THE DEVELOPMENT OF E-BOOK BASED ON MULTIPLE INTELLIGENCE TO TRAIN CRITICAL THINKING SKILL ON CELL DIVISION TOPIC

Pengembangan E-book Berbasis Multiple Intelligence untuk Melatih Keterampilan Berpikir Kritis pada Materi Pembelahan Sel

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Abstract

Critical thinking skill is one of the thinking skill that student must have to face global competition in 21st century. E-book is one of the alternative teaching materials that can be used in distance learning. E-book combined with multiple intelligences theory can facilitate every type of students' intelligence in in receiving and processing information so it can maximize students' critical thinking skill. One of the Biology topic that was considered difficult by students and demanded critical thinking skill was cell division topic. The purpose of this research was to develope e-book based on multiple intelligence to train critical thinking skill on cell division topic that are valid and practical. This research used ADDIE model. The e-book was tried out limited on 10 students of SMAN 1 Cerme grade 12th. The validity of the e-book is determined from the validation result of education expert, material expert and biology teacher in terms of content, presentation and language component. The practicality of the e-book is determined by students' responses to e-book usage. The data analysis technique was carried out by descriptive quantitative. The result of the validity analysis showed an average percentage score of 95% with a very valid category. The practicality of e-book usage showed an average precentage score of 96.53% with a very practical category. Based on the result, it can be conclude that e-book based multiple intelligence to train critical thinking skill on cell division topic is declared valid and practical to be used in the learning process.

Keywords: e-book, multiple intelligence, critical thinking skill, cell division.

Abstrak

Keterampilan berpikir kritis merupakan salah satu keterampilan berpikir yang wajib dimiliki peserta didik untuk mengahadapi tantangan global di abad 21. E-book merupakan salah satu alternatif bahan ajar yang dapat digunakan dalam pembelajaran jarak jauh. E-book yang dikombinasikan dengan teori multiple intelligence dapat memfasilitasi setiap tipe kecerdasan peserta didik dalam mengolah dan menerima informasi sehingga dapat memaksimalkan keterampilan berpikir kritis peserta didik. Salah satu materi biologi yang dianggap sulit oleh siswa dan membutuhkan keterampilan berpikir kritis adalah materi pembelahan sel. Tujuan dari penelitian ini adalah untuk mengembangkan e-book berbasis multiple intelligence pada materi pembelahan sel untuk melatihkan keterampilan berpikir kritis yang valid dan praktis. Penelitian ini menggunakan model ADDIE. E-book diuji cobakan secara terbatas kepada 10 peserta didik SMAN 1 Cerme kelas 12. Validitas e-book ditentukan dari data hasil validasi oleh validator ahli pendidikan, ahli materi dan guru biologi yang mencakup komponen isi, penyajian dan bahasa. Kepraktisan e-book ditentukan dari respon peserta didik terhadap penggunaan e-book. Teknik analisis data yang digunakan adalah deskriptif kuantitatif. Hasil dari analisis validitas menunjukkan rata-rata presentase 95% dengan kategori sangat valid. Kepraktisan penggunaan e-book menunjukkan rata-rata presentase 96.53% dengan kategori sangat praktis. Berdasarkan hal tersebut, dapat disimpulkan bahwa e-book berbasis multiple intelligence untuk melatih keterampilan berpikir kritis pada materi pembelahan sel dinyatakan valid dan praktis untuk digunakan dalam pembelajaran.

Keywords: *e-book,* multiple intelligence*, berpikir kritis, pembelahan sel*

INTRODUCTION

Educational requirement of 21st century is the achievement of skill in a competency learning activity, which includes life and career skills, technology and media information skills, and learning and innovation skills (Depdikbud, 2014). Learning and innovation skill include critical thinking and problem solving, communication, collaboration and creative. According to that, the Ministry of Education and Culture (2017) conveyed the thinking skills that students in Indonesia need to have, including critical thinking, collaborative, communicative and creative (4C).

Critical thinking is the ability to identify facts of a problem clearly, logically, concisely and efficiently to get a conclusion (Cahyono, 2017; Agnafia, 2019; Defiyanti & Sumarni, 2020). There are six aspects in critical thinking, namely interpretation, analysis, evaluation, inference, explanation and self-regulation (Facione, 2015). In fact, the critical thingking skill of Indonesian students are still in the low category. This is supported by survey data from the Organization for Economic Corporation and Development (OECD) using the International Program for Student Assessment (PISA) test. The result showed that thinking ability of students at levels 5 and 6 is only 8% of the total participants and known to be 0,8% of the 8% participants came from Indonesia. Furthermore, it is also known that about 20% of the total participants have the ability to think below level 2, with a total of 42.3% of this percentage being Indonesian students (OECD, 2016).

Indonesian also have an educational emergency caused by the COVID-19 pandemic. World Health Organization declared COVID-19 as a global pandemic. Coronavirus Disease 2019 (COVID-19) is an infectious disease caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) which attacks the human respiratory system (Kemenkes RI, 2020). Indonesian goverment decided to temporarily close educational institutions in attempt to reduce the spread of Covid-19 and starting to implement an online learning system (Handarini dan Wulandari, 2020).

The online learning system initiated by the Ministry of Education and Culture intended to keep students entitled to educational service during the covid pandemic so that students can still practice critical thinking skill in accordance with the educational requirement of 21st century. However, in its implementation there are many obstacles, such us poor internet connection, limited use of technology, lack of teacher guidance in difficult subject and lack of independent learning resources that can train critical thinking skill. All of these obstacles decreasing student's knowledge and critical thinking abilities (Anugrahana, 2020; Azzahra, 2020; Wahyono *et al*, 2020).

The previous research mentioned that one of the most difficult biological topic is cell division, the research based on the avarage student learning outcomes on this topic is in the low category (Lestari, 2014; Fillaili, 2015; Parany, 2016). Cell division describes the process of cells go through divide that cannot be seen directly by students. The basic competency in cell division topic is "Analyzing the process of cell division as a basis for inheriting traits from parent to offspring", the word "analysis" here is one of the critical thingking criteria. (Hartiningrum & Susantini, 2019). Cell division topics is an abstract and complex material, so in its learning activities require all aspect of students' thinking that can be done by using teaching materials based on multiple intelligence.

Based on several studies, the use of teaching materials based on multiple intelligence can improve students' learning outcomes and critical thinking skill (Ege, 2016; Winarti, 2019; Attamimi, 2019; Afsani, 2019; Zuhriyah, 2019; Anwar, 2020). Gardner's theory of multiple intelligence explains that each student has nine types of intelligence, including spatial-visual, linguistic-verbal, interpersonal, musical-rhythmic, naturalist, bodily-kinethetic, intrapersonal, logic-mathematics and extensial-spiritual (Ahmad and Sharifah, 2020). Different types of intelligence cause students to have different ways of receiving and processing information (Armstrong, 2013; Abenti, 2020). Multiple intelligence theory helps students to learn according to their type of intelligence so it can maximize students' understanding and critical thinking skill. Previous research conducted by Wijayanti (2019) stated that e-book based on multiple intelligence can train students critical thinking skill practically with a percentage of 83,33% .

E-book is an electronic version of the book that can be used on a smartphone or PC that contains various features such as images, audio, video, and hyperlinks that allow interaction between students and teacher (Muhammad, 2017). Based on several studies, e-book are effectively use in learning as evidenced by the increased learning outcomes of learners afterthe use of e-books (Alwan,2018; Hwang, Tu and Wang, 2018; Harjono et al., 2020; Prasetyono and Hariyono, 2020). Kemenristekdikti (2016) also mentioned that the right

learning resources used in distance learning are ICT-based learning resources, one of the example is e-book.

Based on the description above, to train students' critical thinking skill in 21st century and in this pandemic situation, the best alternative procedure is developing e-book based on multiple intelligence on cell division topic. There are five types of intelligence used in this e-book that are spatial-visual, linguistic-verbal, interpersonal, musical-rhythmic and logic-mathematics. The type of intelligence used in the e-book has been adapted to the cell division topic. The aim of this study is to develop an e-book based on multiple intelligence on cell division topics, the e-book hoped can facilitate every type of students' intelligence in receiving and processing information so it can maximize students' critical thinking skill.

METHOD

This research is a development research using the ADDIE model (Analysis, Design, Development, Implementation and Evaluation). The analysis, design and development stage was conducted from November 2020 to January 2021 at Learning Lab Center for Mathemathics and Natural Science, State University of Surabaya. The implementation stage was carried out in February 2021 by online. The implementation stage was conducted by means of limited trials to 10 students of 12th grade science of Senior Haigh School 1 Cerme through WhatsApp group and Google meet. The evaluation stage was done by analyzing the result of e-book validation from three validators and questionnaires of e-book usage responses from students.

The validity of e-book based on multiple intelligences on cell division topic measured based on validaion results from one education expert, one material expert and one biology teacher. The result of e-book validity determine the feasibility of the e-book for use in learning. The instrument used to determine the validity of the e-book is a validation sheet that includes the validity of content, presentation and language. The validation result were analyzed descriptively quantitatively, by selecting scores 1-4 using Likert scale. The percentage avarage score of the criteria can be calculated by the following formula :

$$P \text{ Validation}(\%) = \frac{\text{Average score of each aspect}}{\text{Average maximum score}} \times 100\%$$

The percentage of validation result then interpreted using validity criteria (Table 1). E-book-based multiple intelligences cell division material is declared valid if gets value of ≥70% (Riduwan, 2013).

Table 1. Validity Criteria

Criteria	Percentage
Not valid	25% - 39,9%
Less valid	40% - 54,9%
Valid enough	55% - 69,9%
Valid	70% - 84,9%
Very Valid	85% - 100%

Source : (Riduwan, 2013)

The practicality of e-books is measured based on students' response to e-book usage. The instrument used to analyze the practicality of the e-book is a students response questionnaire instrument filled by ten students of grade 12 science. Student responses are collected via the google form. The e-book's practical response uses the Guttman model with the answers "Yes" and "No". The percentage of student response can be calculated by the following formula.

$$P \text{ Response} = \frac{\text{Number of students answered "Yes"}}{\text{Total number of students}} \times 100\%$$

The percentage of student response results then interpreted using practicality criteria. E-book based multiple intelligences cell division material is categorized as practical when it gets a positive response ≥61%.

Table 2. Parcticality criteria

Criteria	Percentage
Not practical	0% - 20%
Less practical	21% - 40%
Practical enough	41% - 60%
Practical	61% - 80%
Very Practical	81% - 100%

Source : (Riduwan, 2013)

RESULT AND DISCUSSION

The result of this study is an e-book based on multiple intelligence on cell division material to train students' critical thinking. This e-book consists of several sub-materials namely amitosis, cell cycle, mitosis, meiosis, and gametogenesis. The e-book developed is equipped with a flip feature that allows the reader to feel like reading a printed book on a smartphone or PC. The e-book consists of three parts, namely the introduction, content and closure.

Figure 1. E-Book cover

The e-book is designed with paper size A4 and uses Comic Sans MS font size 12. E-book contains text, images, videos, and hyperlinks that linked to the Internet.
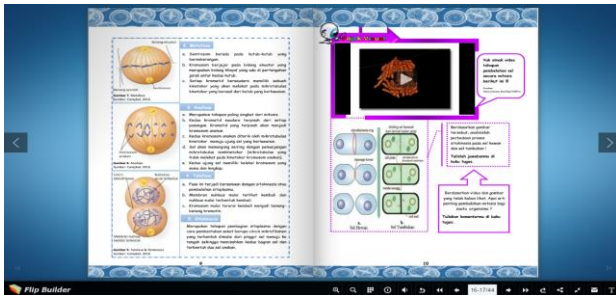

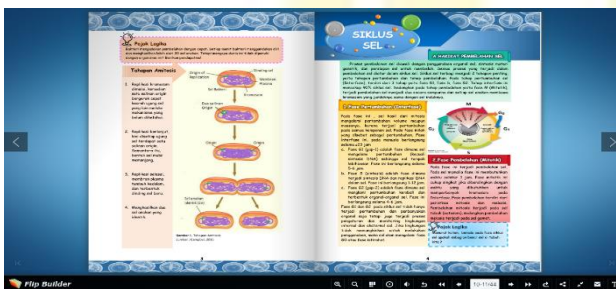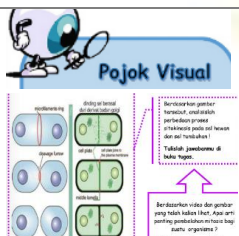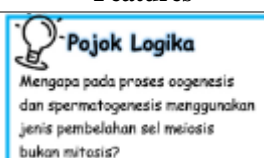**Figure 2.** Present of text, image, video and hyperlink in the e-book

Figure 3. Content and fiture in the e-book

The E-book has several main features based on multiple intelligence that can train critical thinking skills such as *Pojok Logika, Pojok Linguistik, Pojok Visual, Pojok Musikal*, and *Pojok Interpersonal*. In addition, there are several other supporting features including Bio Information, Bio Dictionary, and Bio Evaluation.

Table 3. Features in the E-book
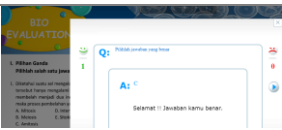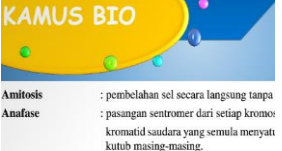
No.	Features	Description
1.		This feature contains videos, images, and critical thinking questions which contain indicator of interpretation, analysis and inference for students with spatial-visual intelligence types.
2.		This feature contains logical questions which contain indicator of analysis, explanation and evaluation for students with logical-mathematical intelligence types
3.		This feature contains experimental activities that involve cooperation with many people, and contain critical thinking indicator namely self-regulation and evaluation for students with interpersonal intelligence types .
4.		This feature contains songs and lyrics of cell division topics for students with musical intelligence types.
5.		This feature contains comment fields and acronyms that facilitate students with linguistic-verbal intelligence types.
6.		This feature contains information about the application of cell division topic in real life.
7.		This feature contains multiple choice question and essay to train students'

No.	Features	Description
		understanding of these sections.
8.	KAMUS BIO Amitosis : pembelahan sel secara langsung tanpa Anafase : pasangan sentromer dari setiap kromos kromatid saudara yang semula menyatu kutub masing-masing.	This feature contains an explanation of the biological term in the ebook.

One of the characteristics of e-book is a flipbook-type e-book that has a transition effect so that it can be flipped like a printed book. E-Books can be operated using a laptop or smartphone and can be accessed online or offline so that students can access e-books anywhere and anytime. E-Book presents videos that can be accessed offline as well as hyperlinks that can be used to access the intended web page. E-Book with criteria like this is very suitable for distance learning during the current Covid-19 pandemic, it is supported by Ambarita (2020) that electronic media-based learning is very effective for distance learning.

E-Book based on multiple intelligence to train critical thinking skills in cell division material has been vaccinated by three validators, namely lecturers of material experts, lecturers of education experts, and biology teachers who are reviewed based on the components of content, presentation, and language. Here's a recapitulation of multiple intelligence-based cell division e-book validation results (Table 4).

Table 4. Recapitulation of e-book validation results

No.	Aspect	Avarage score	Percentage(%)	Interpretation
Content Feasibility				
1.	The scope of material and accuration	3,67	91.67%	Very valid
2.	Current information	3,67	91, 67%	Very valid
3.	Develop skills and stimulate curiosity	3,67	91, 67%	Very valid
4.	Contains multiple intelligences insight	3,67	91, 67%	Very valid
5.	Train critical thinking skill	4,00	100%	Very valid
Average of Content		3,73	93,33%	Very

No.	Aspect	Avarage score	Percentage(%)	Interpretation
Feasibility				valid
Presentation Feasibility				
6.	E-book presentation technique	4,00	100%	Very valid
7.	Material presentation support	3,67	91,67%	Very valid
8.	Other support fiture	3,67	91,67%	Very valid
9.	The choice of letters	4,00	100%	Very valid
Average of Presentation Feasibility		3,83	95,83%	Very valid
Language Feasibility				
10.	Use of language	4,00	100%	Very valid
11.	Use of term	3,67	91,67%	Very valid
Average of Language Feasibility		3,83	95,83%	Very valid
Average of All Feasibility		3,80	95%	Very valid

Based on the validation results by the three e-book validators developed overall obtained a validation score percentage of 95% with a very valid category (Riduwan, 2013). These results show that e-book based on multiple on cell division topics to train critical thinking skills are well worth using in learning.

In the content feasibility component received a percentage value 93.33%, this indicates that the content of the e-book is very valid based on aspects of material coverage, material specificity, loading of multiple intelligences studies, ability to stimulate the proficiency and curiosity of learners, as well as the ability to practice critical thinking skills. Aspect that e-book contain current information received a percentage value of 91.67% with a very valid category. This shows that the cell division material in the e-book is following basic competencies and contains information about the latest phenomena related to cell division material to increase the insights of learners. This is following the opinion of Candra (2016) that a good e-book is an e-book that can provide more knowledge and insight to students.

Aspects that show the characteristics of multiple intelligence received a percentage value 91.67% with a very valid category. The use of multiple intelligence

aspects in e-book is still incomplete because e-book only use 5 types of intelligence only from the 9 types of intelligence presented by Gardner. The five types of intelligence used in e-book have been adapted to the content of cell division materials and the ability to practice critical thinking. The five types of intelligence are logical-mathematical intelligence showed in "Pojok Logika" fiture, interpersonal intelligence showed in "Pojok Interpersonal" fiture, musical-rhytmic intelligence showed in "Pojok Musical" fiture, spatial-visual intelligence showed in "Pojok Visual" fiture, and linguistic-verbal intelligence showed in "Pojok Linguistik" fiture.

Aspects of ability to train critical thinking skills received a percentage value of 100% indicating that theoretically, e-books based on multiple intelligence cell division materials developed are very feasible to train the critical thinking skills of learners. The results are in accordance with Wijayanti research (2019) that multiple intelligence-based ebooks can train students' critical thinking skills to the maximum.

The presentation component feasibility component received a percentage value 95.83% with a very valid category, this shows that e-book based on multiple intelligence in cell division material has excellent presentation based on aspects of presentation techniques, supporting material presentation, supporting features, and font selection of letters used in e-books. The presentation of an e-book is very influential on the reading interest of students. Two aspects get a 100% validity score, namely the technique of presenting and selecting letters. Presentation techniques aspect received a percentage value 100% show that the e-book that is compiled has a good presentation systematics that is the balance between sub-chapters and the correct order of presentation of the material to facilitate the reader in understanding the content of e-book material (Rismawati, 2015). The aspect of letter selection that gets the maximum score also shows that the use of font and font size on the e-book is very precise and supports the presentation of e-books.

In the linguistic component obtained a validation score percentage of 95.83 % with a very valid category, this indicates that the use of language in the e-book developed is following the PUEBI, and the term used does not give rise to double meaning so that students easily understand the content of the e-book. The use of good language and terms affects the development of e-books because, with good language, the delivery of messages to readers will be easier (Nisyak, 2015).

The practicality of e-book based on multiple intelligence in cell division topics to train critical thinking skills is reviewed from the students' response to the use of e-books. The response to the use of e-books was filled by 10 students of class XII Mipa. The results of the student response are presented in Table 5 below.

Table 5. Recapitulation of Students Response Results

No.	Creation assessed	Positive Response (%)	Category
Presentation of e-book			
1.	Interesting e-book presentation	100%	Very practical
2.	The e-book is easy to operate	100%	Very practical
3.	The writing in the e-book can be read clearly	100%	Very practical
4.	The font style and size in the e-book can be read clearly	100%	Very practical
5.	The images on e-book is clearly visible and ilustrates the content of the topic	100%	Very practical
6.	The images on e-book can be enlarged easily	90%	Very practical
7.	The video on e-book is clearly visible and ilustrate the content of the topic	100%	Very practical
8.	Flip fiture on e-book can work fine	90%	Very practical
9.	Table of content on e-book can be clicked to a specific page	80%	Practical
10.	The e-book has some interesting fiture	100%	Very practical
Average		96%	Very practical
Content of the e-book			
11.	The e-book contents' is accordance to the learning objective	100%	Very practical
12.	E-book contents' can increse knowledge about cell division topic	100%	Very practical
13.	Information in the form of articles in e-books help add insight	100%	Very practical

No.	Creation assessed	Positive Response (%)	Category
	to students		
14.	E-book features can attract students' learning interests and motivation	100%	Very practical
15.	The e-book contains interpretation activities	90%	Very practical
16.	The e-book contains analysis activities	100%	Very practical
17.	The e-book contains inferences activities	90%	Very practical
18.	The e-book contains evaluation activities	80%	Practical
19.	The e-book contains explanation activities	100%	Very practical
20.	The e-book contains self-regulation activities	100%	Very practical
Average		96%	Very practical
Language of the e-book			
21.	E-book use informative language	100%	Very practical
22.	E-book use easy-to-understand sentences	100%	Very practical
23.	E-book use easy-to-understand biological terms	100%	Very practical
Average		100%	Very practical
Overall average category		96,53%	Very practical

Based on the results of the response of students in Table 5, it can be known that the students showed a positive response with an average percentage of 96.53% with the category "Very Practical". The response of students became one of the indicators of the practicality of multiple intelligence-based e-books. In the presentation aspect, it is known that e-books based on multiple intelligence have an interesting presentation to make students more motivated to learn. Retariandalas (2017) stated that interesting presentation in teaching materials is expected to influence students interest in learning so that students can do their learning activities well and can improve the learning outcomes of learners. In addition, e-books have an advantage value related to the flexibility that can facilitate students in using e-books

anywhere and anytime through many electronic devices (Zahara, 2014).

In terms of content received a positive response with an average score of 96% with a very practical category. In the content aspect, there are critical thinking criteria such as interpretation, analysis, inference, evaluation, explanation, and self-regulation activities. Interpretation, inference, and evaluation activities do not receive a fully positive response but it's still categorized as very practical. The ability of each student to accept and understand the material is different so some critical thinking criteria are unacceptable to some students. Meanwhile, on other critical thinking criteria, namely analysis, explanation and self-regulation scored 100% with a very practical category. The analysis activity is contained in "Pojok Logika" faeture in the form of questions about the problems that occur at the stages of cell division. The explanation activity is contained in "Pojok Visual" feature in the form of study activities about the process of cell division based on video observations. The self-regulation activity is contained in "Pojok Interpersonal" in the form of creating experiment reports. The data result shows that the e-book developed is proven to train students' critical thinking skills, it's accordance with Wijayanti's opinion (2019) that multiple intelligence-based e-books can train students' critical thinking skills practically and effectively.

On the language aspect got a positive response with an average score of 100% with a very practical category, this shows that the use of language, sentence selection, and the use of terms in ebooks have been very good. The use of good language in e-books will facilitate the delivery of information to facilitate students in understanding the material of the ebook (Nurhasikin, 2019).

Ebook-based Multiple intelligence has several advantages that present interesting features to increase the motivation of students in learning and training critical thinking skills following the opinion of Alwan (2018) which states that learning to use e-books can attract students' learning interests and fit with the current student learning style that is more flexible anywhere and anytime.

CONCLUSION AND SUGGESTION
Conclusion

E-books based on multiple intelligence on cell division materials to train critical thinking skills are considered very valid and practical to use in learning. E-book validity based on the test results of material expert

validators, educational experts, and biology teachers obtained an average percentage score of 95% with a very valid category based on the component of presentation, content, and language. The practicality of e-book based on the results of students' response to e-book usage obtained an average percentage score of 96.53% with a very practical category.

Suggestion

Based on the study that had been done, the suggestions can be given as follows:

1. Need for further implementation so that the e-books can be applied in the learning not just as supporting material.
2. Study with other materials is necessary considering the response of students is very positive.
3. There needs to be further development of e-book based on multiple intelligences that is more interactive both in terms of appearance and content presented.

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