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# Electronic Enrichment Book Design "Solar Energy and Its Benefits" to Improve Environmental Problem Solving Skills

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**Abstract:** This study is a development research using the Borg and Gall model. This study aims to determine the design of electronic enrichment books. The instrument used was a questionnaire and the data was analyzed descriptively based on the validity and practicality score sheets. The product was validated by experts and the practicality was validated by teachers and students. The results of the validity data showed an average value of all aspects of0.88 with very high criteria. The validity results show that the electronic enrichment book meets valid data so that it is worthy of use and a little revision and the practicality results show that the electronic enrichment book has an average value of all aspects of 0.81 with very high criteria from teacher practitioners and an average value of all aspects of 0.70 with high criteria from student practitioners. The conclusion obtained is that the design of this electronic enrichment book can be used from the valid results and can make it easier to use electronic enrichment books from the results of practitioners.

**Keywords:** Electronic enrichment books; problem solving skills; solar energy and its benefits.

## Introduction

The 21st is a century where science and technology are developing rapidly. The rapid development of science requires students to be able to adapt and follow these developments (Junedi et al., 2020). DevelopmentThe 21st century currently requires education that prepares students to face the demands of life in gaining problem-solving skills (Dewi, 2019; Kurniawati et al., 2019). This problem solving abilityvery important because it can have a significant impact on how future generations of a country face the challenges of life in the 21st century (Junedi et al., 2020). According to Saad & Ghani (2008), breakdown Problem solving is a deliberate process that must be carried out to obtain a concrete solution to a problem that cannot be achieved immediately. Problem solving essentially means applying scientific methods, or thinking systematically, logically, orderly, and comprehensively (Idris et al., 2018).

Solution Problems are a creative process in which individuals make changes to themselves and their environment, make new decisions and adjustments that are in line with their life goals and values (Setianingsih et al., 2014). The ability to contribute new ideas and apply them in problem solving including cognitive traits such as curiosity, willingness to ask questions, and a constant desire for new experiences can also be trained through creativity tests given to students (Sambada, 2012).

Solution problems require thinking skills such as observing, reporting, explaining, analyzing, classifying, interpreting, criticizing, estimating, drawing conclusions, and generalizing based on the information collected and processed (Hamalik, 1995). Ability21st century problem solving can be integrated to solve real world problems and competitions (Cahyani &

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Setyawati, 2017). According to Susilowati & Anam (2017), "Problem solving ability is one of the important abilities that must be taught and trained so that students are accustomed to facing problems both in academic environments and in complex daily life". According to Sidenvall, problem solving is identical to reasoning and critical thinking, which is a behavioral process (Sidenvall et al., 2015). Ability Problem solving plays an important role in finding the root of the problem and evaluating information so that the problem can be solved in the future (Christiyoda et al., 2016).

As an ability that students must have, there are several indicators that include several problem solving indicators according to Chabibah et al. (2019), namely defining the problem, formulating a strategy, implementing the strategy and conducting an evaluation. According to Polya (1973), there are four stages of problem solving, namely understanding the problem, planning to solve the problem, carrying out problem planning, and reviewing the results obtained.

PreparationStudents who are accustomed to facing problems will be more mentally prepared to face 21st century problems (Cahyani & Setyawati, 2017). So thatStudents are able to compete in the 21st century and utilize technological advances appropriately, so students must apply problem-solving skills (Gunawan & Widiati, 2019). Withsolving problems, students actively think, obtain information, create, communicate, search for and process data, and finally draw conclusions (Limbong, 2019). Problem solving is useful for learning to solve complex problems (Karpicke & Aue, 2015).

Benefits of problem solving skills for children according to Chouchenour and Chrisman (Nuryatmawati, 2019) namely: Training children to think critically, Giving reasons, Solving problems, Finding cause and effect relationships. According to Lestari (2020) expressed something similar, namely that the goals or benefits of problem-solving skills in children are: Training children to think, Preventing children from jumping to hasty conclusions, Weighing up the possibility of various solutions, Postponing decision-making until there is sufficient evidence.

A similar opinion was expressed by Sanusi et al. (2020), which reveals that getting children used to learning to solve problems can provide great benefits, namely by training children to think analytically in managing the information they get and then being able to make decisions on their own.Withonce the child can make his own decisions. Thus, as he grows, the child will be able to independently solve the problems he faces.

Other benefits of problem-solving skills include that children who are able to solve problems tend to be more adaptable, more creative, and have better critical thinking skills (Izzuddin, 2021). According to Pohan et al. (2021), there are several benefits that students will gain through problem solving, namely: a) Students will learn that there are many ways to solve a problem (divergent thinking) and there is more than one possible solution to a problem; b) students are trained to explore, think comprehensively and reason logically; c) develop communication skills, and form social values through group work. Sumartini (2016), states that teachers must have learning methods as a strategy to help students acquire the knowledge taught. Based on the results of the 2018 PISA from the Center for Education Evaluation, the reality on the ground, especially in Indonesia, is that the ability to solve mathematical problems in Indonesia is still low (Wahyuni et al., 2022).

The following is a graph of the average mathematical problem-solving ability of Indonesia in the PISA test from 2006 to 2018.

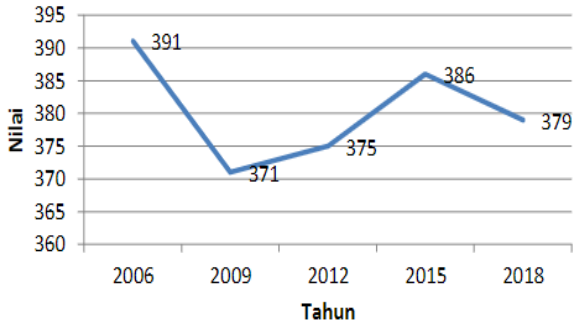


**Figure 1.** Problem Solving Ability Score in Mathematics according to PISA

Figure 1. shows that in 2018, the average assessment of Indonesian students' problem-solving abilities decreased compared to the previous year. This confirms that Indonesian students' mathematical problem-solving abilities are still not optimal in solving problems (Luthfiyah et al., 2021).

Previous research results by Aryana (2009), namely the problems that exist in schools in training problem solving skills because: teachers are not aware that problem solving skills are very important for students to master in the current era, teachers directly provide solutions to problems faced by students, and teachers tend to lecture on the material rather than guiding students in finding learning materials themselves through problem solving. According to Hermaini, an analysis of students' problem solving skills has never been carried out (Hermaini & Nurdin, 2020). The monotonous learning process makes students feel bored which has an impact on the learning process that occurs in the classroom (Pramita & Yulkifli, 2023). Students experience difficulties if the questions are changed to be

different from the initial formula. This can happen when students only memorize formulas without providing reinforcement for the concept or the explanation of the formula or equation is not accompanied by an explanation (Suharlan et al., 2023). Limited use of learning media to support learning. Besides that, the learning media used by teachers does not take advantage of technological developments, making students easily bored and less interested in participating in the learning process (Tsaniyyati & Andriani, 2024). Unavailability of learning resources (Nerita et al., 2018), (Arsih et al., 2023). The limitations of structured learning resources are felt by teachers and students (Christopoulos & Sprangers, 2021).

Still use conventional learning methods, and practicums are only used as a means of proving theory, not as a medium for conveying material (Asbanu, 2023). The learning resources used by all children as printed teaching materials are worksheets (LKS) which in reality are not sufficient for use in classroom learning. The drawback is that the book design is less attractive so the material is difficult for students to understand (Putri et al., 2024).

Based on the description, one of the efforts that can be made to improve environmental problem solving skills is by developing electronic enrichment books. Thus, electronic enrichment books can be used as supporting materials in understanding and getting to know more about the material being taught, so that it can increase students' knowledge and insight about learning objects around them. Students can now improve their problem solving skills collaboratively using online platforms (Stadler et al., 2020).

The novelty of this research is that the material presented refers to the independent curriculum from an environmental perspective, enrichment books using an environmental problem-solving ability approach and electronic-based enrichment books. Based on several things above, the researcher is interested in raising the title for this study, namely "Electronic Enrichment Book Design “Solar Energy and Its Benefits” to Improve Environmental Problem Solving Skills”.

## Method

This research is a research and development (Research and Development) using the Borg and Gall development model (Borg and Gall 1989). This research and development is used to produce a product design for an electronic enrichment book on solar energy and its benefits with the aim of becoming a learning resource according to needs.

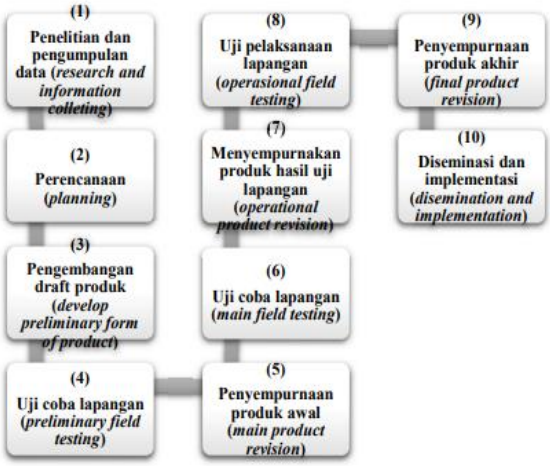


**Figure 2.** Development Research Model (Borg & Gall, 1983)

The validity components of the electronic enrichment book on solar energy and its benefits include aspects of content suitability, presentation suitability, language suitability, and graphics, and the practicality component includes ease of use of the electronic enrichment book, efficiency of learning time, and benefits.

The design assessment of this electronic enrichment book was carried out by experts who are experienced in their fields.The data from the electronic enrichment book design results were carried out by expert validation and teacher and student practitioners and then analyzed by calculating the validity and practicality values. The calculation of validation and practical values was carried out using the following Aiken's V formula (Aikens, 1985). Next, it is measured using the Aiken's coefficient value according to Table 1.

$$S = R - Lo \quad (1)$$

$$V = \frac{\sum S}{n\,(C-1)} \quad (2)$$

Information :
V = Aiken index
S = score score given by rater minus lowest score in category
R = score given by the assessor
Lo = lowest assessment score (1)
C = highest assessment score (5)
n = number of validators/practitioners (assessors)
(Nabila, 2022).

**Table 1.** Validity and practicality coefficient values

| Mark | Category |
|---|---|
| 0.80-1 | Very high |
| 0.60-0.79 | Tall |
| 0.40-0.59 | Currently |
| 0.20-0.39 | Low |
| 0.00-0.19 | Very low |

1The Aiken's V coefficient value ranges from 0 – 1. The closer it is to 1, the more adequate the content validity of each item will be (Widodo et al., 2022).Validity and practicality are said to be valid and practical if the results obtained are at least in the range of 0.40-0.59 with a moderate category so that they can be used.

## Results and Discussion

The results of this study discuss three stages in the development research conducted, namely validity analysis, practicality, and design of electronic enrichment books.

*Validity Stage*

At the validity stage, the stages carried out are looking at it from the aspect of suitability. suitability of content, conformity suitability of presentation, conformity appro priateness of language, and graphics. According to Sugiyono (2013), product validation is carried out by inviting several experts or experienced professionals to evaluate the designed product and identify its advantages or disadvantages. Akbar (2013) strengthens that, validation of users of this electronic enrichment book aims to determine the advantages or disadvantages in terms of relevance, accuracy, language and also its suitability for student-centered learning, based on this assessment users can provide input for improvements to the electronic enrichment book being developed. The enrichment book being developed is in the form of an electronic enrichment book entitled "Solar Energy and Its Benefits". Before being declared suitable for use as an electronic enrichment book, validation is carried out first.

Validation of the electronic enrichment book is very important to find out whether the electronic enrichment book developed has weaknesses or deficiencies and to correct errors in the compilation. In the design of this electronic enrichment book, expert validity testing was carried out by 5 experts to examine the following aspects: content suitability, presentation suitability, language suitability, and graphics. The results can be seen in table 2.

**Table 2.** Electronic Enrichment Book Validation Results

| Aspect | Average | Criteria |
|---|---|---|
| Content eligibility | 0.86 | Very high |
| Suitability of serving | 0.85 | Very high |
| Language eligibility | 0.92 | Very high |
| Graphics | 0.92 | Very high |
| Average | 0.88 | Very high |

The results given by the validator above show that the electronic enrichment book is very high with an overall average validity value using Aiken's obtained a value of 0.88. These results can be used in physics learning with a little revision. In line with the results obtained. According to Nur (2008), stated that expert testing or validation was carried out with expert respondents which were useful for reviewing initial products and providing input for improvement. According to (Hardiansyah et al., 2018) validinitial product tie-ups are very important so that the weaknesses and deficiencies of the learning resources being developed can be identified.

The suggestions from the validator were revised to obtain a product that is suitable for physics learning in high school. The data can be seen in table 3.

**Table 3**. Validator Suggestions

| Sara Validator | After Revision |
|---|---|
| Change the color of the text in the book title | The text color in the title has been adjusted |
| Change the layout of the author name position | The layout of the author's name position has been adjusted. |
| Present electronic enrichment books in an interactive way | Enrichment books have been upgraded to be interactive |
| Add the summary | Summary has been adjusted |
| Add a book description that describes the contents of the book. | The book has been adapted to the description that describes the contents of the book. |

*Practicality Stage*

The stages carried out in practicality are to see in terms of ease of use, efficiency of learning time and usefulness. Practicality was assessed by measuring completion rates (Gerard et al., 2004). The practicality test was carried out by four teachers and 31 students at SMAN 4 Padang which can be seen in table 4.

**Table 4**. Results of teacher practicality tests

| Aspect | Average | Criteria |
|---|---|---|
| Ease of use | 0.84 | Very high |
| Learning time efficiency | 0.78 | Tall |
| Benefits | 0.83 | Very high |
| Average | 0.81 | Very high |

The results provided by the practitioners above are based on the following aspects: The ease of use of electronic enrichment books obtained an average of 0.84 with a very high category. Then the efficiency of learning time obtained an average of 0.78 with a high category, and the usefulness aspect obtained an average of 0.83 with a very high category. The overall results show that the electronic enrichment books developed are included in the very practical category with an average overall

aspect of 0.81 according to the teacher. This means that electronic enrichment books can facilitate teachers in the learning process, are efficient in learning time and are useful in honing students' abilities.In general, this is the same as the research of Jannah & Dwiningsih (2013) where the book that was developed had a level of conformity of 80.53% to the book, because the main contents of the book were in accordance with the competency standards and basic competencies. The results of the lecturer's assessment of the practicality of Android-based e-books obtained an overall average score (very practical). Aspects assessed include ease of use, efficiency of learning time and benefits. From all these aspects, it has met the practicality criteria in accordance with the aim of achieving the practicality of Android-based e-books for lecturers (Latif et al., 2024).

**Table 5.** Practicality test by students

| Aspect | Average | Criteria |
|---|---|---|
| Ease of use | 0.73 | Tall |
| Learning time efficiency | 0.69 | Tall |
| Benefits | 0.69 | Tall |
| Average | 0.70 | Tall |

The results given by students are based on the aspects of kThe ease of use of electronic enrichment books obtained an average of 0.73 with high criteria. Then the efficiency of learning time obtained an average of 0.69 with high criteria, and the usefulness aspect obtained an average of 0.69 with high criteria. The overall results show that the developed electronic enrichment books are included in the high category which means they are practical to use with an overall average of 0.70 aspects according to students. This means that electronic enrichment books can make it easier for students in the learning process, are efficient in learning time and are useful in honing students' abilities.

*Product Design Results*

After conducting the validity of the revised product and practicality. Next is the product design results. The product developed is an Electronic Enrichment Book using the Flip PDF Professional application. Learning resources are developed in high school physics subjects based on the environment. The product is used as a learning resource as a learning support that can be used by students and teachers. This electronic enrichment book uses several software or applications. Where the applications used are Microsoft Word 2010, Canva and Flip PDF Professional. Canva is used to create book covers. Microsoft Word 2010 software is used to compile the contents of the book at the beginning and end of the book related to the type and size of fonts, margins, color selection, and so on that are in accordance with the quality of electronic enrichment books, especially in electronic form. While the Flip PDF Professional application is used as the final media for displaying electronic enrichment books and the final step of collecting or unifying the results of the Canva and Microsoft Word 2010 applications.

The following are several images that show the results of the electronic enrichment book design from the revision of validity and practicality consisting of the cover or book cover, book identity, competency and guidelines for using the book, foreword, table of contents, list of figures, list of tables, and the contents section (material), bibliography and author biodata.

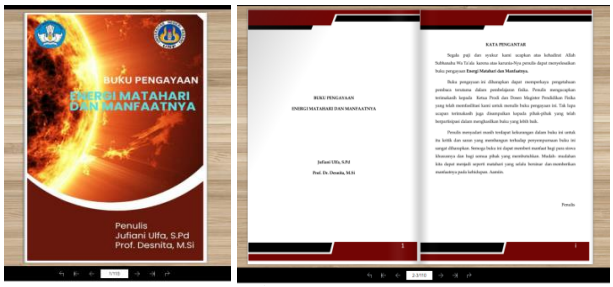


**Figure 3.** Book Cover, Book Front Page

On the front cover of this electronic enrichment book there is an element of the book title "Solar Energy Enrichment Book and its Benefits", the visual element chosen is an illustration of a picture of the sun, the name of the book's author includes the author of the second and first editions, then the name of the publisher is not yet available because it has not been published but a logo is available Padang State University and the Kemendikbudristek logo. The back of the cover can be seen in the author's biodata section.

The Foreword is a collection of introductory sentences made by the author for the reader. Forewords can be in the form of thanks, hope or gratitude. Forewords must be made using standard sentences (Gunawan, 2017). The foreword to this electronic enrichment book is designed with thanksgiving to Allah Subhanahu Wata'ala, thanks to the parties involved in compiling the electronic enrichment book and hopes for the use of this electronic enrichment book.

**Figure 4.** Instructions for using the enrichment book, foreword, table of contents, materials

The table of contents is a list of titles of parts of an enrichment book or document which also contains page numbers in sequence. The image list contains the title, number and page number the image is on. In this section, the electronic enrichment book divides the discussion about solar energy and its benefits into six chapters.

**Figure 5.** bibliography, glossary, author biodata

A bibliography is a list that includes the book title, author's name, publisher, and so on which is placed at the end of an essay or book, and arranged alphabetically. In this section, the biodata is equipped with the name, photo of the author, and a brief summary of the author's education.

The use of teaching materials has a very big role in learning activities. One of the teaching materials is used to help teachers in conveying learning material and creating a pleasant classroom atmosphere learning (Desnita et al., 2021). The teaching materials used greatly determine the achievement of each set of basic competencies (Hernandez-de-Menendez et al., 2020).

## Conclusion

Based on the discussion that has been presented, it can be concluded that the validity stagethat validation of the electronic enrichment book developed with the title Solar Energy and Its Benefits is very important to ensure the feasibility of the product before being used in learning. Based on the validation results, an average validity value of 0.88 was obtained using Aiken's V, which indicates that this electronic enrichment book has a very high level of validity and can be used in physics learning, with a little revision. The practicality stage is that the results of the practical data from teachers are very high and the practical data from students are obtained with high criteria.Based on this, the electronic enrichment book that has been developed and compiled in such a way can be used as physics learning in environment-based high schools.

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**Author Contributions**

Contributed to designing the research, conducting the research, curating the data, and writing the research article, JU.; contributed to reviewing the original draft and providing feedback, D.; validation, E, U, PN, PA, R.

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**Conflict of Interest**

The author declares no conflict of interest.

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