

Research Article

The Amazing Eco-Enzyme: Contextual 3D Pageflip E-Book for Environmental Chemistry Learning

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Abstract.

This study uses a Design-Based Research method to describe the stages of production, validation test, and feasibility test of a 3D Pageflip e-book titled *The Amazing Eco-Enzyme*. Contents of the e-book were presented contextually, discussing the production, characterization, and application of Eco-Enzymes for environmental sustainability and Islamic values. Those topics emphasize the study of pollutants and environmental pollution, biogeochemistry and environmental toxicology. The results of the validation test indicated that the e-book was valid in the range of r 0.85-0.92. It was revised, and then a feasibility test was carried out on ten respondents who were selected through purposive sampling. The feasibility test obtained a percentage of 96.67% on the material aspect, 92.50% on the language aspect, and 95.00% on the appearance aspect. The e-book is very feasible and can easily be accessed on a website as an enrichment book to enhance the learning process of environmental chemistry.

Keywords: pageflip e-book, eco-enzymes, environmental sustainability, islamic values.

1. INTRODUCTION

One of the alternative media for presenting learning material is popular scientific books or enrichment books [1]. The content in the book is scientific, accurate, and educational, but easy and comfortable to read, thereby eliminating negative impressions from rigid and relatively complicated scientific papers [2]. In the modern era, book publication in digital form or electronic book (e-book) is growing rapidly [3]. The transformation of e-books allows the efficiency of hundreds of book pages to become one-page screens and helps users to access knowledge more efficiently, easily, cheaply, and quickly [4]. It is environmentally friendly and also more profitable for educational institutions or library institutions in terms of efficiency of maintenance costs and space [5]. So that students can use their gadgets to access learning anytime and anywhere [6].

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Education is an effective means of implementing awareness of preserving the environment. With this awareness, chemistry leads to the concept of Green Chemistry (GC) which considers environmental impacts as a top priority [7]. One of the applications of GC is to substitute synthetic materials with natural materials that are renewable and environmentally friendly [8]. The principles of GC are in line with the values contained in Al-Quran, and hadith [9]. This is in line with the typology of science education at Islamic universities which does not only involve cognitive but also integrated with Islamic values, to improve affective and metacognitive knowledge [10]. Through four stages, namely facts, concepts, applications, and values, this integration can be implemented contextually [11].

The majority of students have difficulty learning chemistry at a higher level due to a lack of process skills and contextual understanding of science [12]. This is triggered by less attractive teaching materials and only focuses on textual principles and theories, but students do not understand its concrete application [13]. In fact, the content in teaching materials needs to be presented contextually to facilitate students in understanding the relationship to the knowledge learned and its implementation in real life, especially actual phenomena [14].

The making of Eco-Enzyme (EE) is increasingly popular and widely developed because it is very practical, economical, and environmentally-friendly [15]. EE was first developed by Dr. Rosukan Poompanvong by utilizing vegetable protein, minerals, and juvenile hormones. Through fermentation, organic matter, sugar, and water at a ratio of 3: 1: 10 will react each other to form a complex but stable enzymatic ecosystem [16]. EE contains various hydrolytic enzymes such as amylase, lipase, caseinase, protease, and cellulase, as well as secondary metabolites such as flavonoids, quinones, saponins, alkaloids, and cardio glycosides [17]. EE also has antimicrobial properties [18], and contains acetic acid and alcohol [19]. EE has various benefits as a cleaning fluid, disinfectant, antiseptic, fertilizer, pesticide, water purifier, air purifier, and deodorizer [20]. So that characterization and utilizing of EE can be an attractive angle for studying environmental chemistry contextually

The e-books with three-dimensional (3D) views are being developed just like the real book in the form of transitions between pages, attractive appearance, and sound effects on book page displacement [1]. The 3D e-book models provides a more natural and comfortable reading sensation [5]. Flash software made digital documents in various extensions becomes realistic (3D), then embed on the HyperText Markup Language (HTML) page from websites and blogs [15]. The media is adapted in science, as well as

chemistry is considered effective [21], and have been developed as learning media in several schools and universities [22].

By discussing the issue of EE, the concept of chemistry is presented contextually makes the product compelling to read. The research question of this study is how to develop a 3D page flip e-book about Eco-Enzyme for environmental chemistry learning, in terms of the stages of making, the results of the validation test, and the feasibility test. This research product is expected to be quality popular scientific books which is contextually integrated with Islamic values and GC principles. So that expected to be able to train affective intelligence in various educational institutions and society generally.

2. RESEARCH METHOD

This study uses the DBR (Design-Based Research) method to encompass; define the concept analysis, design the product, as well as develop the product by validation tests and feasibility tests [23]. Data collection was carried out by making flowcharts and storyboards, using instruments in the form of validation questionnaires filled in by three validators, and filling out a feasibility test questionnaire by ten students of the chemical education study program UIN Sunan Gunung Djati Bandung who were selected through purposive sampling.

3. RESULTS AND DISCUSSION

3.1. Stages of Making and Displaying 3D Pageflip E-Book

The 3D Pageflip e-book entitled Amazing Eco-Enzyme discusses three main topics, namely the production of EE, characterization of EE, and the use of EE for environmental preservation. This is correlated with discussions in environmental chemistry courses, especially in the study of environmental pollutants and pollution, as well as biogeochemistry and environmental toxicology. The contents are related to environmental conservation principles in theoretical and contextual terms, such as the contribution of moeslim to science (chemistry), verses of the Quran related to the concept of environmental preservation and moral values, as well as relevant authentic hadiths such as the concept of Hariem (environmental conservation) and lhya almawat (reviving the dead land) taught by Rasulullah SAW. The phenomena presented are data and cases of environmental problems, such as organic waste and pollution in water, soil, and

air. In addition, the material in the book also presents chemical concepts in the study of EE characterization through infrared (IR) spectroscopy, acid-base titration, pH test, secondary metabolite test, enzyme assay, and antimicrobial test.

In the define stage, a concept analysis and concept map were made regarding the production and use of Eco-Enzyme (EE) integrated with Islamic values. This is to produce a conceptual structured presentation with a precise, clear, and systematic hierarchy of concepts. After that, the analysis is presented in the form of a concept map so that the relationship between concepts can be clearly observed. The discourse analysis is carried out to identify the linkages between the topics, with integrated contextual aspects such as facts, concepts, applications, and values. The research is continued with the design stage in the form of a flowchart to describe the sequence and relationship between one part and another. The flow description is then followed up by making a storyboard, which is containing a more detailed description of the content and appearance of the e-book in a systematic arrangement.

After the storyboard is made, the collection of material in the form of articles, pictures, graphics, illustrations, photos, as well as laws and regulations from books, research journals, mass media, government websites, and other reliable sources. This process facilitates the e-books creation with coverage of facts as issues and environmental pollution data; concepts as related chemistry theories and principles; application of concepts for environmental conservation; and values as integration of Islamic values from the Quran and hadith, as well as moral messages. Then the e-book design is carried out using Canva software, starting from placing text, images, and graphics in the e-book, to obtaining the initial product in PDF format. The format is then converted into 3D by making a flash document and embedding it into an HTML page via the site www.pubhtml5.com. With this process, an initial product is obtained in the form of a 3D Pageflip e-book that is ready to be validated and can be accessed via a link or scanning a QR code. Reviewing description of the display flow presented, the e-book was conveyed inductively, accompanied by perceptual questions that direct the reader to explore and discover the concept independently. This is in accordance with the opinion that a teaching material can be said to be good if it is able to present material inductively because it can encourage students to find concepts independently [24]. A display of several pages of the e-book are shown in Figure 1.

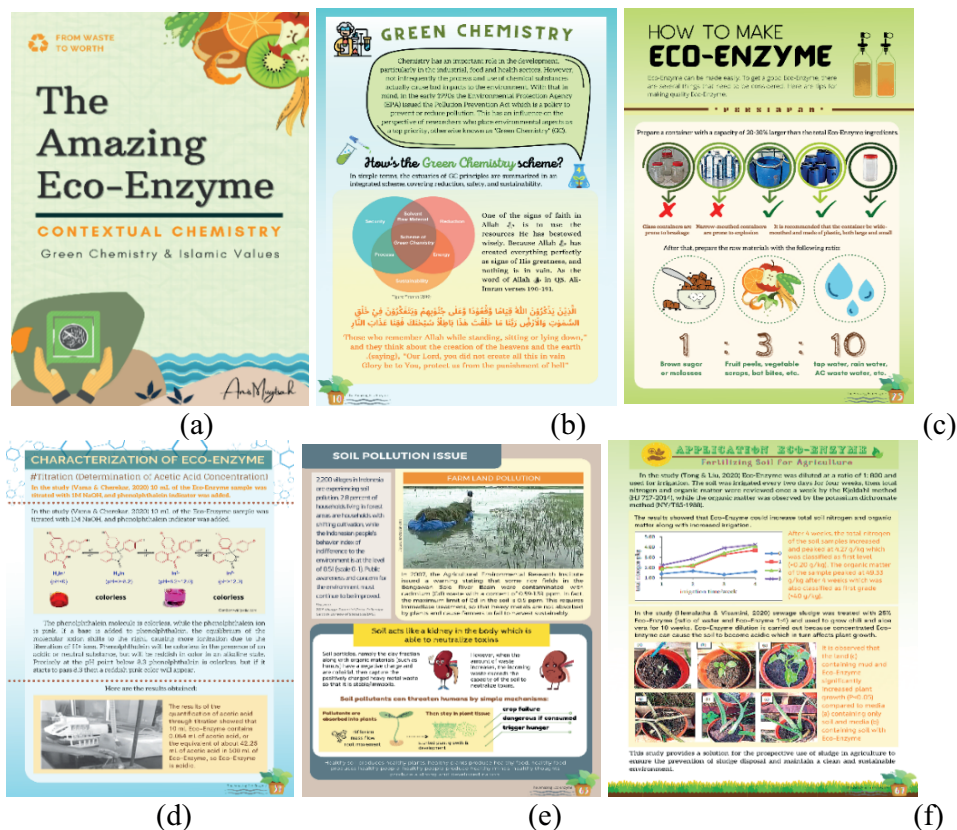


Figure 1: Display of the amazing eco-enzyme e-book (a) Front cover (b) GC scheme and Islamic value integration (c) Procedure for making EE (d) Characterization of acetic acid content in ee through titration (e) Issues and mechanisms of soil pollution (f) Application of ee to fertilize soil.

3.2. Validation Test

The purpose of this stage is to determine the quality of the initial product more specifically, and classify suggestions for improvement for deficiencies in the initial product. what is the opinion [25] that the validation process is to test the validity of the products that have been made. The results of the validation test of The Amazing Eco-Enzyme e-book can be seen in Table 1, Table 2, and Table 3.

TABLE 1: Validation test results for material aspect.

Statement	r _{critical}	r _{count}	Result
Conformity of Material Content with Contextual Aspects	0.3	0.92	Valid
Clarity of Description of Material Delivered	0.3	0.90	Valid
Suitability of Illustrations / Images	0.3	0.91	Valid
Average	0.3	0.91	Valid

Based on Table 1, it is found that the highest rcount value is in the statement that the suitability of the content of the material with the contextual aspect, which is 0.92.

Meanwhile, the lowest is 0.90 in the statement item on the clarity of the material description presented, with an average of 0.91. These results indicate that the e-book is valid in terms of material presentation [26].

TABLE 2: Validation test results for language aspect.

Statement	$r_{critical}$	r_{count}	Result
Accuracy of spelling, terms, and punctuation	0.3	0.87	Valid
The accuracy of sentence/phrase structures	0.3	0.85	Valid
Consistency in the use of scientific/foreign terms	0.3	0.85	Valid
Ease of understanding the language used	0.3	0.90	Valid
Average	0.3	0.87	Valid

Based on Table 2, it is found that the highest r_{count} value is in the statement on the ease of understanding the language, which is 0.90. Meanwhile, the lowest is 0.85 in the statement on the accuracy of sentence/phrase structures, and consistency in the use of scientific terms, with a mean of 0.87. These results indicate that the e-book is valid in terms of language delivery [26].

TABLE 3: Validation test results for appearance aspect.

Statement	$r_{critical}$	r_{count}	Result
Suitability of text, object, and image layout	0.3	0.85	Valid
Harmonious and attractive color collaboration	0.3	0.89	Valid
The typeface used is attractive and easy to read	0.3	0.87	Valid
Shape, the size of the object/illustration/image is proportional	0.3	0.85	Valid
Format compatibility with the contents of the e-book	0.3	0.89	Valid
Illustrations can illustrate the contents of the e-book	0.3	0.87	Valid
Have a good center of the view	0.3	0.89	Valid
Average	0.3	0.87	Valid

Based on Table 3, it is found that the highest r_{count} value is in the statement item of harmonious and attractive color collaboration, conformity of the format with the content of the e-book with good point of view, which is 0.89. While the lowest is 0.85 in the statement item on the suitability of the layout of text, objects and images, and shapes, the size of the illustration/image is proportional, with an average of 0.87. These results indicate that the e-book is valid in terms of display presentation [26].

In the validation test results, the material aspect has a higher value than other aspects, namely 0.91. This shows that the e-book has an advantage in presenting material

content. As the opinion that a good popular science book has a scientific depth of substance, based on data, pictures, and other sources of quotations that are correct and can be justified [27]. Meanwhile, the results of the validation test in terms of language and appearance have the same count rate of r , which is 0.87. These aspects describe the quality of a popular scientific work, because it represents the material in a written work, and bridges the information conveyed by the author to the reader [28]. Thus, The Amazing Eco-Enzyme e-book overall is valid, in terms of material, language, and appearance, with the category of product validity being very good [26].

3.3. Feasibility Test

After being declared valid, and corrected based on criticism and suggestions from the validator, the e-book is ready for due diligence. The feasibility test was carried out on respondents who were selected based on purposive sampling, consisting of 10 chemistry education students who had studied environmental chemistry. This feasibility test aims to obtain data regarding the feasibility of using The Amazing Eco-Enzyme e-book as an enrichment book to support environmental chemistry. The results of the feasibility test of the e-book can be seen in Table 4, Table 5, and Table 6.

TABLE 4: Feasibility test results for material aspect.

Statement	Respond (%)	
	Yes	No
The content/description of the material in each part of the e-book is clear.	100	0
The content/material in the e-book is complete (covering contextual aspects; facts, concepts, applications, and values).	90	10
Providing the appropriate/relevant concrete examples of the environment.	100	0
Illustrations/pictures represent the description.	90	10
Clearly presented description of the integration of Islamic values.	100	0
The description of the material presented is easy to understand.	100	0
Percentage Average	96.67	3.33

Based on Table 4, it is found that an average percentage value of 96.67% of respondents agreed with the feasibility of the e-book in terms of material delivery. This shows that the e-book can be declared very feasible to be used as learning support [29].

Based on Table 5, it is found that the average percentage value of 92.50% of respondents agreed with the feasibility of the e-book in terms of language use. This shows that the e-book can be declared very feasible to be used as learning support [29].

TABLE 5: Feasibility test results for language aspect.

Statement	Respond (%)	
	Yes	No
Use correct spelling, terms, and punctuation.	90	10
The sentence/phrase structure is strung properly.	90	10
Consistent use of scientific/foreign terms.	90	10
The language used is easy to understand.	100	0
Percentage Average	92.50	7.50

TABLE 6: Feasibility test results for appearance aspect.

Statement	Respond (%)	
	Yes	No
The layout of text, objects, and images is appropriate.	90	10
The color combination presented is harmonious and attractive.	100	0
Shape, size of object, proportional illustration/image.	100	0
Efficient and clear text display.	90	10
The format for placing the text is by the content of the e-book.	100	0
Types and sizes of letters used are clear, easy to read, and attractive.	90	10
The illustrations presented can illustrate the content in the e-book.	90	10
The cover has a good point center.	100	0
Appearance and layout on the front cover coherently with the back cover.	90	10
The e-book presentations are efficient and easy to use.	100	0
Percentage Average	95.00	5.00

Based on Table 6, it is found that the average percentage value of 95.00% of respondents agrees with the feasibility of the e-book in terms of display presentation. This shows that the e-book can be declared very feasible to be used as learning support [29]. Based on the due diligence result, it can be stated that in terms of material, language, and appearance, The Amazing Eco-Enzyme is a very suitable e-book to be used as an enrichment book, to support environmental chemistry learning.

4. CONCLUSION

The Amazing Eco-Enzyme 3D e-book was developed and presented contextually, including facts (issues and environmental pollution data), concepts (related chemistry theories and principles), application of concepts (for environmental conservation), and values (integration of Islamic values from the Quran and hadith, as well as moral messages). Based on the validation results from the aspects of the presentation of

material, language, and appearance, with a mean value of 0.85-0.92, the e-book was declared valid. Meanwhile, the results of the feasibility test obtained a percentage of 96.67% in the material presentation aspect, 92.50% in the language aspect, and 95.00% in the display aspect. So it can be stated that the e-book is very suitable to be used as an enrichment book for environmental chemistry learning. Further research can be carried out by refining the e-book in the aspects of language and appearance, then be applied through the learning process of environmental chemistry course.

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References

- [1] Ningsih Z. Pengembangan buku pengayaan kimia terintegrasi keislaman pada mata kuliah kimia lingkungan. 2019.
- [2] Trim B. Mengenal penulisan buku ajar. *Universitas telkom*. 2018;1(50).
- [3] Mustika D, Ain SQ. Peningkatan kreativitas mahasiswa menggunakan model project based learning dalam pembuatan media ipa berbentuk pop up book. *Jurnal Basicedu*. 2020;4(4):1167–75.
- [4] Ziden AA, Khalid NK. E-Book as learning tool: a review and focus for future research. *Online J Distance Educ Elearn*. 2014;2(4):19–33.
- [5] Bozkurt A, Bozkaya M. Evaluation criteria for interactive e-books for open and distance learning. *Int Rev Res Open Distance Learn*. 2015;16(5):58–82.
- [6] Prasetya DD, Wibawa AP, Hirashima T. An interactive digital book for engineering education students. *World Transactions on Engineering and Technology Education*. 2018;16(1):54–9.
- [7] Redhana IW, Suardana IN, Selamat IN, Merta LM. Pengaruh praktikum kimia hijau pada sikap siswa terhadap kimia. *Edusains*. 2020;12(2):154–65.
- [8] Armenta S, Garrigues S, de la Guardia M. Green Analytical Chemistry. *Trends Analyt Chem*. 2008;27(6):497–511.
- [9] Fatimah. Refleksi nilai-nilai keislaman pada perkembangan dan aplikasi ilmu kimia. 2017.

- [10] Nasrudin D, Helsy I, Rochman C, Irwansyah FS, Munir, Mahmud. Science education at Islamic university: vision and distinction. *Journal of Physics: Conference Series*. 2019;1280(3).
- [11] Harry F. Challenges for the Future Hopes. Presented at the. 2019.
- [12] Woolley JS, Deal AM, Green J, Hathenbruck F, Kurtz SA, Park TK, et al. Undergraduate students demonstrate common false scientific reasoning strategies. *Think Skills Creativity*. 2018;27(December):101–13.
- [13] Syahri W, Muhaimin M, Sirait DT. Pengembangan bahan ajar e-book berbasis metakognisi menggunakan 3d pageflip pada materi hukum-hukum dasar kimia dan stoikiometri di kelas X Mipa SMA Negeri 1 Muaro Jambi. *Journal of The Indonesian Society of Integrated Chemistry*. 2017;9(1):18–25.
- [14] Andriani M, Muhali M, Dewi CA. Pengembangan modul kimia berbasis kontekstual untuk membangun pemahaman konsep siswa pada materi asam basa. *Hydrogen: Jurnal Kependidikan Kimia*. 2019;7(1):25.
- [15] Kumari P. a Low Cost Material, Banana peel for the removal of lead (ii) from aqueous solutions [IRJET]. *International Research Journal of Engineering and Technology*. 2017;4(6):1404–6.
- [16] Rasit N, Hwe Fern L, Azlina Wan Ab Karim Ghani W. Production and characterization of eco enzyme produced from tomato and orange wastes and its influence on the aquaculture sludge. *International Journal of Civil Engineering and Technology*. 2019;10(3):967–80.
- [17] Vama L, Cherekar MN. Production, extraction uses of eco-enzyme using citrus fruit waste: wealth from waste. *Biotech. Env. Sc.* 2022;22(2):346–51.
- [18] Mavani HA, Tew IM, Wong L, Yew HZ, Mahyuddin A, Ahmad Ghazali R, et al. Antimicrobial efficacy of fruit peels eco-enzyme against enterococcus faecalis: an in vitro study. *Int J Environ Res Public Health*. 2020 Jul;17(14):1–12.
- [19] Neupane K, Khadka R. Production of garbage enzyme from different fruit and vegetable wastes and evaluation of its enzymatic and antimicrobial efficacy. *Tribhuvan University Journal of Microbiology*. 2019;6(1):113–8.
- [20] Hemalatha M, Visantini P. Potential use of eco-enzyme for the treatment of metal based effluent. *IOP Conference Series: Materials Science and Engineering*. 2020;716(1). <https://doi.org/10.1088/1757-899X/716/1/012016>.
- [21] Tsai TP, Lin J, Lin LC. A flip blended learning approach for ePUB3 eBook-based course design and implementation. *Eurasia J Math Sci Technol Educ*. 2017;14(1):123–44.

- [22] Wiharjo J. Pengembangan ebook ipa berbasis 3d page flip untuk meningkatkan keterampilan komunikasi dan berpikir kritis siswa smp tarakanita solo baru. 2020. p. 1–20.
- [23] Rabiudin, Taruh E, Mursalin. Development of authentic affective assessment instrument in high school physics learning. *Journal of Physics: Conference Series*. 2018;1028(1).
- [24] Y. Ariyana, A. Pudjiastuti, R. Bestary, and Zamroni, “Buku pegangan pembelajaran keterampilan berpikir tingkat tinggi berbasis zonasi. Buku Pegangan Pembelajaran Berorientasi Pada Keterampilan Berfikir Tingkat Tinggi; 2018. pp. 1–87.
- [25] Zawacki-Richter O, Kerres M, Bedenlier S, Bond M, Buntins K. Systematic reviews in educational research: Methodology, perspectives and application. Springer Nature; 2020. <https://doi.org/10.1007/978-3-658-27602-7>.
- [26] Sugiyono. Metode penelitian kuantitatif, kuanlitatif, dan R&D. 2017.
- [27] Helmi RL. Panduan penelaahan dan penilaian naskah buku ilmiah. Jakarta: LIPI Press; 2017.
- [28] Wardani I. “Hakikat dan karakteristik karya ilmiah.,” *Teknik penulisan karya ilmiah*. p. 2014.
- [29] Kariadinata R. Dasar-dasar statistik pendidikan. 2015.