creative thinking. Concept analysis aims to identify the main concepts in ecosystem topics. Assignment analysis aims to group students' abilities in practicing creative thinking based on developed indicators. Meanwhile, student analysis aims to determine the condition of students who meet the needs based on the level of mastery of the material, age, and gender.

The design stage (D*)* is the product design, starting with material planning, determining the systematics of e-books, determining the packaging format, and choosing the supporting media. The development stage (D) started with collecting material for each sub-chapter into one using Microsoft word and Canva software. Therefore, a theoretical feasibility test in the form of the validity of the three validators, namely education expert lecturer, material expert lecturer, and biology teacher. The implementation (I) stage consists of two stages, namely the readability test and student response questionnaires carried out at SMAN 2 Lamongan with a target of 15 students of class X MIPA 8 who were chosen randomly. The variables used in this research are validity and practicality. The validity variable is reviewers by assessing three experts, namely education expert, material expert, and biology teacher. Meanwhile, the practicality variable in terms of the readability test results uses the fry graph formula and student response questionnaire.

The validation data obtained were then analyzed descriptive quantitative using the Likert scale criteria, namely: a score of 4 categories was very valid, a score of 3 categories was valid, a score of 2 categories was quite valid, a score of 1 category was less valid (Riduwan*,* 2013). The score obtained is then calculated using the following formula:

$$Validity\ feasibility\ (\%) = \frac{\sum total\ score}{\sum maximum\ score}\ x\ 100\%$$

Furthermore, the results of the percentage of validity feasibility will provide interpretation according to the validity criteria determined in Table 1. Based on the interpretation table, an interactive e-book is declared valid if it gets a percentage of ≥ 70%.

**Table 1.** Validation Score Criteria

| Score (%) | Criteria |
|---|---|
| 25-39.9 | Invalid |
| 40-54.9 | Less valid |
| 55-69.9 | Enough valid |
| 70-84.9 | Valid |
| 85-100 | Very valid |

(Riduwan, 2013)

The following data collection technique uses the readability test method, which aims to determine the readability level of the developing e-book. This method is repeated three times by selecting a sample of readings on the e-book taken at the beginning, middle, and end e-book of 100 words. Then count the number of sentences and syllables. The data from the readability test were analyzed descriptive quantitative using the fry graph formula.

The readability value is taken one sample in each sub-chapter containing 100 words. The 100 words count the number of sentences (y-axis) and the number of syllables (x-axis) then the number of syllables is multiplied by 0.6. The readability test result from the meeting point between the number of sentences and the number of syllables of the fry graph. The readability test can determine the suitability of the e-book developed with reading difficulty based on the cognitive level of class X SMA students (Kinanti & Raharjo, 2021). The data obtained can determine the level of readability of the developed ecosystem topic e-book. The results can be categorized as empirically feasible if the meeting point on the fry graph is at grades 10th, so the e-book developed is suitable for class X SMA.

The following data collection technique uses the response questionnaire method given students to know the empirical feasibility of the e-book based on the responses given. The student response data were analyzed descriptive quantitative. Analysis using the Guttman scale based on the response result students. Score 1 is for the "Yes" answer and 0 for the "No" answer (Riduwan, 2013). Furthermore, analysis student responses in the form of percentages using the formula:

$$Response\ percentage\ (\%) = \frac{\sum "Yes"\ anwer}{\sum overall\ student}\ x\ 100\%$$

The results of student responses are interpreted using practicality criteria, as shown in Table 2. An interactive e-book is declared empirically feasible if it gets a percentage of ≥ 61%.

**Table 2.** Student Response Scores

| Score (%) | Criteria |
|---|---|
| 0 – 20 | Not good |
| 21 – 40 | Less good |
| 41 – 60 | Good enough |
| 61 – 80 | Good |
| 81 – 100 | Very Good |

(Riduwan, 2013)

The evaluation stage (E) is the final stage of research based on suggestions from the validator and student responses to produce a suitable e-book.

**RESULTS AND DISCUSSION**

This research succeeded in developing an interactive e-book based on multiple intelligences on ecosystem topics to train creative thinking skills, which were declared theoretically and empirically feasible. The data acquired are in the form of validation, readability test, and student response. The interactive e-book was developed with three parts, namely introduction, content, and closing. The front and back cover of the e-

book are attractively designed with images that represent the topic and display the title of the topics, based on multiple intelligences, school level, UNESA logo, 2013 curriculum logo, and the names of the authors.



**Figure.1** E-book front cover



**Figure. 2** E-book back cover

The introductory section contains an introduction, a brief explanation related to multiple intelligences and creative thinking, the characteristics of the e-book, the 2013 curriculum for ecosystem topics, and a table of contents. The content section consists of ecosystem material with three sub-chapters, namely constituent components and interactions within the ecosystem, energy flow and ecosystem productivity, biogeochemical cycles, and community dynamics.
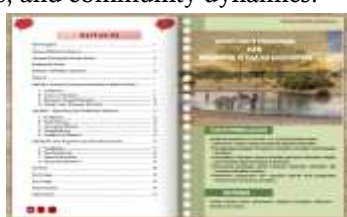


**Figure. 3** Sub-chapters I



**Figure.4** Sub-chapters II



**Figure.5** Sub-chapters III

The closing section contains a summary, evaluation questions, a glossary, image sources, and a bibliography. The e-book is designed using Microsoft Word and Canva software, then converted using Flip PDF Professional software. This software has the advantage of making e-books more interactive and easier to convey contextual topics. This software can combine PDF files, images, videos, YouTube, and hyperlinks. E-books developed with Flip PDF professionals can be accessed via PC or smartphone (Nurjadi *et al.,* 2021). In addition, Flip PDF Professional also has template designs such as background, control buttons, navigation, and back sound. The resulting e-book can also be saved in .exe, Html, and other formats (Rindaryati*,* 2021). The developed e-book has features to help students train creative thinking skills based on their multiple intelligences are presented in Table 3.

**Table 3.** Interactive E-book Feature

| E-book Feature | | |
|---|---|---|
|  **Bio-MindMaps, located in each sub-chapter, contains a concept map discussed in that sub-chapter.** |  Bio-Suplemen, containing videos, articles, and essential concepts presented to increase student knowledge more broadly. |  Bio-Smart, contains questions that can trigger student creativity in problem-solving based on their intelligences. |
|  **Bio-Kreasi, contains the task of further deepening the material. The purpose is to find solutions to problems presented in creative works.** |  Bio-MiniLab, contains direct experiment activities for a student to practice students' skills in designing and concluding experiment results. |  Bio-MA (Biology My Adventure), contains field practicum activities so that the theory obtained by students can be put into practice directly. In addition, it trains a student to think |

scientifically so that learning activities are meaningful.

**Bio-Tek (Biology of Technology), integrating the use of technology in learning activities, this feature is in the form of tasks related to computer applications or technology-based software.**

Bio-Info (Biology Information), contains information in facts and essential concepts related to ecosystem material.

Bio-Grafi, contains information related to biographies of world leaders in the expert of an ecosystem.

**Bio-Notes, contains a summary of material from each sub-chapter.**

Bio-Refleksi, contains questions for self-reflection to determine how far the student has understood the competencies.

Bio-Quotes, contains aphorisms about an ecosystem that can increase student learning interest.

## Bio-Evaluasi

**Bio-Evaluasi is questions to measure student cognitive understanding. In this feature, three types of questions are presented: matchmaking, multiple-choice, and essay.**

E-book based on multiple intelligences are learning that leads the student to increase learning motivation by making problems, solving problems, and creating something based on understanding level and varying intelligence (Aljarabah & Mai, 2020). Development of e-book based on basic competencies 3.10 and 4.10 class X SMA integrated creative thinking indicators into learning based on multiple intelligences. E-book uses nine intelligence components: logic-mathematical, linguistic, musical, visual-spatial, kinesthetic, intrapersonal, interpersonal, naturalist, and spiritual.

Logic-mathematic intelligence, for example in the Bio-Smart feature, questions are asked about the effect of water hyacinth abundance on the balance of the river ecosystem. The Bio-MiniLab and Bio-MA feature experimental and observational activities that train students in reasoning, making hypotheses, and solving problems. The activity data are grouped in tables to bring up logical-mathematical intelligence (Yuliawaty *et al.*, 2018). Linguistic intelligence, for example, in the Bio-MA feature, students are asked to compile reports after students make observations. This shows that linguistic intelligence trains students to determine conclusions and communicate the results of their activities or observations verbally and in writing (Riyanti *et al.*, 2020). Musical intelligence, as in the Bio-Tek feature, students are asked to create a song about the biogeochemical cycle based on an important concept. This intelligence makes it easier for students to convey their understanding.

Visual-spatial intelligence, for example in the Bio-Suplemen feature, a video about the Yellowstone National Park Ecosystem is presented. Further refined in the Bio-Kreasi feature, which asks students to observe the video and collect important concepts, will be compiled into a concept map. This intelligence trains students to observe environmental conditions based on various points of view. This intelligence is also obtained from representing the understanding obtained when observing phenomena through images, videos, or articles. Creating concept map works is one way to make visual-spatial intelligence more meaningful (Yuliawaty, *et al.*, 2018).

Kinesthetic intelligence trains students to conduct experimental activities and direct observations in the surrounding environment and create creative work. As in the Bio-MiniLab feature, students are

trained to design experiments in making natural humus. The Bio-MA feature invites students to observe the environment directly, and the Bio-Kreasi feature, such as creating a miniature ecosystem based on previous observations. Kinesthetic intelligence will emerge if in learning, students are encouraged to utilize their body's potential in solving problems in the environment (Yuliawaty *et al.*, 2018). This is appropriate in the e-book for students to observe the surrounding environment.

Intrapersonal intelligence trains students to understand themselves as in the Bio-Refleksi features, questions are presented for themselves so that students know the extent of their abilities. This intelligence trains students to determine the implementation of understanding concepts and everyday life based on their life goals (Yuliawaty *et al.*, 2018). Interpersonal intelligence trains students to interact and collaborate with others, such as the Bio-Kreasi, Bio-MiniLab, and Bio-MA features, where learning activities are carried out in groups to discuss with their friends. Research conducted by Riyanti *et al.* (2020) supports that interpersonal intelligence is referred to as social intelligence, which in addition to interacting with group friends, also trains students to have abilities such as leading, managing, and handling disagreements. So that students will interact effectively with their friends.

Naturalist intelligence trains students to understand the conditions of the surrounding environment. This intelligence is prominent in the features of Bio-MiniLab and Bio-MA, where learning is designed with experimental activities making natural humus and encouraging students to interact with the environment directly. Students will observe phenomena in the environment objectively and comprehensively. In addition, ecosystem topics support this intelligence because they can encourage students to develop a sense of environmental care by observing phenomena in detail (Adisendjaja *et al.*, 2019). This feature will increase students' interest in understanding learning materials that can increase naturalist intelligence. Spiritual intelligence such as the Bio-MA feature invites students to observe the environment directly. The Bio-Refleksi feature is where students are trained to be grateful for the perfection of nature and can implement important concepts in everyday life (Yuliawaty *et al.*, 2018).

Multiple intelligences based learning needs to be given to students who have abilities that can help problem solve. The ecosystem topic is suitable to be integrated with multiple intelligences because it can facilitate student activities in understanding material concepts based on their intelligence (Widyawati & Setianingsih, 2021). It is supported in Negara & Wiyono (2018) that the ability to integrate multiple intelligences is influential in the learning ecosystem because student intelligence is suitable for use in solving various problems that exist in the environment.

In addition to being based on multiple intelligences, the e-book also trains creative thinking skills, including fluency, flexibility, originality, and elaboration. Practicing fluency indicators by generating lots of ideas in solving the problems presented, such as in the Bio-Smart feature, a video about parasitic worms in snails is presented. Students are asked to analyze the process of parasitic worms attacking snails. It is appropriate that the fluency indicator can train students to develop many ideas based on problems. That student will explore and develop their understanding to solve problems (Ernawati *et al.*, 2019).

Practicing flexibility indicators, namely observing the environment from various points of view to analyze problems and find solutions to problems, for example, in the Bio-Suplemen feature, an article is presented on the substitution of inorganic fertilizers into organic fertilizers. After understanding the article's contents, students were asked to answer questions in the Bio-Smart feature to analyze the relationship between the effect of urea fertilizer on the growth of tobacco plants and the components. Train the flexibility indicator to solve problems in different ways, so that students can formulate solutions with various answers (Ernawati *et al.*, 2019).

Practicing originality indicators, for example in the Bio-Kreasi and Bio-Tek feature, students are asked to create a miniature ecosystem or vivarium and documentation it as a report. Students communicate it through social media such as YouTube. Giving learning activities such as creating complex creation can be started by determining the topic, designing, and creating the creation to construct student creativity in solving problems through new ideas displayed in creation (Ernawati *et al.*, 2019).

The elaboration indicator trains students can develop ideas in detail. For example in the Bio-MiniLab feature, students are asked to experiment with natural humus according to the existing

instructions. Next, the student analyzed the experimental data. In the process of analyzing, students develop ideas by looking for literature that supports the experimental results that have been obtained with detailed steps and then connected with concepts that have been obtained during learning activities. Ernawati *et al*., (2019) argue that by thinking elaboration, students can develop ideas in detail to understand the conditions or problems given optimally.

The developed e-book was then validated to obtain theoretical feasibility results. A feasibility test is carried out to determine the e-book developed was appropriate and followed the standard by looking at the criticism and suggestions that needed to be improved so that the e-book produced was up to standard. It could be used in learning (Suryanda *et al*., 2020).

Three validators carried out validation, namely education expert, material expert, and biology teacher. The validation results are a percentage of validity scores accompanied by suggestions to improve the e-book. The aspect of the validation instrument was adapted from the BSNP (2014), which includes the feasibility of presentation, content feasibility, and language. The results of the e-book validation are in Table 4.

**Table 4.** Recapitulation of Validation Results

| No. | Assessed Aspect | Score | | | Average |
|---|---|---|---|---|---|
| | | $V_1$ | $V_2$ | $V_3$ | |
| **A. Presentation** | | | | | |
| 1. | Physical display | 4 | 4 | 4 | 4 |
| 2. | Use of e-book | 4 | 4 | 4 | 4 |
| 3. | Layout | 3 | 4 | 4 | 3.67 |
| 4. | Presentation support | 3 | 3 | 4 | 3.33 |
| 5. | Presentation technique | 4 | 4 | 4 | 4 |
| **Average / Percentage (%)** | | | | | **3.80 / 95%** |
| **B. Content** | | | | | |
| 6. | Material coverage | 4 | 4 | 4 | 4 |
| 7. | Material recency | 4 | 3 | 4 | 3.67 |
| 8. | Develop skills and stimulate curiosity | 4 | 4 | 4 | 4 |
| 9. | Activities to support cognitive and psychomotor KD | 4 | 4 | 4 | 4 |
| 10. | Study of multiple intelligences | 4 | 4 | 4 | 4 |
| 11. | Achievement of multiple intelligences in each feature | 4 | 4 | 4 | 4 |
| 12. | Train creative thinking skills | 3 | 4 | 3 | 3.33 |
| **Average / Percentage (%)** | | | | | **3.86 / 96.5%** |
| **C. Language** | | | | | |
| 13. | Use of language | 4 | 4 | 4 | 4 |
| 14. | Use of the term | 4 | 4 | 4 | 4 |
| **Average / Percentage (%)** | | | | | **4.00 / 100%** |
| **Average / Percentage (%) of all validity feasibility** | | | | | **3.88 / 97.16%** |
| **Criteria** | | | | | **Very valid** |

Description:

$V_1$: education expert lecturer; $V_2$: material expert lecture; $V_3$: biology teacher

The validation result on the presentation aspect obtained a percentage of 95% with very valid category feasibility of presentation in the book, according to BSNP (2014), focus on presentation techniques, presentation support, and completeness of product used in learning.  The layout aspect has not received maximum because the video in the offline version cannot be accessed, so it does not appear. There is free space that makes the layout less proportional and reduces student interest in reading the offline version of the e-book. That is supported by a suggestion from the validator, namely adding video titles and images in the free space so that even though the video cannot be accessed, the appearance of the e-book remains attractive and can motivate the student to read the contents of the e-book. The layout concept must be appropriately designed so that the appearance of the e-book becomes attractive and increase student understanding by the objectives of e-book development (Oey, 2013). This is supported by Turčić & Pap

(2018) which state that development of e-books focuses on the readability and accessibility of layout content such as videos which must be considered in the preparation of appearance, size, and layout.

In addition, the aspect of supporting the presentation has also not received maximum. Because the offline version of the e-book with the .exe file format can only be accessed on a PC, if students want to open the offline version, they must use a PC. The author adds PDF file types so that the offline version of the e-book has easy access. These PDF files have advantages: the file format is ready to be printed, the display is like a book namely the file format that is ready to be printed, the display is like a book, the data in the file is neatly arranged (Ruddamayanti, 2019).

Feasibility of content obtained percentage 96.5% with very valid category. Feasibility of content includes material based on the truth of the concept. According to the 2013 curriculum, the concept is arranged coherently and systematically, up-to-date, develops skills and stimulates curiosity, supports cognitive and psychomotor basic, includes studies and the achievement of multiple intelligences in each feature, and trains creative thinking skills. That is by the BSNP (2014), which states that the feasibility of the content must pay attention to the breadth of the material, the accuracy of the material, it is up-to-date, and the development of biological science and technology.

These components have been listed in the e-book, spread over three sub-chapters adapted to the 2013 curriculum, which is arranged systematically. Then presented various phenomena in the environment. Bio-MiniLab and Bio-MA features develop students' curiosity to explore the environment and its understanding. This feature also trains students to develop their cognitive and psychomotor. This is appropriate that the selected material is important because it aims to make students understand the material so that in its preparation, the material must be systematic, according to concepts, and be able to practice various activities (Prastowo, 2015).

The maximum validation result has not been obtained in material recency because the material used in the e-book does not reflect phenomena. In addition, the aspect of train creative thinking skills also has not obtained maximum validation results because the creative thinking component is not highlighted. So that one of the validators provides a suggestion, namely by explaining creative thinking in the introduction and writing down the components of creative thinking in each feature. Using phenomena that exist in the surrounding environment can create new ideas so that they can find creative solutions in solving problems, designing experiments, and determining conclusions (Ratnasari *et al.*, 2014). Learning support materials must be following the development of science and technology, and the latest phenomena are tailored to the needs of students (Kinanti & Sudirman 2018). That shows if the developed e-book is equipped with the latest phenomena in the surrounding environment, it can train students to think creatively.

The developed e-book integrates multiple intelligences components to train creative thinking skills through learning related to contextual phenomena in the surrounding environment. Features in e-book such as Bio-MiniLab and Bio-MA guide students to explore their skills through group discussions, find concepts based on experiences in the environment, apply the concept obtained, and carry out an evaluation. That the activities carried out can be a means to actualize self-potential for student cognitive development (Irwanto *et al.*, 2018).

The language aspect obtained a percentage of 100% with a very valid category. In this aspect, get maximum result. The language aspect shows that language and terms follow a standard where the e-book is informative and easy to understand, does not cause multiple interpretations, and follows students' cognitive development (BSNP, 2014).

From recapitulation of the validation, the results are 97.16%, with very valid criteria. These results indicate that the developed interactive e-book is theoretically feasible and can be used in learning with minor revisions according to suggestions from the three validators. After the validation test and minor revisions were made to improve the e-book, a trial process was carried out to determine the empirical feasibility. A readability test was carried out to determine the level of practicality of the e-book by looking at the difficulty or ease of reading the text in the e-book, which students could understand through the level

of readability. The following are the results of the recapitulation of the readability of the e-book presented in Table 5.

**Table 5.** E-book Readability Level Recapitulation

| Sample | Pages | Σ sentence | Σ syllables | Level |
|---|---|---|---|---|
| **Sub-Chapter 1: Mutualism** | 20 | 6,75 | 267x0.6 = 160,2 | 10 |
| **Sub-Chapter 2: Food chain** | 36 | 5,78 | 262x0.6 = 157,2 | 10 |
| **Sub-Chapter 3: Biogeochemical cycle** | 54 | 6,04 | 263x0.6 = 157,8 | 10 |

E-book readability data on samples analyzed using the fry formula are then interpreted on the fry graph. Based on Table 5. the readability of the e-book is at level 10th. From the three samples taken in each sub-chapter, it is known that the readability test results are presented in the following fry graphic image (Figure. 6).
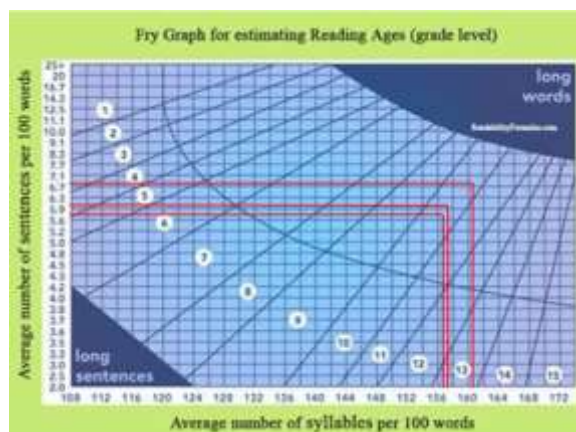


**Figure. 6** Fry graph e-book readability test

Based on the readability test results, the three samples have the same level of readability, namely at level 10th, which indicates that the readability of the e-book is according to the level of cognitive development of class X high school students. The results of the three samples are included in the difficult category, according to Kinanti & Raharjo (2021) the readability test results were supported by the results of the validity test of linguistic aspect, which gets a score of 4.0 with a very valid category in terms of the language used according to students' cognitive development level. Therefore, the level of readability of reading affects the reader's level of understanding. A reading text must have a readability level that is suitable for the reader so that the information is easy to read and understand (Susantini *et al.,* 2021).

Furthermore, a practicality test was carried out based on student responses. The interactive e-book was responded to by 15 students. The results of the response questionnaire, the student responded with very good criteria to the e-book developed by researchers based on four aspects, namely presentation, content, language, and the relationship between multiple intelligences and creative thinking. The results of the student response questionnaires are practically presented in Figure.7.
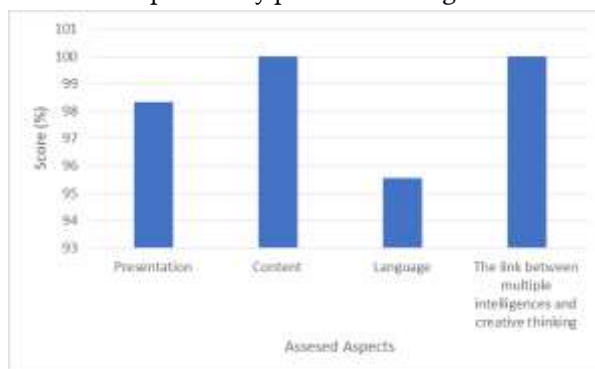


**Figure. 7** Student Response Questionnaire Results

Based on Figure. 7 The response questionnaire given to students got a percentage of 98.48%, with a very good category. The presentation aspect of the e-book received a positive response with a percentage

of 98.33%, which was included in the very good category. E-books are equipped with text, images, videos, and hyperlinks that can be accessed online to attract attention and add new insights for the student in operating e-book because they have never used interactive e-book before in learning activities.

The presentation e-book is attractively equipped with text, images, videos, and hyperlinks to help visualize abstract material so that students will more easily understand the material. In addition, the e-books presented will attract students' interest and motivation to read e-books (Rahim *et al.*, 2020). In accordance with one student's comment: *"e-book is very creative because they are equipped with videos so that when reading can minimize boredom".* According to Wong (2020) statement that e-book equipped with videos and attractive displays can improve students' learning abilities. Besides, videos can also help students understand the material, motivate learning, and minimize boredom when reading e-books. However, on the layout criteria, about 13.13% of students give negative responses. That is directly proportional to the validation result, which shows that for the e-book, it looks less proportional so that it can reduce the understanding of the material.

The content aspect of the e-book material received a positive response with a maximum result of 100%, which was classified as very good. That means e-book can help the students understand the material to achieve learning goals through its feature, complemented by phenomena in the environment around the students. Based on a comment from one student: *"the e-book is easy to understand, and the material in it is exciting".* The e-book was also developed by using evaluation questions that were integrated with mini-games in the hope that in addition to evaluating students' creative thinking skills, they also minimized boredom when working on evaluation questions. The developed e-book uses evaluation that is integrated with the mini-game. E-books that are equipped with various activities can eliminate student boredom. E-book content presented in various ways is equipped with phenomena that can encourage students to make observations so that the material will be easier to reach and master the learning objectives better (Rahim *et al.*, 2020).

The language aspect gets 95.56%, including the very good category. The language aspect did not get maximum results because the components of attracting interest in reading and learning motivation were 13.33% of students who responded negatively. The offline version, video of the e-book cannot be accessed. However, there was a comment from one student: *"the e-book helps the student who has limitations in terms of having the book, increasing student motivation to read because it is equipped with a feature that adds to the attractiveness of student to read it".*

The connection between multiple intelligences and creative thinking is 100% in the very good category. With the development of e-book accompanied by questions, case studies, and assignments, students can think creatively by utilizing the type of intelligence they have. Learning that focuses on contextual problems in the environment can improve learning outcomes and life skills (Saputro, 2018).

Based on the result of the theoretical and empirical feasibility test. It is known that the e-book developed used four main criteria as a teaching material according to Arsanti (2018), namely the scope of content according to the curriculum, presentation of material according to the concept, readability, and display of the e-book that interesting. So that e-book is suitable for use in learning. The developed e-book is declared good if it uses quality aspects, including validity, practicality, and effectiveness (Nurkayanti *et al.*, 2021). However, only two aspects were used in this research, namely validity and practicality.

## CONCLUSION

The results of the development of interactive e-book based on multiple intelligences on ecosystem material to train creative thinking skills, it can be concluded that it is theoretically feasible with a validity score of 97.16% and is empirically feasible with a readability level at $10^{th}$, which is suitable for use class X SMA and the percentage of student responses is 98.48%, so it is feasible to be implemented in learning activities.

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