The Development of Research-Based E-Booklet as Biotechnology Material Supplements to Improve Analytical Capabilities

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Article Info	Abstract
	The background of the problem in this study is the analytical ability of students of SMA Negeri 13 Semarang on biotechnology material is still low. One of the consequences on the absorption of UN in 2017, 2018 and 2019 in the Puspendik (educational research center) is also low. The teaching materials used are not yet in accordance with the needs and tastes of learners. in addition, learning is still focused on teachers with lecture and discussion methods. This, resulting in KD biotechnology has not been achieved. This research aims to develop research-based e-booklets on the application of conventional biotechnology as a supplement to biotechnology materials facilitated with learning devices. The research method used is Research and Development. Data collection in this study used interview guidelines, validation assessment sheet, closure technique form, and response questionnaire. The results showed that based on expert assessment of materials and media on e-booklet developed showed very valid criteria with an average percentage of 92.77% and 93.4%. Trials of learners in the closure tehnique got an average percentage of 96.33% with high criteria. Meanwhile, students and teachers' responses to e-booklets get an average percentage of 91.25% and 97.22% with very decent criteria. In the validation assessment, learning devices get very valid criteria on all devices created, including syllabus, RPP, LKPD, and evaluation questions with the average percentage obtained in a row is 87.76%; 90,04%; 92,01%; and 93.17%. Through learning using e-booklets that have been developed and refer to learning tools that have been created is expected to improve the analytical skills of learners.

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INTRODUCTION

The ability of analysis is the ability to decipher a concept into constituent parts, then be able to relate between them and know how they are connected and organized. According to Saputra (2018) the ability to think analysis is the ability of learners in using their knowledge based on the logical ability to distinguish, organize and make decisions in an effort to solve daily problems. Analytical ability is one of the competencies that are expected to be achieved by students in high school biotechnology material. As stated in KD 3.10, students are expected to be able to analyze the principles of biotechnology and its application as an effort to improve human welfare.

Based on the results of National Examination (UN) recorded on Puspendik (Educational Research Center) in 2017, 2018 and 2019 the absorption of students of SMA Negeri 13 Semarang on biotechnology indicators consecutively 48.75%; 58,65%; and 36.00%. This proves that the analytical ability of learners on biotechnology materials is still relatively low. The results of interviews with biology teachers show that the learning process still uses lecture and discussion methods. Then, the teaching materials used only present theoretical material and give less examples of bioprocess on the application of biotechnology.

Then based on the results of interviews in 10 students of class XII MIPA showed that biotechnology material is interesting but microorganisms related to the application of biotechnology is difficult to memorize. Therefore, a supplement of teaching materials is needed to suit the needs and tastes of learners. Thus, it is expected to complement the shortcomings of existing teaching materials and help learners to achieve basic competencies that must be achieved.

Based on the problems that have been described, researchers found a solution by developing a research-based teaching supplement by utilizing the potential of the environment around learners. A real example of this idea can be realized in the form of research-based e-booklets as a supplement to teaching materials. Booklet is a medium of delivery of learning materials that displays images and real examples of the material being studied, thus making learners interested in learning and can improve learning outcomes (Farkhana, 2017). The e-booklet developed presents additional conventional biotechnology materials that specifically contain the stages of making conventional biotechnology products in the field of food. E-booklet also presents biological processes involving microorganisms in the manufacture of such products. In addition, e-booklets are packaged in electronic form in PDF format so that students can learn independently without being limited by space and time.

E-booklet as a supplement of teaching materials developed based on the results of conventional biotechnology research in the field of food conducted by researchers serves to facilitate learners to conduct independent experiments at home. It is expected that through these activities will make learners able to analyze and apply bioprocess that occur in the process of making conventional biotechnology products in the field of food. Thus, basic competencies in biotechnology learning can be achieved.

RESEARCH METHODS

The development of research-based e-booklets for the application of conventional biotechnology in the food sector is an R&D type research using Research and Development measures from Sugiyono that have been modified. R&D research according to Sugiyono (2015) contains ten steps, but in this study was only carried out until the seventh stage, namely small-scale trials. The research was conducted at SMA Negeri 13 Semarang from November to December 2020. The research samples used in the study were 10 students in grade XII MIPA 4 who were selected on the recommendation of biology teachers who had different levels of ability, namely high, medium, and low.

DISCUSSIONS AND RESULTS

The results obtained in this study consisted of material validation data and e-booklet media that obtained percentages with very valid categories, e-booklet feasibility data tested on a small scale, including the responses of biology teachers and learners who got very decent criteria as well as a trial by students who get high criteria. In addition, the validation results of learning devices in the form of validation syllabus, Lesson Plan (RPP), and evaluation questions that all get criteria are very valid.

Material Validation Results and E-booklet Media

Based on the assessment of material validation by two validators, the eBooklet developed is considered very valid with an average percentage gain of 92.77%. The assessment of material validation that has been done based on three aspects of feasibility, namely material or content, presentation, and language. Details of the assessment results by material experts can be seen in table 1.

Table 1. Material validity results

No.	Eligibility Aspects	Percentage
1.	Material or content	95%
2.	Presenting	95,83%
3.	Language	87,5%
	Average persentage	**92,77%**
	Criteria	**Very valid**

The first component in the material validation assessment is the feasibility aspect of the material or content is considered very feasible with a percentage gain of 95%. This is because the e-booklet was developed in accordance with the basic composition of biotechnology material curriculum 2013 revised edition. In addition, the material in the e-booklet is considered very feasible because it has presented concepts and definitions on the material that can be proven accurately through library sources used in the last 10 years. Toyyibah & Rachmadiarti (2019) in their research said that textbooks with the criteria of finality are indicated by the preparation of books using a library that is not more than 10 years old, current and reflects an up-to-date event.

The second component is the feasibility aspect of the presentation which is considered very feasible with a percentage gain of 95.83%. This is because the e-booklet on the application of conventional biotechnology in the food field presents images of research results relevant to the material described. The images presented make the content of the material described can be conveyed properly and make the presented materials look more attractive to learners.

The third component of the material validation assessment is the language feasibility aspect which is considered very feasible with a percentage gain of 87.5%. The percentage gain in this third aspect is the lowest percentage when compared to the other two components in the validation assessment which obtain ≥ 90%. This is because, there are still some language discrepancies displayed, namely, there are still typos, scientific names have not been italicized and the writing of time descriptions that have not been displayed clearly. In accordance with the comments and suggestions of the validator, some errors in that aspect of the language have been corrected. The use of vocabulary has been adjusted to the rules of good and correct Indonesian language.

Based on media validation assessment by two validators, the e-booklet developed is considered very valid with an average percentage gain of 93.4%. Media validation assessment that has been done based on three aspects of feasibility, namely booklet design format, attractiveness, and graphy. Recapitulation of media validation results can be seen in table 2.

Table 2. Result validity media

No.	Eligibility Aspects	Percentage
1.	Booklet design format	96,87%
2.	Attraction	87,5%
3.	Graphics	95,83%
	Average percentage	**93,4%**
	Criteria	**Very valid**

The first component in the media validation assessment is the feasibility aspect of the booklet design format which is considered very feasible with a percentage of 96.87%. This is because the e-booklet developed has an attractive and consistent design format both from cover design and page design. E-booklet displays a

cover that contains the identity of the e-booklet clearly, namely the title of the e-booklet, the name of the compiler, and an image of conventional biotechnology products in the field of food that corresponds to the products contained in the e-booklet.

The second component in the media validation assessment is the feasibility aspect of attractiveness which is considered very valid with a percentage gain of 87.5%. Percentage in the second aspect this time becomes the lowest percentage when compared to the other two aspects of media validation feasibility that can get a ≥ 90%. This is because, in the indicator of proportion and composition of colors used in the e-booklet still needs improvement, namely there is a color that feels bright enough on the background of the title that contains the product image so that the focus of the product image is disturbed. In addition, there are tables that do not match the colors in the background. In accordance with the comments and suggestions of validators some of these deficiencies have been corrected.

The third component in the media validation assessment is the feasibility aspect of graphs which is considered very feasible with a percentage gain of 95.83%. This is because the e-booklet developed presents an interesting image with a proportion of the image size that has been adjusted to the page size. The images presented have good quality and clear. The picture presented at the stage of making the product is taken from the research results to represent the stages described. So that the reader can easily understand the meaning of the explanation. This is in line with the explanation put forward by Klarisya et.al. (2019) that in the criteria for the use of images in the booklet can be used to clarify the delivery of the information that you want to display.

E-Booklet Eligibility

The result of teacher response to the e-booklet developed got a very decent assessment criteria with a percentage of 97.22%. The teacher's response resulted in a perfect score (four) on eight aspects of the assessment of the total nine aspects of the assessment tested. The teacher response questionnaire tested contained nine statements with aspects of assessment, namely material, contextual, presentation, language, cover design, e-booklet media, assessment of the use of e-booklets, and the desire to use e-booklets in learning.

The language aspect gets the lowest score of all aspects tested. This is because there is still typo in the scientific vocabulary that has not been printed in the form of italic word. The typo has been corrected in accordance with PUEBI. Klarisya et.al. (2019) stated that the sentences used in the booklet do not contain double meanings, use good and correct language in accordance with PUEBI (Indonesian Spelling Guidelines) and use language that is easy to understand for high school students. Klarisya et.al. (2019) stated that the sentences used in the booklet do not contain double meanings, use good and correct language in accordance with PUEBI (Pedoman Umum Ejaan Bahasa Indonesia/General Guidelines for Spelling of Indonesian) and use language that is easy to understand for high school students.

The closure technique is used to see the readability level of the developed eBooklet. The results of the closure technique that has been done obtained an assessment with high criteria. Recapitulation of rumied test results can be seen in table 3.

Table 3. E-Booklet Readability Test Results

No.	Learners	Amount	Percentage	Criteria
1.	High level ability	3	100%	High
2.	Medium level ability	4	97%	High
3.	Low level ability	3	92%	High
	Average percentage		**96,33%**	**High**

High readability test results showed that the e-booklet developed was in accordance with the level of thinking of learners as e-booklet users. This is supported by the acquisition of a percentage of students with low ability levels who managed to obtain a reading percentage of 92% with high criteria.

Learners who have filled out the closure test, are then asked to fill out a response questionnaire about the e-booklet developed. Filling out the response questionnaire of learners aims to find out the match of e-booklets developed with the expectations of learners. Based on the results of the questionnaire of learners'

responses about the e-booklet developed was declared very feasible with an average percentage obtained by 91.5%. Recapitulation of student response results can be seen in Table 4.

Table 4. Student Responses

No.	Pernyataan	Skor	Persentase	Kriteria
1.	The cover view on the eBooklet is interesting.	35	87,5%	Very feasible
2.	Sentences used are easy to understand.	37	92,5%	Very feasible
3.	The material presented is systematic so that it is easy to understand.	37	92,5%	Very feasible
4.	Easy-to-use eBooklets.	38	95%	Very feasible
5.	E-booklets are easy to save.	38	95%	Very feasible
6.	E-booklets can be carried so they are easy to learn at any time.	37	92,5%	Sangat layak
7.	E-booklet helps understand biotechnology material easily without teacher's help.	34	85%	Very feasible
8.	The material presented relates to daily life.	38	95%	Very feasible
9.	Letters used can be read easily.	37	92,5%	Very feasible
10.	I am interested in using eBooklets in biotechnology learning.	34	85%	Very feasible
	The average percentage		**91,25 %**	
	Criteria		**Very feasible**	

Learners are involved to provide responses through the questionnaires provided. This is because, learners as users have the right to participate in responding to the e-booklet developed. According to Hamzah & Mentari (2017) in their research suggested that in addition to the feasibility test by expert validators, learners also conduct tests to determine the level of feasibility related to learning devices developed from the user aspect.

E-Booklet based on research on the application of conventional biotechnology in the field of food is practical in the use and storage. The practicality of e-booklets is demonstrated by the ease of use and storage that does not require special space or care from users, because e-booklets are presented using PDF format (Portable Document Format) that makes it easy for learners to open e-booklets without having to use data connections and can be accessed using smartphones, notebooks, or laptops wherever and whenever students want.

Learning Device Validation

Based on the validation results of learning devices that have been compiled is declared very valid. Recapitulation of learning device validation results can be seen in table 5.

Table 5. Learning Device Validation Results Recapitulation

No.	Learning Device	Score Precentage	Criteria
1.	Syllabus	87,76%	Very valid
2.	RPP	90,04%	Very valid
3.	LKPD	92,01%	Very valid
4.	Evaluation questions	93,17%	Very valid

The syllabus is considered very valid with an average percentage gain of 87.76%. This is because the syllabus is made by referring to eight aspects of the preparation of the syllabus, namely identity conformity, accuracy of KI and KD with Permendikbud number 24 of 2016, subject matter, GPA, learning activities, assessment, time allocation, and learning resources. All of these aspects become aspects tested in the syllabus validation test and get percentage with very valid criteria on six aspects and the other two aspects only get a percentage with valid criteria. Aspects of assessment that get valid criteria are aspects of

assessment and learning resources that only get a score percentage of 75%. This is because at the time of validation test both aspects have not been presented in detail on the syllabus. The assessment aspect only displays the assessment technique, but has not listed the assessment form in detail. In accordance with the advice given by the validator, both aspects have been corrected in the syllabus.

The next learning device that is validated is the Lesson Plan (RPP) which is considered very valid with an average percentage gain of 90.04%. This is because the preparation of RPP refers to three aspects of RPP preparation, namely, identity aspects containing subjects, schools, classes and semesters of learning. Competency aspects containing KI and KD biotechnology materials in accordance with Permendikbud number 24 of 2016. Component aspects that contain operational, measurable and in accordance with KD learning objectives, a series of learning activities, time details, assessment forms and techniques, media and learning resources.

The third learning device validated is the Learner Worksheet (LKPD) which is considered very feasible with an average percentage gain of 92.01%. This is because the LKPD compiled in terms of content is in accordance with KI, KD, and learning indicators. Then the LKPD has been presented with clear indicators and in accordance with the material contained in the e-booklet developed. The language used in LKPD is in accordance with Indonesian language rules and the development of learners.

The fourth learning device that was validated was an evaluation question that was considered very feasible with an average percentage gain of 93.17%. This is because the question is prepared by using the rules of making a good question, in accordance with the rules of the preparation of the question according to the Ministry of National Education as cited by Aulia (2020) that a good question must be in accordance with the guidelines for the preparation of the question covering several aspects, namely materials, construction and language. The evaluation problem made has been adjusted to the KD and indicators. Then, the problem that is made focus on the cognitive sphere in the form of C4, which is to measure the analytical ability of learners. The subject matter and choice of answers are clearly and logically arranged. Presentation of questions using language that is in accordance with Indonesian rules and easy to understand.

All learning tools that have been validated are declared very valid. Therefore, all learning devices can be used in the learning process. This is in line with Ni'mah et.al. (2018) in his research concluded that syllabuses and RPP that have been declared very valid by expert validators can be used or utilized by both teachers and learners in learning activities.

Learner analysis skills can be achieved by using learning tools that have been compiled and declared very valid by expert validators and teachers. The learning process refers to the learning steps in RPP by using e-booklets that have been developed as learning supplements. Young people use LKPD and evaluation questions that have been declared very valid.

The analytical ability of learners is expected to be achieved by applying analytical capability indicators to the learning process. The learning process to improve the analytical ability using e-booklet supplements that have been developed refers to three indicators, namely differentiating, organizing and connecting (Astriani, et. al., 2017).

Distinguishing indicators are shown by the learning steps by learners who study the e-booklet application of conventional biotechnology in the field of food, then through the e-booklet, learners distinguish various microorganisms that play a role in each biological process in the manufacture of conventional biotechnology products. Furthermore, organizing indicators are indicated by learning steps by learners who conduct and organize an experiment in the manufacture of conventional biotechnology products in the field of food by using the reference of work steps on the e-booklet. Then, the connecting indicator is shown by the learning steps by the learners answering the questions in the LKPD by connecting the knowledge gained through the experiment results with the e-booklet. In addition, there is a question of multiple-choice evaluation that must be done by learners, where the questions made are adjusted to the e-booklet developed.

CONCLUSION

Based on the results of the research obtained, it can be concluded that the research-based e-booklet developed is considered very valid both in terms of materials and media, and is very feasible to be used as a supplement to biotechnology materials in class XII MIPA. Then, learning tools designed to facilitate learning achievement that is expected to improve the analytical ability of learners by using e-booklets developed are declared very valid.

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